LEARN HOW TO
MAKE MONEY
BY SELLING
INTERNET ACCESS

Find all the information here that you need to install equipment for internet access and to sell internet por fichas for cash payments with a minimal investment and limited technical knowledge

JOHN D. BARKER PH.D

The author wishes to thank the following manufacturers for supporting the preparation and publication of this book:

www.InternetDaDinero.com
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Contact the author to request a copy of this book:
john@fire4.com

Contents

Preface

There is a strong demand for Internet access that is not being fully met by established Internet service providers and telecom companies. Many rural areas lack a fast Internet access service and some rural areas have no Internet service. The telecom providers have infrastructure investment budgets but concentrate network build-out in urban areas where the cost to connect a customer is less than connecting a rural customer and so they are able to make more money with less investments.

There are satellite services available now and services which will soon to be available that can provide an Internet access service for rural areas, however the current satellite services have poor performance and the cost is higher than many people can afford. There is also a strong demand for mobile broadband Internet services because many people have mobile devices that have limited data access to 3G and 4G networks, and the mobile devices have WiFi that can connect to a Hotspot mobile broadband service.

What may be a problem for the telecom companies is an opportunity for entrepreneurs and businesses, called Wireless Internet Service Providers (WISP's), are already providing Internet services using wireless broadband. The cost of high performance wireless technology reduced over the past several years so that it became possible for an individual to start a business providing a wireless Internet service to customers with a very small investment. The wireless equipment also became simpler to use allowing people with limited technical training to install wireless networks.

Although many people understand wireless technology there has been a lack of information and products for network management and customer billing. While there are cloud service companies that provide a turnkey service, which does not require much technical knowledge to install, the cost is very high in the region of $1.00 to $1.50 per subscriber per month. This level of cost might be acceptable for the USA or countries in Europe, however it is not affordable for Internet service providers in other countries where the charges for Internet service are much lower for a service with reduced performance due to customers limited economic ability.

The path for established WISP's has been to develop network management and billing systems in-house that permit them to operate the business for a much lower cost. Such a task however required a high level of technical skills that include network design, programming routers, modifying open-source software and writing new software to integrate the system components. People who have many years of experience in the networking industry and have software development skills built these WISP's.

Low cost methods of managing networks and billing customers for Internet services have recently become available, that require only limited technical knowledge, and very little investment. The author has been working with the development of low cost management and billing products for

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many years, as well as advising many new and established WISP's who wish to start and grow Internet service businesses while using simple technology with low acquisition and operating costs.

This book was written to help prospective entrepreneurs who wish to start providing Internet services to customers. The author has included in one volume all the information necessary to start a business that provides basic wireless Internet services. This book is predominately focused on delivering a mobile broadband service, which is generally the simplest service to provide and has a great demand in many locations and countries because many people already own low cost mobile devices. This book also includes some sections describing fixed broadband services.

The author would like to provide entrepreneurs with access to technology and knowledge that is presently locked inside high-price black box management systems or acquired only through many years of technical training and work within the telecom industry. Through this approach many more people will have access to the Internet because new entrepreneurs will be there to deliver the services, while making money at the same time.

While there are many publications and training videos that describe how to install and configure wireless devices, very little information is available about managing the wireless network, monitoring the network for failures, billing customers, plus all the associated tasks like provisioning, activation, network inventory and financial management.

This book is the first of a series that describes the process of starting and operating a business that sells Internet access to the public using WiFi technology. The methods of charging customers for the Internet service are described and one popular method is explained in detail; this method is selling Internet access for cash payments by providing vouchers that have a unique access code printed on them that is valid for a limited duration. The cash sale of vouchers is a very popular mode of operation in many parts of the world as the cost is extremely low and the system is very simple to operate.

A companion volume to this book is being prepared for publication that will provide comprehensive information to develop a wireless Internet service provider (WISPs) business that delivers fixed broadband services to subscribers in a technically simple and low cost way and is written to help entrepreneurs establish and grow their businesses.

A future will describe how to start and operate a WISP business or transition an existing WISP business to use the Starlink low earth orbit satellite network as a tower backhaul. The cost of the Starlink service is low and the WISP will eliminate many infrastructure costs. Starlink is currently in beta testing and available only in limited areas of North America. However the Starlink system will provide worldwide coverage within a year.

This series of books are sponsored by manufacturers and are available as free downloads from the authors website.

1.

The Internet Service Provider Business

Most people get Internet access services from large companies, usually telecom businesses. In the past it was difficult for small businesses to provide Internet access services because the cost or equipment was high and an advanced level of technical knowledge was required to configure the equipment that provided the Internet service. Many people still don't have Internet access for one of several reasons.

- The prices that the big Internet service providers charge for Internet access are too high for some consumers.

- Big businesses ignore rural customers because the service infrastructure cost is high, and instead concentrate on urban customers where the infrastructure cost is low.

- Some customer geographic locations are very remote and it is impossible to get any type of wired or wireless connection, with Internet access limited to an expensive satellite service.

Fortunately for prospective rural customers there is a growing group of entrepreneurs worldwide that are providing Internet access in the locations that the big companies ignore. These entrepreneurs often provide Internet access using a wireless connection and are called Wireless Internet Service Providers (WISP's).

Until recently the Internet service entrepreneur required a very high level of technical training in order to install and configure the wireless equipment that provides Internet access. However with technology that is now available the entrepreneur can start a WISP business with limited technical knowledge, it is only necessary to know how to use a computer and configure a wireless access point; no formal technical training is required. Obviously other skills are required such as installing antennas, selling the service and planning investments.

In the past the equipment that was required to provide Internet access was very expensive and equipment costs were in the range of thousands of dollars. With the development of semiconductors and low cost volume manufacturing, wireless equipment that includes all software required to manage and charge customers for the service costs less than $100.

Most people are not aware that it is now technically easy to start a WISP business with a low investment cost. The purpose of writing this book is to provide information to potential WISP entrepreneurs in the form of a how-to guide, an instruction manual describing how to start and operate a WISP business.

2.

The Market for Internet Access Services

T here are several methods listed below of delivering Internet access to customers.

- Via cable using a DSL, TV service or fiber connection, this is an Internet Service provider (ISP).

- Via 3G/4G wireless to a smart phone, this is a mobile phone company.

- Via WiFi wireless to any type of mobile or wired device, this is a Wireless Internet Service Provider (WISP).

- Via satellite which can be geo-synchronous (e.g. Hughes) or low-earth-orbit (e.g. Starlink) to a ground receiver.

There are also two classifications for broadband customer types.

- Fixed broadband, Internet access is delivered to a home or business using a wired connection or a wireless connection, both wired and wireless connections are provided inside the building to connect devices.

- Mobile broadband, Internet access is delivered to a mobile device, smart-phone or tablet, using a 3G/4G wireless service (mobile phone operator) or a WiFi wireless service (Wireless Internet Service Provider).

The demand for Internet access services is growing quickly for many reasons.

- Communicate through the Internet using Apps like Skype and zoom instead of making phone calls.

- Use social media which requires Internet access.

- Switch to buying on-line instead of going to stores as they get lower prices.

- Using Internet to manage money due to limited access to banks.

- Use the Internet to search for information.

- Access educational courses through the Internet.

- Work from home using Internet access.

- Businesses provide Internet access to attract customers: motels, hotels, restaurants, cafes, shopping malls, retail stores, etc.

- Public services provide Internet access for visitors: schools, hospitals, municipal offices, etc.

- 3G/4G coverage is poor in rural areas and overloaded in urban areas so alternative services are popular with mobile phone users.

- Telecom companies charge high prices and impose data caps for 3G/4G Internet data services so alternative lower cost services are popular with mobile phone users.

Selling Internet access is a great opportunity for any entrepreneur who wants to build a business with very little investment using low cost WiFi equipment. WiFi is the best and lowest cost technology for Internet access and all computer and mobile devices can connect to WiFi.

3.

Types of Internet Service Customers: Fixed and Mobile

Internet customers are classified into groups where each requires a different technical method of providing the Internet service. The customers of a wireless Internet service can be categorized as follows.

- Mobile broadband customers want to connect to any wireless access point in the providers network using a mobile device. If the mobile device is a smart-phone then the customer is seeking an alternative to the 3G/4G service, which may be slow or have a monthly data cap. Mobile broadband customers are also travelers who are out of their provider service area and don't have 3G/4G service. Travelers also seek broadband access at airports and hotels for smart-phones, tablets and laptops. Mobile device communication range is limited to a few hundred meters due to the poor performance of the mobile device WiFi wireless antenna. The mobile broadband customer is anonymous and will purchase an access code to get Internet access for a pre-determined period of time, called pay-on-demand. A monthly subscription plan can also be offered to mobile broadband customers.

- Fixed broadband subscribers want to have Internet access at a fixed location that will be a residence or a business. The location may be several Km from the wireless antenna and the service provider will install a directional antenna on the roof of the customer's premises for long-range communications. The fixed broadband customer provides contact and billing information to the service provider and has continuous access to the Internet. The customer is billed each month either before the service (pre-pay) or after the service (post-pay). If the bill is not paid then the service is temporarily interrupted until the bill is paid. Fixed broadband subscribers may also want a pay-on-demand rather than having a fixed monthly payment.

The service characteristics that mobile broadband customers seek are as follows.

- Each mobile broadband customer is anonymous because there is no agreement for payment that requires the service provider to have knowledge of the customer; the customer purchases an access code to get Internet access.

- Each mobile broadband customer has several devices that have WiFi wireless technology (smart-phone, tablet or laptop) and wants to be able to use any device with the mobile broadband service.

- Each mobile broadband customer wants to connect to any designated wireless access point within the range of the mobile device using an access code via a login page.

- Mobile broadband customers want the mobile broadband service available at as many locations as possible.

- Mobile broadband customers want roaming (mobility) so that they can move between many wireless access points and get Internet access when required.

- Mobile broadband customers will pre-pay for the Internet service when they wish to use it, which means purchasing Internet service, measured either by duration (e.g. 1-day, 1-week, 1-month) or by data limit (e.g. 1GB download, with 100MB upload limit). This is called a pay-on-demand service.

- One segment of mobile broadband users are travelers who have no other means of communication or Internet access. Travelers want the broadband Internet service available at airports, train stations, hotels, motels, resorts, etc.

- A problem with mobile broadband is that the wireless access point is not encrypted and therefore can be hacked. A later section describes measures that the service provider must implement to deter hackers.

The service characteristics that fixed broadband customers seek are as follows;

- Each fixed broadband customer provides personal information so that the service can be billed monthly. The service provider can offer different payments options that are available; check, credit card, cash, etc.

- A fixed broadband customer can purchase access on demand if preferred, similar to the mobile broadband customer.

- The broadband service is to a fixed location, home or business, via a point-to-point wireless connection, range is up to several Km from the wireless access point but must be line of sight. The service provider is responsible for the installation of a wireless antenna (customer premise equipment: CPE) on the customers building roof for long-range communication (several Km) and also to provide a network connection inside the building, usually with a wireless router.

- The customer is authenticated onto the broadband service with one of several types of credentials, this includes authenticating via a point-to-point protocol over Ethernet (PPPoE), authenticating the MAC address of the CPE, or authenticating via a WPA2-enterprise protocol, which requires the installation of a RADIUS server in the network.

- The broadband service is always connected to the Internet, unless payment is not made. Therefore a login page not required unless the service includes the option to pay-on-demand for the service as required.

- The wireless connection between the CPE wireless and the service providers point-to-multipoint antenna is encrypted preventing hackers getting access to the link.

- A CRM portal permits the customer to pay bills, see invoices and check Internet use.

The service providers network is build according to the types of customers to whom service will be delivered. Most Internet service providers have both fixed broadband and mobile broadband customers. Business customers who have a fixed broadband wireless service may have guests or visitors who require a mobile broadband service; this is the case with motels, hotels and resorts.

4.

Branding the Mobile Broadband Service

When starting a business to provide wireless Internet access for mobile customers it is very important to create a clear and easily recognized brand. Once created the brand can be developed as a trustworthy vendor who provides a high quality and reliable service. Developing the brand is important for two areas.
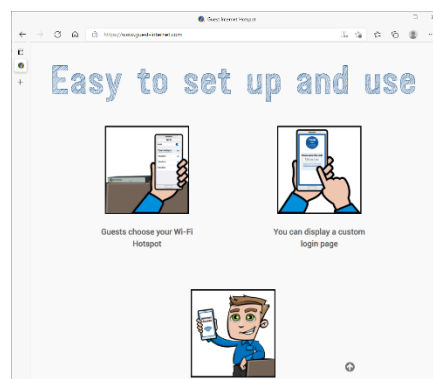
- Marketing, name recognition.

- Growth, trust and reliability.

With an established brand, enthusiastic customers can become part of the sales organization to bring referrals, which will drive business growth. The results of good branding are that the mobile Internet service will not only increase sales month by month but the business equity will increase in value. There are three steps to brand the mobile broadband service.

1. Hotspot login page: Create a name and graphic logo design that is instantly recognized. Apply to the Hotspot login page.

2. Access code voucher: The access code vouchers that are printed for sale also show the brand name and logo so they are instantly recognized.

3. Business website: Create a quality website that simply explains the value of the Internet service. The website will be used later to implement the marketing reward and loyalty programs via links on the login page.

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5.

Internet Service Sales and Marketing Techniques

Marketing describes a set of tasks that create an awareness of the Internet service with potential customers and attracts them to purchase the offer. Marketing can be accomplished with many methods; some typical methods are listed below.

- Door to door distribution of flyers.

- Advertising through popular mediums; local radio, local newspapers, etc.

- Advertising posters and flyers in locations of high foot traffic; supermarkets, shopping malls, etc.

The methods chosen depend on the situation where the service will be installed. The content of the advertising material can include.

- Explain the unique advantages of the service.

- Irresistible offers, first month free if purchased within 5 days, etc.

- Lower cost or better service than a competitor.

Potential Internet service customers must be in range of the antenna or antennas. Anyone outside the range of the antennas will not have access to the Internet service.

Probably the most effective marketing method is the door-to-door distribution of flyers within the area of the antenna, with the flyer advertising a unique or irresistible offer. The business will have a website with additional information that can be accessed by anyone seeking further information, and should have a method to collect contact information from people who want to ask questions about the service.

The purpose of marketing is to generate leads. Leads are calls or messages that are received, or messages sent via the website, from people who are responding to the flyer.

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The sales process follows on from the marketing process, and its purpose is to convert sales leads into paying customers. The sales process depends on the location and the types of potential customers.

The sales process can be implemented a retail store where people who are attracted by the marketing can go to speak with a knowledgeable person and eventually purchase the service. The sales person will seek to commit a customer to a monthly subscription, or to make periodic payments for the service.

A retail store is important when payments are received in cash. In some countries cash payment gateway services are available, such as Oxxopay in Mexico. If prospective customers can make payments with credit or debt cards then sales can be made on-line with telephone support.

There are four principal marketing strategies to develop sales of the Internet providers business.

CITY WiFi SERVICE

Do you need WiFi Internet access anywhere in the City?

Purchase a ficha at any magazine stand and connect to any one of our 110 Hotspots around the city.
Your code is valid to the time started on the code and can be used with different antennas before it expires.

1. Advertising flyer: tell the potential customers about the Internet service by printing flyers and posting them through letterboxes. Flyers can also be distributed via retail businesses.

2. Customer loyalty program: The mobile Internet customers are anonymous; gather contact information for marketing through a loyalty program.

Customer Loyalty Program

3. Referral reward program: Have customers work as salespeople, offer rewards for referrals of new customers.

Customer reward for a referral

4. Subscription program: Guarantee cash flow by converting Hotspot customers into monthly subscribers by offering attractive low cost monthly rates.

cloud**4WISP**

The cloud4WISP software will manage your subscribers

6.

Broadband Internet Wireless Access Point Technology

A ll types of computers, desktops, laptops, tablets and smart-phones, have a technology called WiFi, which is a wireless data interface that can connect to any WiFi wireless access point (WAP). WiFi technology is widely used throughout the world. The wireless access point is a data communications product that transmits and receives data information over specific frequency bands. Many homes and offices have a wireless router that provides a wireless connection for any computer. Wireless access points are also installed outside on the top of masts or tall buildings so that remote homes and office can connect over long distances using wireless.

Figure 1: Wireless access point with WiFi connection.

The wireless bands used for data communications are the 2.4GHz and 5.8GHz frequencies, and the bands do not require any license to operate equipment in most countries. Governments do impose limitations on users of the unlicensed frequency bands requiring that the radio frequency power is kept below a maximum limit and that the equipment must not cause interference to other users.

The unlicensed frequency bands of 2.4GHz and 5.8GHz are very popular for use with many types of wireless equipment such as cordless phones and garage door openers so there is a lot of interference on these bands. The 2.4GHz band is used by microwave ovens to heat food. The

interference will be low in rural areas, but will be very high in dense residential areas. The 5.8GHz band has less interference than the 2.4GHz band.

Wireless equipment for the 2.4GHz band will cost less than equipment for the 5.8GHz band due to the popularity of the 2.4 GHz band for wireless LAN networks. The cost of dual band wireless equipment (2.4GHz and 5.8GHz) is higher, however dual band wireless equipment will provide the best performance for throughput and number of subscribers that can be connected.

Each band is divided into channels that the wireless access points can be set to. A wireless access point is configured for one channel, however a wireless access point with a high data rate will occupy several channels due to the bandwidth required. The figures show the channels for the unlicensed 2.4GHz and 5.8GHz bands that are permitted in many countries.
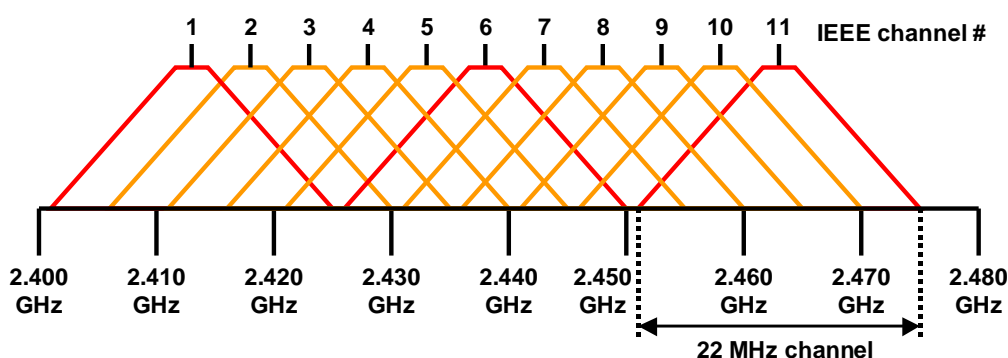
Figure 2: IEEE 802.11 overlapping channels in the 2.4 GHz band.
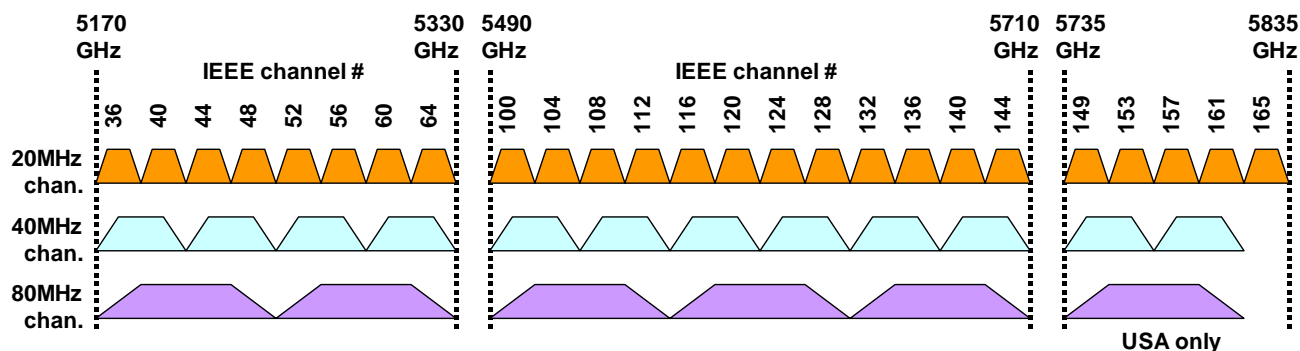
Figure 3: IEEE 802.11 channels in the 5.8 GHz band.

7.

How to Provide a Mobile Broadband Internet Access Service

The mobile broadband customer can use any wireless device to connect to the Internet. There are three components that must be built by the service provider to deliver Internet to the customer.

- The wireless access point; this is called a point to multi-point (PtMP) wireless because the wireless signal will be beamed over a wide area so that many client wireless devices can connect to it.

- The access controller; The wireless access point connects to this device which serves a login page (captive portal) and blocks access to the Internet until the customer provides a code that was purchased to get Internet access. The access controller can be a router, or else it can be access control software that is installed on the wireless access point.

- Connection of the access controller to the Internet is called the Backhaul connection. This might be a wired connection at the antenna site, such as a DSL connection, or might be a wireless point-to-point (PtP) connection to a remote site where a wired connection is located. The backhaul connection might also be through a satellite connection.

The fixed broadband customer has one additional component;

- A wireless receiver is installed at the residence or business that communicates with the point to multi-point antenna. This wireless receiver can connect with a much greater distance than the mobile device can connect to the PtMP antenna.

The connection of the components listed above is shown in the diagram.
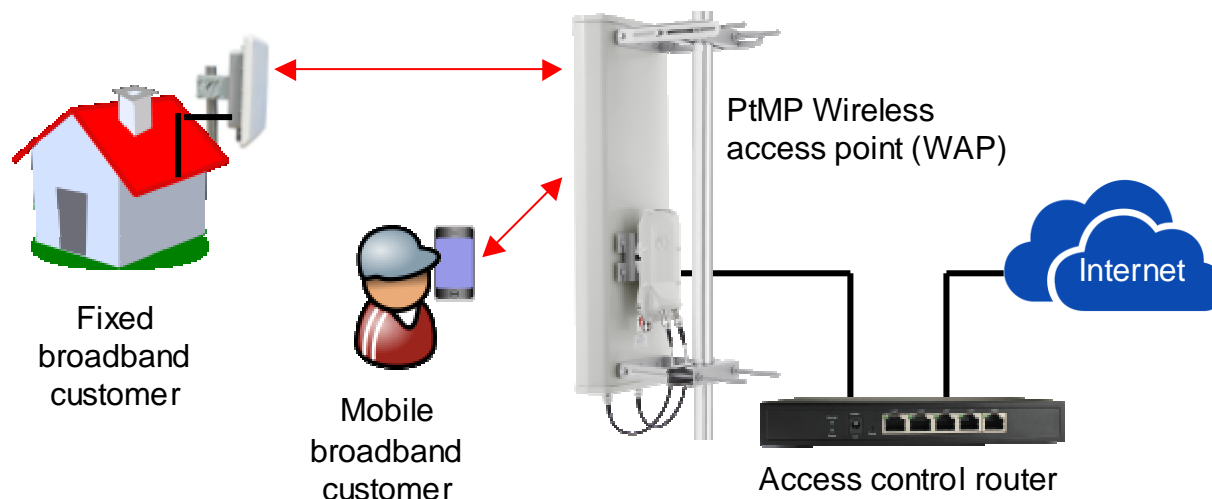
Figure 4: Equipment required to provide Internet access.

The fixed broadband customer is charged for the Internet service every month, and has a connection to the Internet for as long as the bill is paid. The maximum distance that the fixed broadband can connect to the PtMP antenna is a few kilometers.

The mobile broadband customer pays for an Internet connection for a specific duration (pay-on-demand). An access code is purchased which allows the mobile broadband customer to login via the captive portal login screen or pay-wall. The customer remains connected for the duration specified by the code. The maximum distance that the mobile user can connect to the PtMP antenna is a few hundred meters.

Both the fixed broadband and mobile broadband customers have conditions imposed on the service provided to them. The conditions can include the maximum download and upload speeds permitted, and/or the maximum download and upload byte count permitted. The limits that are given to each customer are called the customers rate-plan.

The differences between providing mobile broadband and fixed broadband services are elaborated in later sections.

8.

Mobile Broadband Wireless Service (WiFi)

A mobile broadband service is provided in public areas and by businesses that provide services for the public.

Some examples of mobile broadband in public areas are listed below.

- Municipal and state parks and campgrounds, municipal sports arenas.
- Municipal offices that open to the public.
- Public areas in villages, towns and cities.

Some examples of mobile broadband service locations are listed below.

- RV parks and campgrounds.
- Airports.
- Internet cafes, restaurants, coffee bars, retail stores.
- Motels, hotels, and resorts.
- Sporting events, team games, sports clubs, and gymnasiums.
- Shopping malls.
- Marinas.
- Schools and colleges.
- Churches.
- Trade shows.

In some cases the mobile broadband service is provided without charge as this is part of the services provide by the public or business entity. Free Internet is required for all hotels and motels when advertising for customers. Other mobile broadband Internet providers charge a fee for use; this is

the case with many airports, especially International airports. There are situations where the mobile broadband service is both free and paid. One example of this is hotels where free WiFi is offered to guests at a slow download and upload speed. If the guest wants faster download and upload speeds then the guest can purchase the fast service using a credit card.

An important characteristic of the mobile broadband service is that the wireless access point WiFi antenna has no encryption, unlike a wireless access point installed in a business or installed for fixed broadband use, where the data connection will be encoded using WPA2 or WPA2-enterprise encryption. When the transmission is encrypted the credential is maintained as a secret and known only to the technical people installing the network. Encryption protects the wireless network from hackers. In the case of mobile broadband there is no purpose in having encryption because the encryption key must be given to everyone, eliminating the security value of a secret key. When the wireless connection is not encrypted a hacker who has a 'sniffer' tool installed on a computer can intercept the communications. The 'sniffer' software captures data packets permitting the hacker to see passwords, IP and MAC addresses.

A user should always remember that using a public broadband service has risks and the user should always make encrypted connections to websites (https://) or else install reliable VPN software before using a mobile broadband service.

Two examples of mobile broadband installations are shown in the figures below.
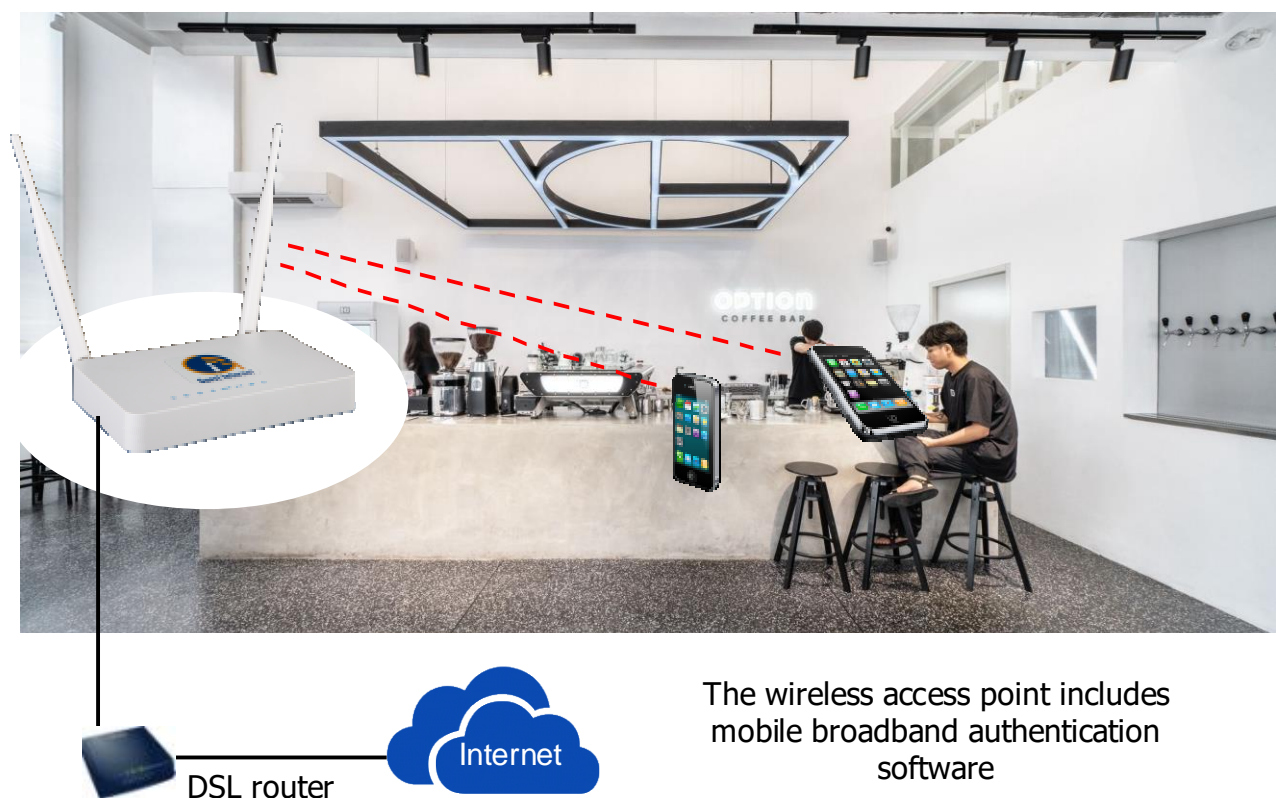
Figure 5: Coffee bar, restaurant or Internet cafe mobile broadband installation.
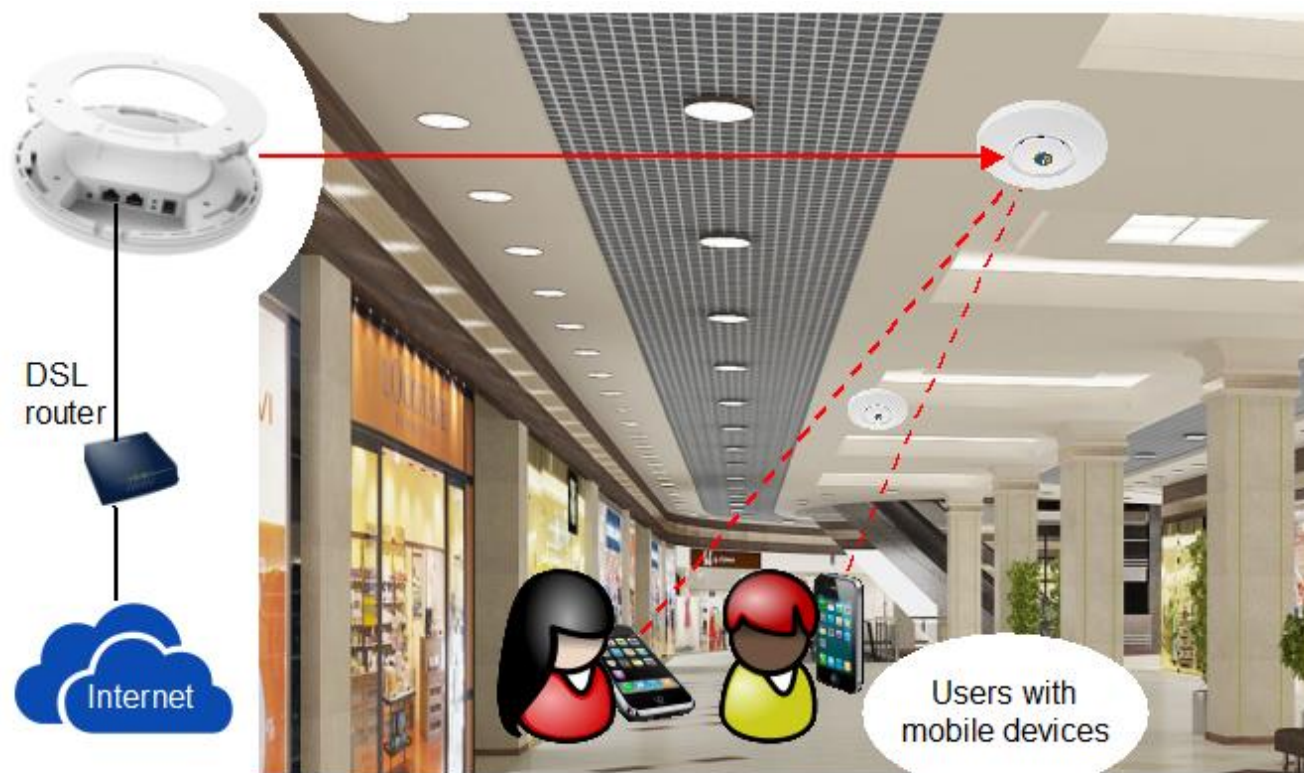
Figure 6: Shopping mall mobile broadband installation.

9.

Mobile Broadband Mobility

Many mobile broadband systems that issue access codes to customers have a serious limitation because the access code will only work with the wireless access point for which it was issued.

Customers want mobility, which is the ability to roam between many wireless access point antennas and have the access code work with any one of them. Mobility is achieved by one of two means.

- Install many wireless access points, which are all wired back to one access control unit. Access codes issued by the central access control will work with any one of the wireless access points connected to it. In many cases this method is not practical as it is impossible to wire all wireless access points back to a single access control unit, or else possible by configuring VPN networks between the wireless access points and the access controller.

- Install many wireless access points that each have access control software, and issue access codes using a cloud management system or Internet connected server that is accessed by any one or the wireless access points; each wireless access point authenticates the code with the cloud management system or central server.
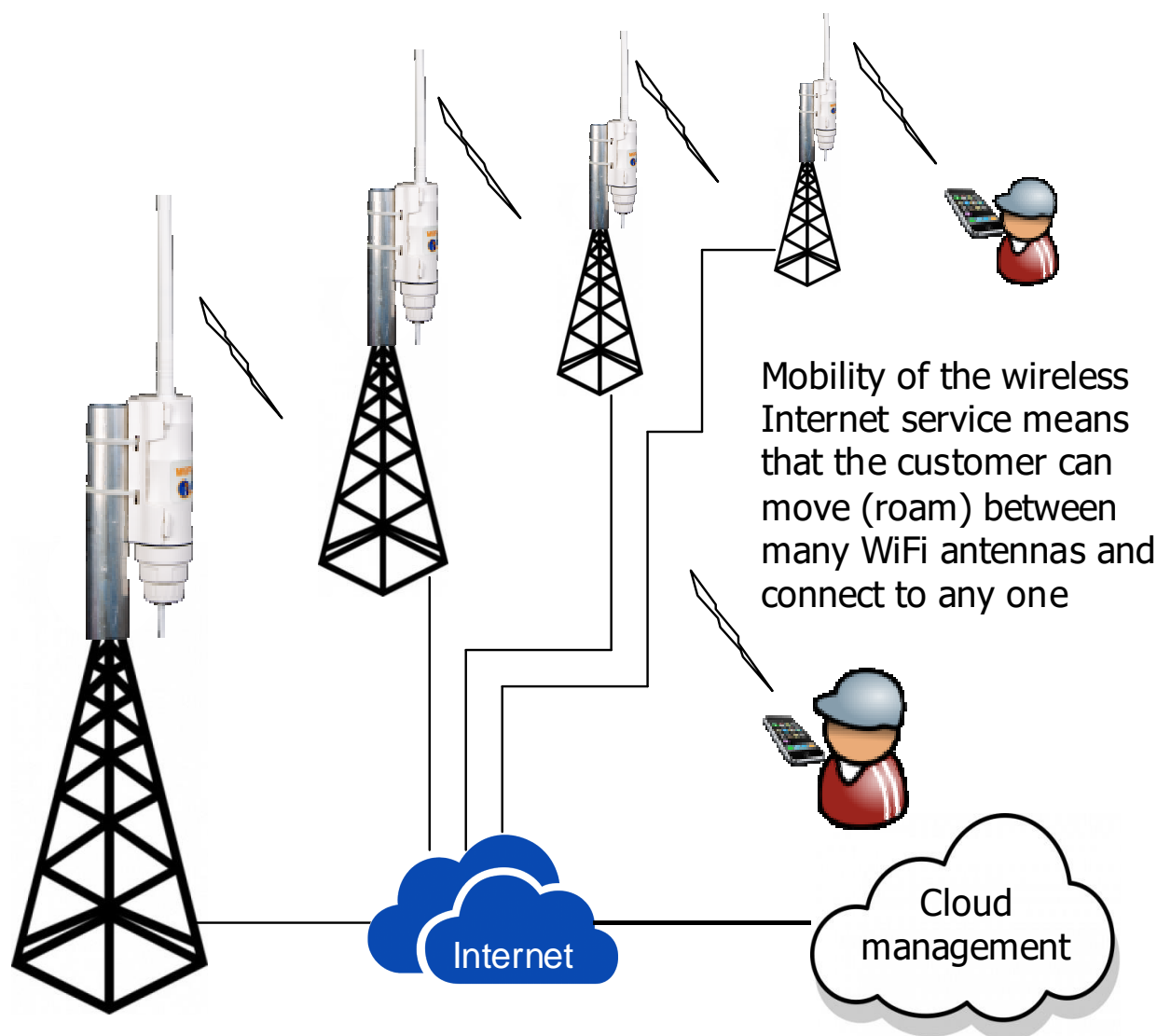
Figure 7: Mobile Broadband service with mobility (roaming).

The most popular mobile broadband wireless products that are used for Internet voucher applications rely on cloud management to centrally generate and authenticate access codes while the access control of users occurs at the wireless access point. The diagram below illustrates the cloud management of several wireless access point antennas. The customer can connect to any antenna with one access code and move to a different antenna.

A number of businesses have been established to provide mobile Internet on a national or global scale. All have cloud-managed services that issue access credentials to subscribers. Subscribers create an account in the same way that they would for a fixed broadband provider and pay a monthly subscription. The subscription permits the customer to access branded wireless mobile broadband access points anywhere in the world.

The names of some well-known mobile broadband wireless Internet providers are shown in the table below.

Figure 8: Well-known brands that provide wireless mobile broadband Internet.

The best known of these mobile broadband businesses is Boingo who provides wireless broadband Internet at many airports throughout the world.

In addition to implementing mobility with roaming, cloud management can also provide other valuable functions such as monitoring the status of each wireless access point, and generating an alarm if any wireless access point fails or goes off-line.

Some cloud services have a monthly or annual charge for use and there are cloud services that are provided free of charge by product manufacturers for use with their products. Cloud services are described further in a later section of this book.

A mobile Internet service provider can partner with any one of the mobile WiFi companies described previously. The Internet service provider will invest in the installation of wireless access points and shares the revenue in exchange for the brand marketing the WiFi service. Although this type of partnership can bring results for locations such as airports, it is not beneficial to a city network in a country where the brand will not advertise.

With mobility technology the Internet service provider can offer a mobile Internet service for a town or city. Wireless access points are placed at high points such as the roofs of tall buildings. It is important that customers have good visibility of the antennas. The Internet service provider can print vouchers at a central location then distribute them throughout the city to be sold at many retail points. The vouchers can sell at the same locations that phone cards are sold. A customer can then purchase access anywhere in the city and connect to the Internet at any point in the city. The customer can use the same access purchase to connect to the Internet at other city locations.

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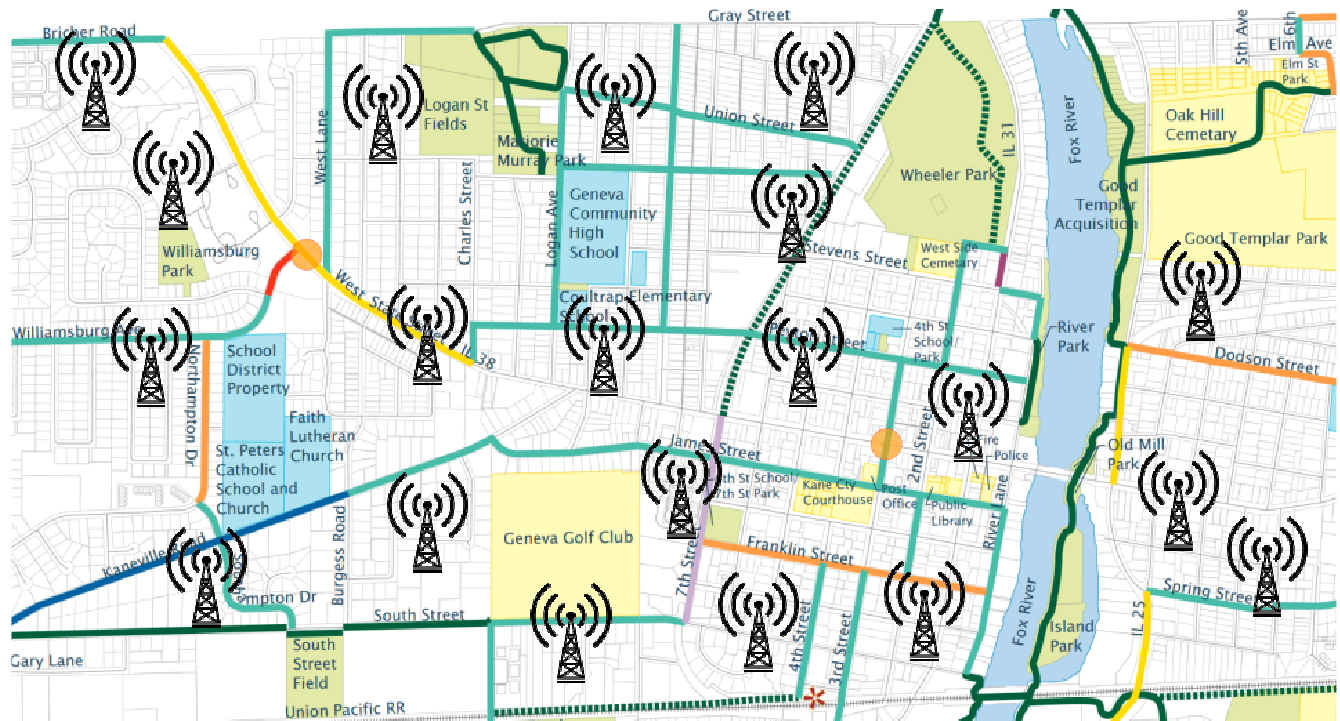
Figure 9: Wireless access point locations throughout a city.

10.

Fixed Broadband Wireless Service

The fixed broadband wireless service requires the same PtMP and backhaul infrastructure as the mobile broadband installation, however the PtMP wireless is configured differently, the wireless transmission is encrypted using WPA2 or WPA2-enterprise.

The customer location is a residence or business with a fixed antenna installation. The advantage of the customers fixed antenna installation is that a high gain directional antenna can be installed to give a long range of communications to the PtMP antenna, and can extend to a few Km. The distance between the two antennas must have line of sight with a clear space around the line of sight. Any obstacle such as a tree or building will block the transmission.

The diagram illustrates the fixed broadband wireless infrastructure installation.
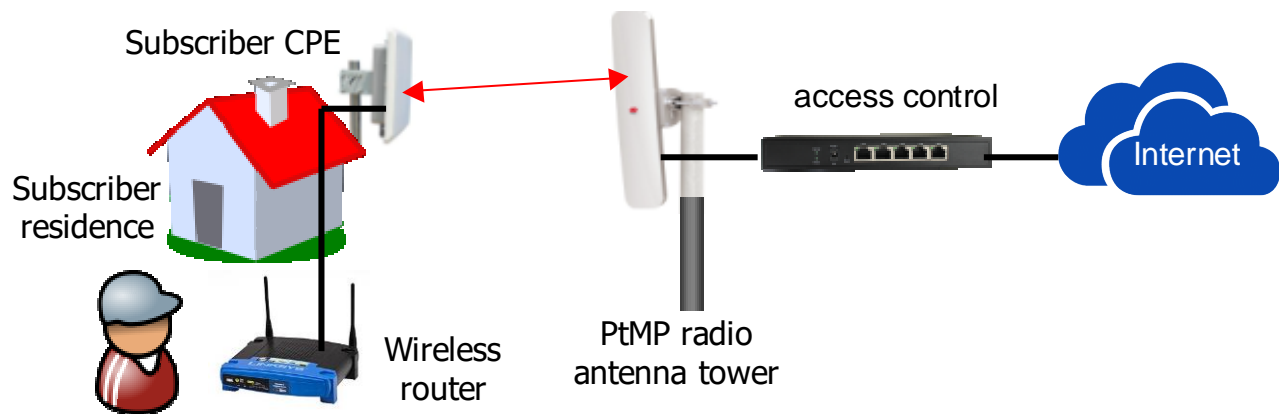
Figure 10: Fixed broadband wireless infrastructure.

The same PtMP tower infrastructure can be used for both fixed broadband and mobile broadband customers when the PtMP wireless is configured with two broadcast channels, called Service Set Identifiers (SSID's). One SSID will be encrypted using WPA2 or WPA2-enterprise, while the second SSID is not encrypted.

The wireless Internet service provider has an expense to install the client's premises equipment, which includes the cost of the equipment and the time of the technician to install and test the equipment. The wireless Internet service provider must recover this cost, which can be done with one of two methods.

- Charge the customer for the installation before proceeding with the installation.

- Amortize the cost of the installation with the customer's monthly payments for the service.

The first option is the best for the wireless Internet service provider, but may cause the prospective customer to decide not to install the service due to the high cost of the installation.

The second option is more attractive to customers as each monthly payment will be small when compared to the cost of the installation. The wireless Internet service provider has to ensure that the customer maintains the service for a minimum period of time in order to recover the cost of installation and not loose money. It is necessary to have a written agreement between the wireless Internet service provider and the customer specifying the terms and conditions.

- The customer must commit to using the service for a minimum period, which can be one year or two years. The wireless Internet service provider should plan to amortize the installation cost within half the minimum contract period.

- If the customer desires to terminate the agreement early then the customer must pay a termination fee so that the wireless Internet service provider can recover the cost of the installation.

The wireless Internet service provider should consult a lawyer to prepare an agreement that incorporates all aspects of local laws. Most lawyers will have access to a pre-prepared agreement that needs only specific alterations for the providers business.
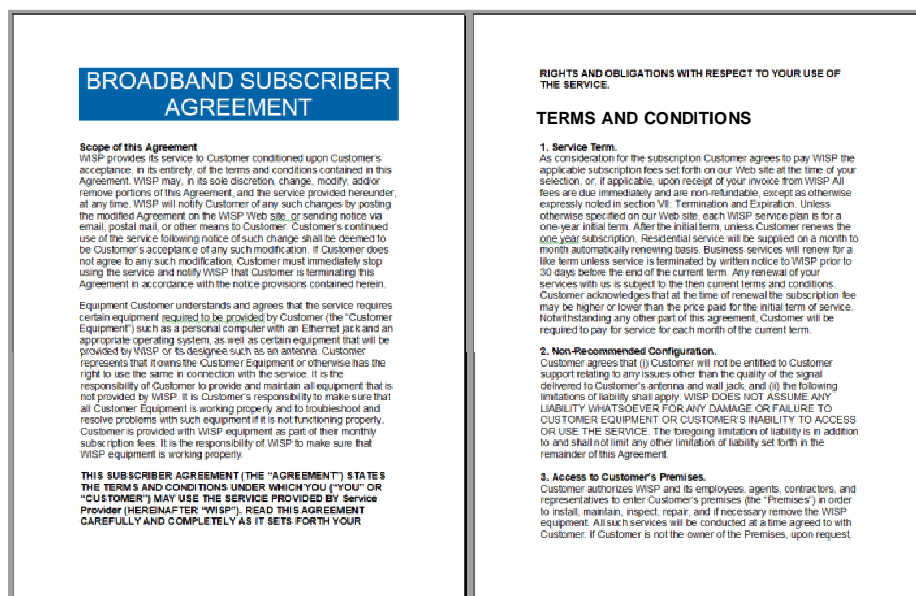
Figure 11: Fixed broadband subscriber service agreement.

11.

Fixed Broadband Client Premise Equipment (CPE)

The fixed broadband customer can be located several Km from the Internet service provider PtMP antenna, providing that the customer has a line of sight view of the PtMP antenna. The long distance is possible because a wireless receiver with a high gain directional antenna is installed on the roof of the customer's premises. This wireless receiver with high gain directional antenna is called the Client Premise Equipment (CPE) as this was the name given to the product by telecom companies who connected the client last mile using wireless.

Some technical characteristics are listed below that are required to install the wireless directional antenna.

- The antenna must be installed securely at a high point on the building so that wind or other climate effects do not cause movement of the antenna.

- The antenna must have line of sight visibility to the transmitting antenna with clearance around the line of sight view (Freznel zone).

- The antenna position must be carefully adjusted for maximum signal strength using a signal strength meter incorporated into the CPE software.

- Outdoor Ethernet cable connects the CPE to the equipment inside the building. The Ethernet cable will carry the CPE data and also provide the CPE with power (Power over Ethernet).

Figure 12: CPE antenna installed on the roof of a subscriber building.

The wireless Internet service provider is responsible for the installation of the CPE antenna on the roof of the customer's building. In addition to the CPE antenna the wireless Internet service provider must also install basic network infrastructure to permit the customer to connect any type of device to the Internet. Devices include wired desktop computers, and wireless laptop, tablet and smart-phone devices.

The wireless Internet service provider therefore should prepare a customer installation kit which will include the following;

- CPE wireless ant antenna.

- Adjustable roof mounting bracket for the CPE antenna.

- Outdoor Ethernet cable and connectors to connect the CPE wireless with equipment inside the building.

- Power over Ethernet power (PoE) supply to power the CPE wireless over the Ethernet cable.

- Wireless router with power supply providing Ethernet ports for several wired devices and WiFi wireless for several wireless devices.

- Ethernet patch cord to connect the wireless router to the PoE supply.

The fixed broadband customer installation is illustrated in the figure below.
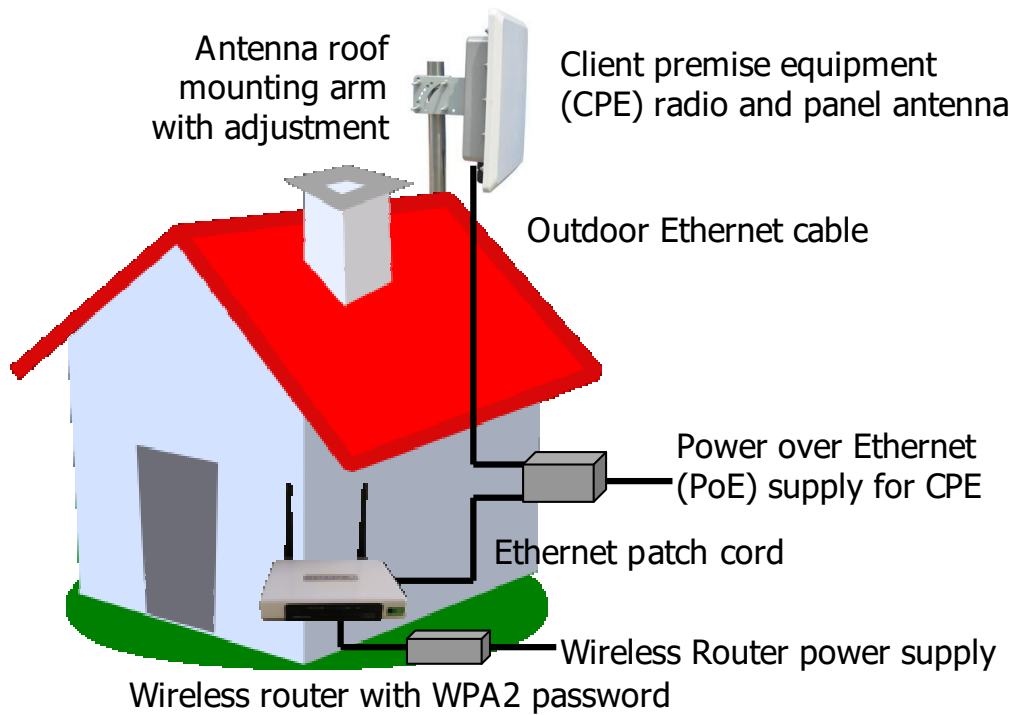
Figure 13: CPE installation in a residential building.

12.

Installing the Internet Access Wireless Equipment

Customers of the Internet service connect wirelessly to a point-to-multi-point (PtMP) wireless access point (WAP), which in turn connects to an Internet service via the access control unit. The wireless access point can connect several customers simultaneously and this is the reason that it is called point to multi-point. The number of customers that can connect to a wireless access point depends on the performance of the product. Most wireless access points are able to connect 30 users, better performance wireless access points can connect over 50 users, and the highest performance wireless access points can connect over 100 users. The performance of the wireless access point is determined by the processor speed and memory size, by the wireless frequency bands that the wireless access point has, and the speed of the Internet connection.

It is important to install the wireless access point antenna at a point where it is visible for the maximum number of users. The reason that users must have line-of-site to the antenna is that the signals of the two frequency bands of 2.4GHz and 5.8GHz are blocked by buildings and trees. For this reason the wireless access point antenna is installed at a high point to give the maximum visibility. This might be on the roof of a tall building, on an antenna tower, or on a hillside overlooking a town. Antenna installations are illustrated in the following figures.

Figure 14: Wireless access point antenna installed on a building roof.

Figure 15: Wireless access point antenna installed on an antenna tower.

Figure 16: Wireless access point antenna installed on a hillside overlooking a town.

One final technical detail is that the point-to-point line of sight is essential for reception, and there must be a clear space around the line of sight connection to ensure a good quality connection and be able to operate at the maximum distance. The space that must be maintained around the line of sight is called the Freznel Zone and is illustrated in the figure below.
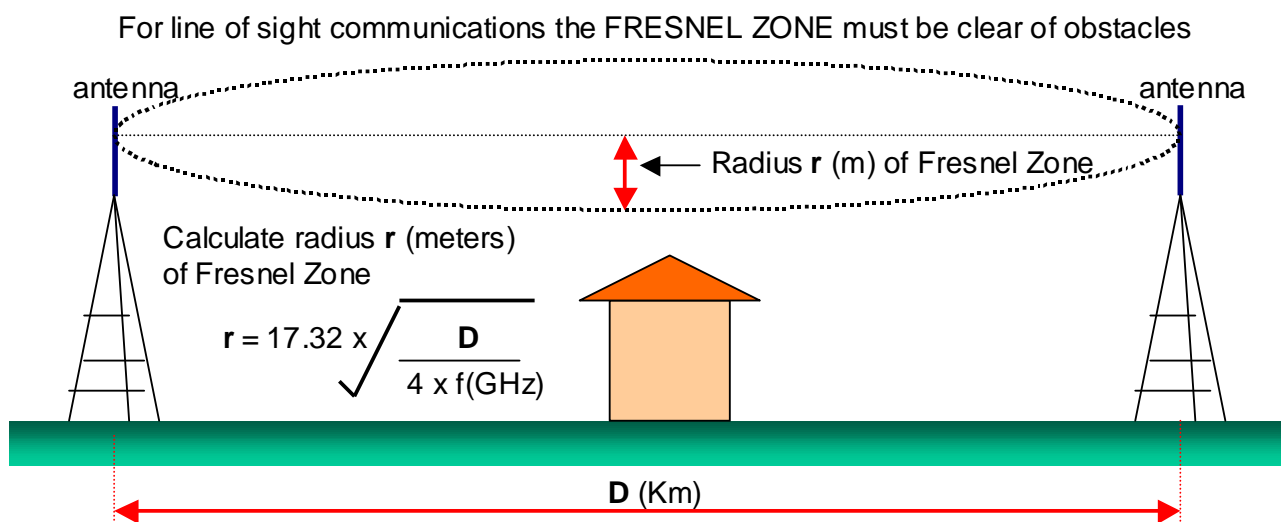
Figure 17: Freznel zone calculation.

When connecting to an antenna the visibility around the antenna should look like the figure shown below.

Figure 18: Clear space around the antenna for the Freznel Zone.

13.

Connecting the Wireless Access Point to the Internet

The wireless access point and access controller must be connected to an Internet Service Provider (ISP). This can be a wholesale provider such as a telecom company that sells Internet access to a service reseller. The service can also be a retail connection such as a DSL service. If using a retail connection then verify that the provider allows the service to be resold.

The type of connection depends on where the wireless access point antenna is located. If the PtMP wireless access point is installed on the roof of a tall building then it is likely that a data circuit, such as a DSL service, can be connected to the building using existing phone lines. The installation of a wireless access point on the roof of a building with a connection to a DSL service is illustrated in the diagram. The access control will be installed between the wireless access point and the DSL service.
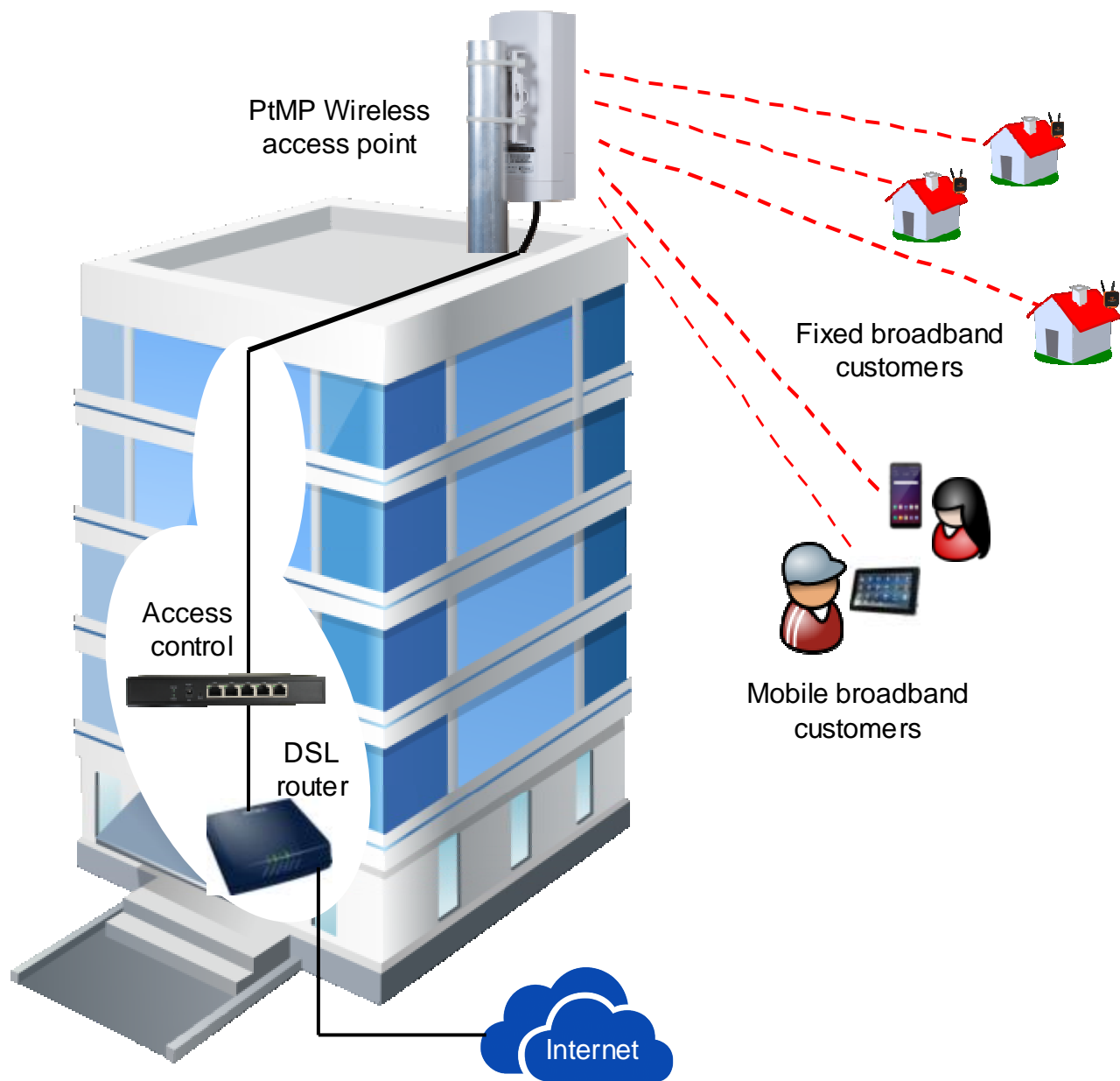
Figure 19: Wireless access point connected to an Internet service provider.

The antenna might be located at a point where it is impossible to get a wired Internet connection and so the antenna must be connected to a remote location using a point-to-point wireless link where it is possible to get a wired connection to the Internet. The wireless point-to-point data link configuration is shown in the figure. Installing the access controller between the PtMP wireless access point and the backhaul antenna eliminated to need to support WDS over the point-to-point wireless link.
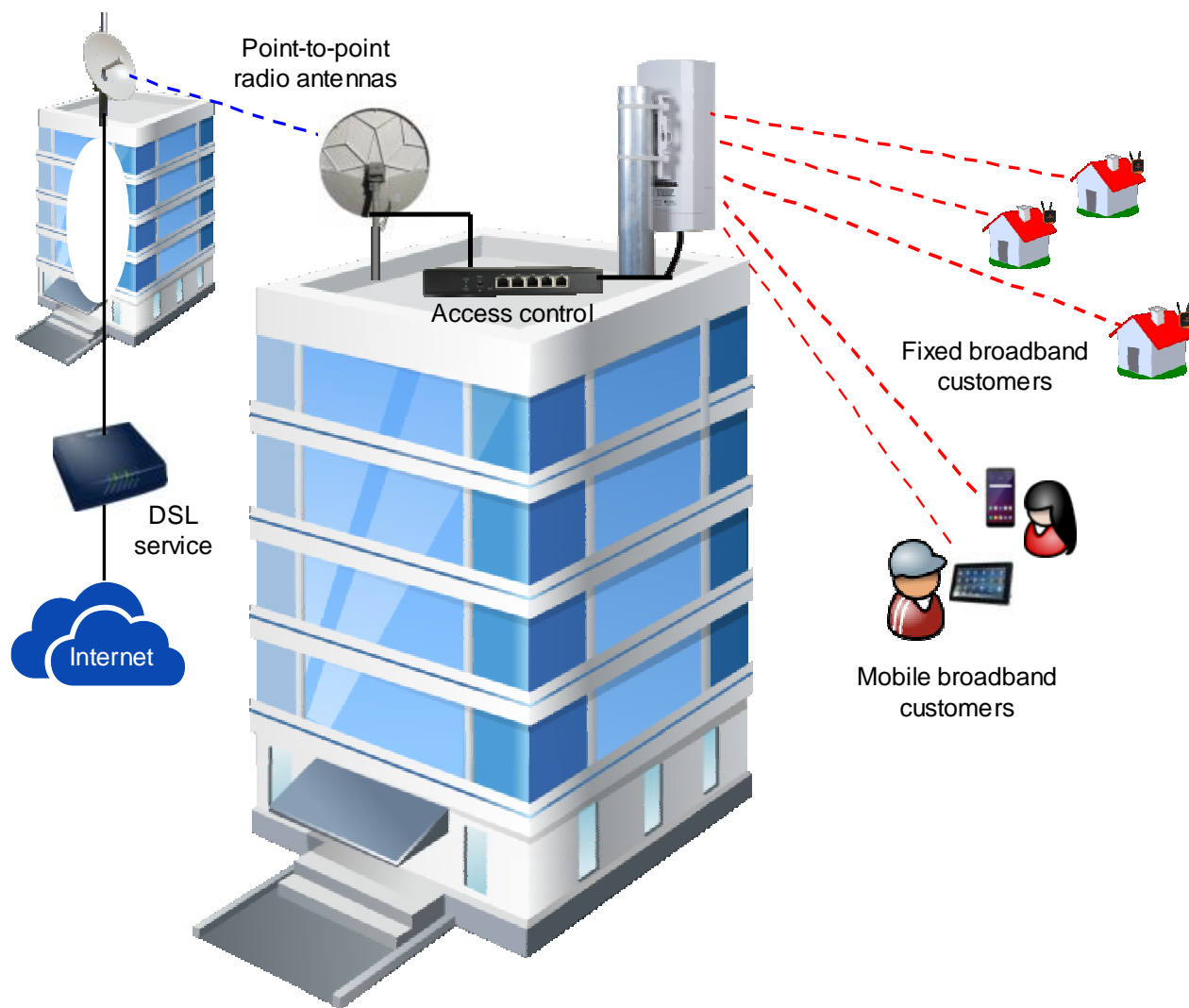
Figure 20: Wireless access point connected remotely to an Internet service provider.

If the geography of the installation is hilly or mountainous the wireless access point can be installed on a hillside overlooking a town. Such an installation will give the wireless access point a much wider area of coverage than if it was installed on the roof of a building. The customer connections are the yellow lines shown in the figure. The wireless access point is connected to an Internet service provider in the town through a point-to-point wireless link, shown as the blue line in the figure.

Obviously a wireless installation installed on a hillside needs power and this is provided by a generator that combines solar with wind power. This power installation is described in a later section of this book.

Figure 21: Wireless access point installed on a hillside and connected to an Internet
service provider over a point-to-point wireless link.

When a network grows in size with multiple PtMP wireless access points to provide Internet service for many people, then point-to-point wireless links can connect multiple sites to one central location with the access control installed at the central location. This is the Network Operations Center (NOC) connection model used by many Wireless Internet Service Providers (WISP's). Although the connection model is simple to understand it has a very serious weakness; there is a single point of failure. If the central antenna or network operations center fails then all customers will loose the Internet service.
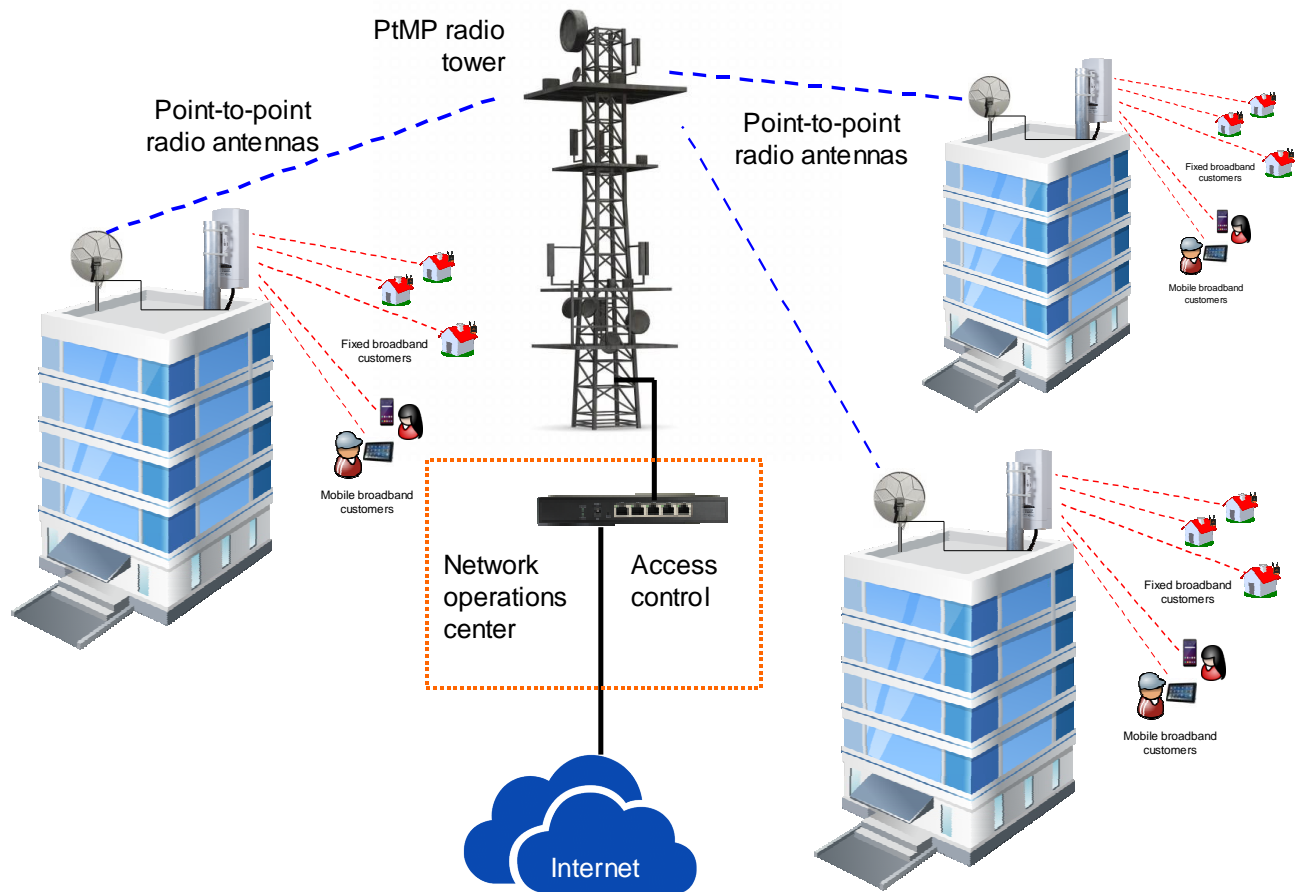
Figure 22: Multiple wireless access points with the access control at a central site:
The central site is the network operations center (NOC).

Multiple wireless access point sites can be connected to a local telecom point-of-presence (PoP) service and managed by a cloud service. With some cloud implementations each site can function autonomously if the cloud service is interrupted so there is no single point of failure making the system much more reliable. If a defect occurs at one wireless access point site then only the customers at that site will be affected.

Many start-up wireless Internet service providers prefer this type of network configuration. They select a cloud service that is plug-and-play, which means that the Internet provider does not need much technical knowledge to start in business.
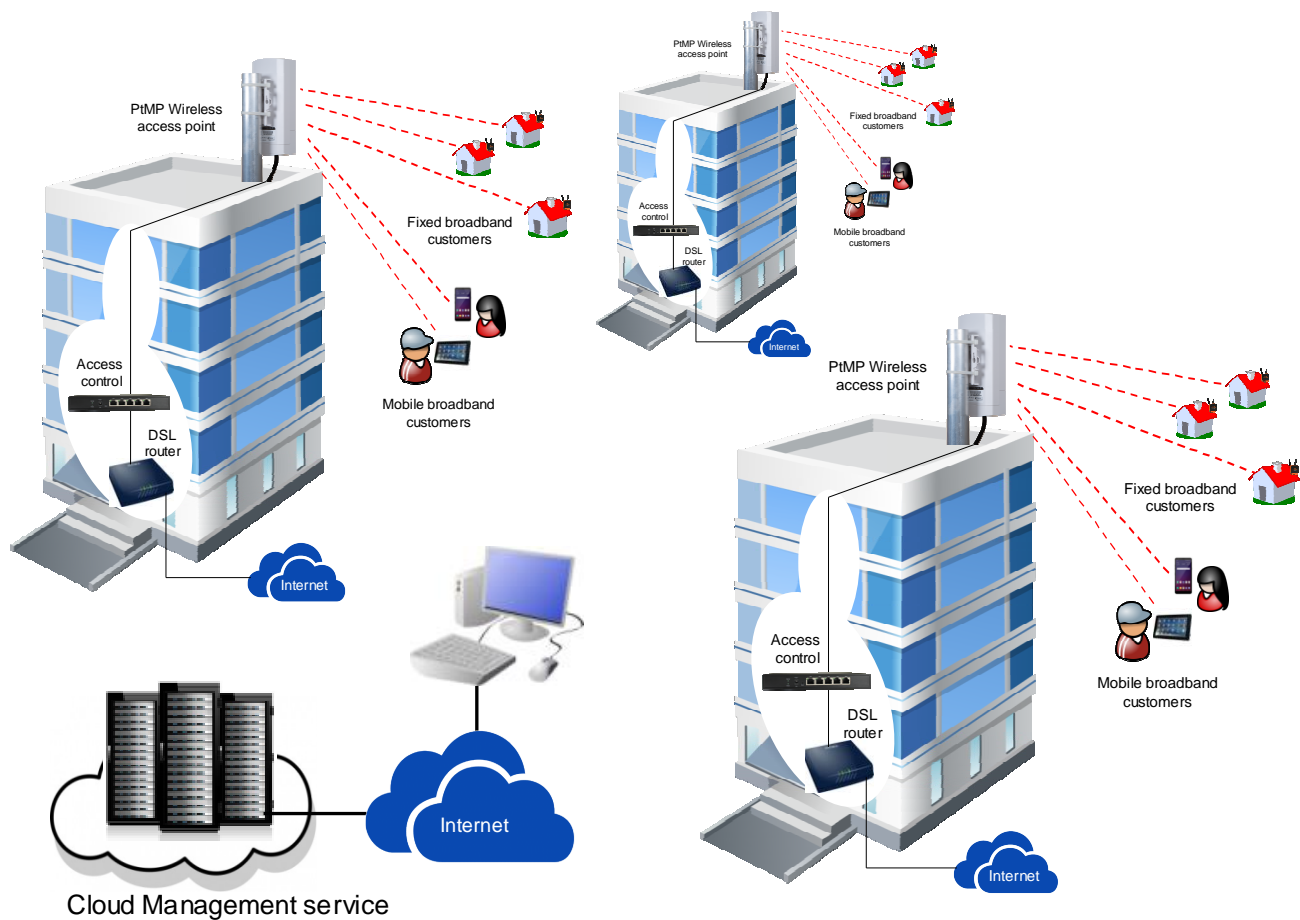
Figure 23: Multiple wireless access points each with the access control and a local Internet
DSL connection, using a cloud management service.

In situations where a local ISP service is not available at the wireless access point sites, and cannot be connected via a point-to-point link to a remote location, then each site can be connected to a satellite service and managed through a redundant cloud system for high reliability. The Hughes geo-stationary satellite system is the only service currently available for many customers. The service is expensive with limited data speeds and so it is only possible to connect a few customers at each site. SpaceX is currently launching low earth orbit (LEO) satellites for the Starlink system. For less than the price of Hughes, Starlink will deliver 10x the data capacity therefore many more customers can be connected at each site. The Starlink latency (delay to access the Internet) is also much less than Hughes because the distance to the satellites is a few hundred Km, rather than 22,000 Km to the Hughes satellites. The eventual global availability of Starlink will permit a rapid expansion of Internet services in locations where no Internet service is available.

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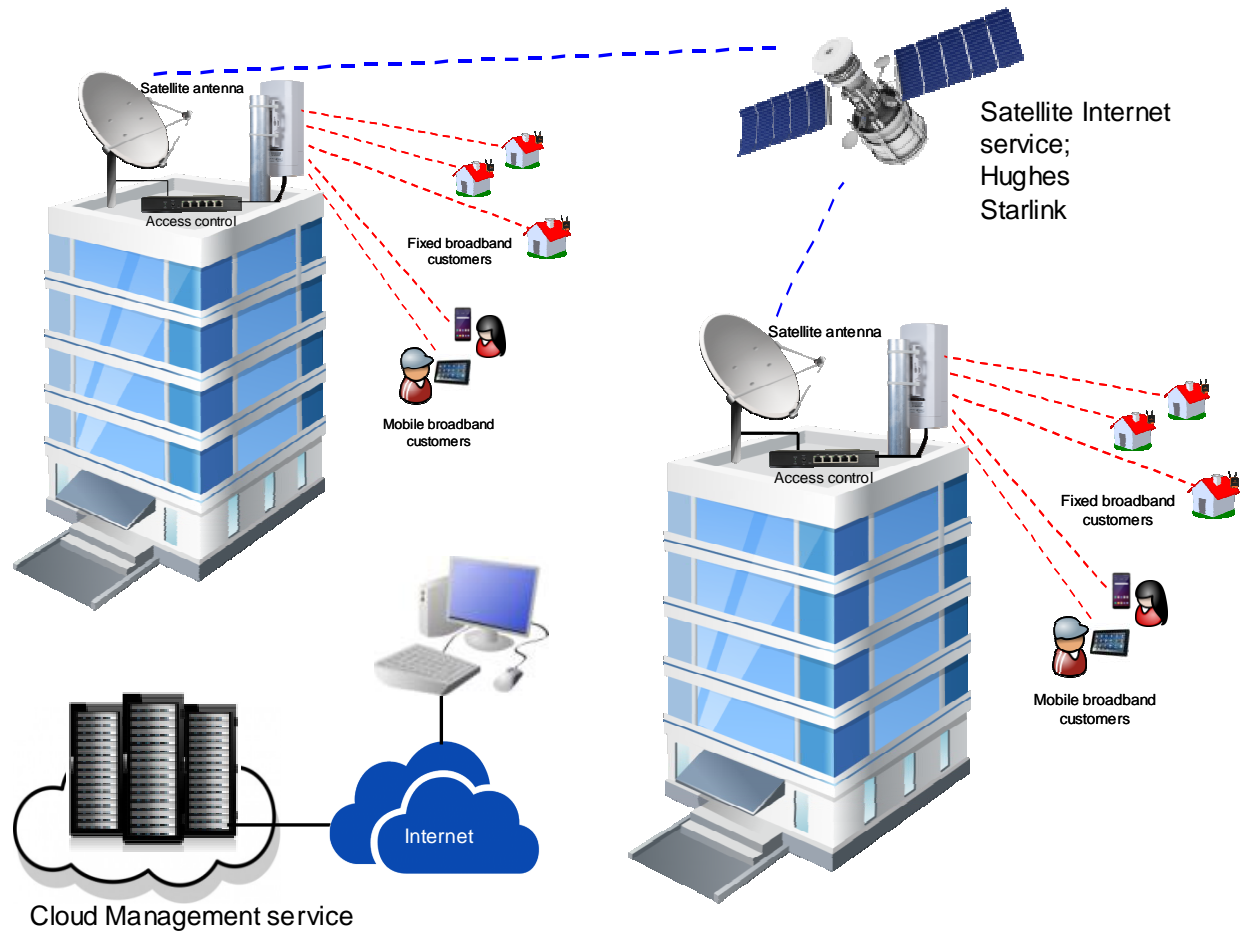
Figure 24: Multiple wireless access points each with the access control and a satellite data connection, using a cloud management service.

14.

How to Power an Antenna Site that has no Electricity

The point to multi-point (PtMP) wireless access points and point-to-point (PtP) wireless backhauls have to be installed at a high location, which can be the roof of a tall building, a tower or a hillside. In some of these cases electrical power is not available which is a common problem for Internet service providers. There are power kits available from many manufacturers, which provide the electrical energy for the installation. The power generation kit has four components.

- Solar panel, 100 watts.

- Wind turbine, 100 watts.

- Battery, 12 or 24 volts.

- Battery charger and voltage regulator.

The wireless and access control equipment is low power and will consume between 10 and 20 watts. The power generation and storage system will be designed for 100 watts so even when no power is being generated (night-time with no wind) there is a reserve of power stored in the battery.
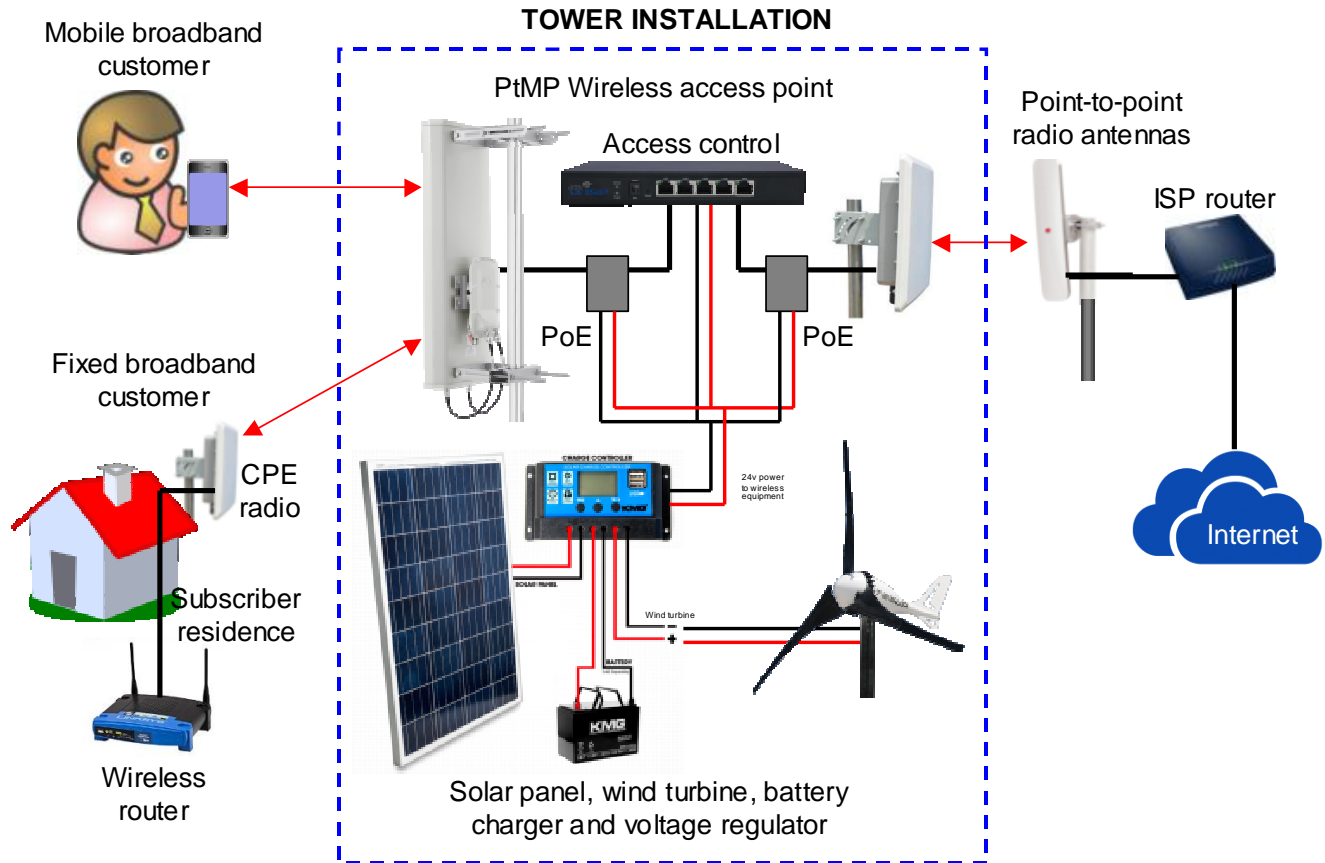
Figure 25: Power generation at the antenna site.

The figure below shows a hillside antenna installation with solar panels and wind turbine that charge a large capacity battery. A point-to-point wireless backhaul parabolic antenna points towards the town to provide the Internet connection. A point-to-multipoint sector antenna on the mast provides access for the towns residents. A second parabolic antenna provides a backhaul link to a second PtMP site. The wireless Internet service provider has also installed an IP camera so that the site can be observed remotely. The equipment is tied down to a foundation in the ground to prevent wind damage. With any hillside installation it is always a good idea to install a fence around the equipment to prevent animals from damaging the equipment.

Figure 26: Hilltop PtMP antenna installation with backhaul antennas and solar panel power supply.

15.

The Benefits of Cloud Management

W hen choosing the wireless and network products to implement a wireless Internet service provider the installer will benefit by choosing products that have cloud management. Some products have free cloud management; and some products require a monthly or annual payment for a cloud management service.

Some product manufacturers provide software to install on a PC for remote access or else provide a remotely accessed monitoring appliance. While the monitoring software or appliance does not provide all the features of a cloud managed system, it does add some essential remote management features.

If the wireless Internet service provider is proficient at programming then a cloud management system can be built using open source software that interfaces with routers, which provide local access control. The routers have to be programmed (scripted) for the cloud application and will require the installation of custom macros.

The ready-to-use cloud systems require very little configuration for use and can be installed and operational in a few days. The custom could system using open source software will require a high level of expertise and several months of development time.

An example of a cloud-managed network for broadband Internet access is shown in the diagram below.

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Install Internet Wireless Equipment and Sell Vouchers for Cash Payments with Minimum Investment and Limited Technical Knowledge
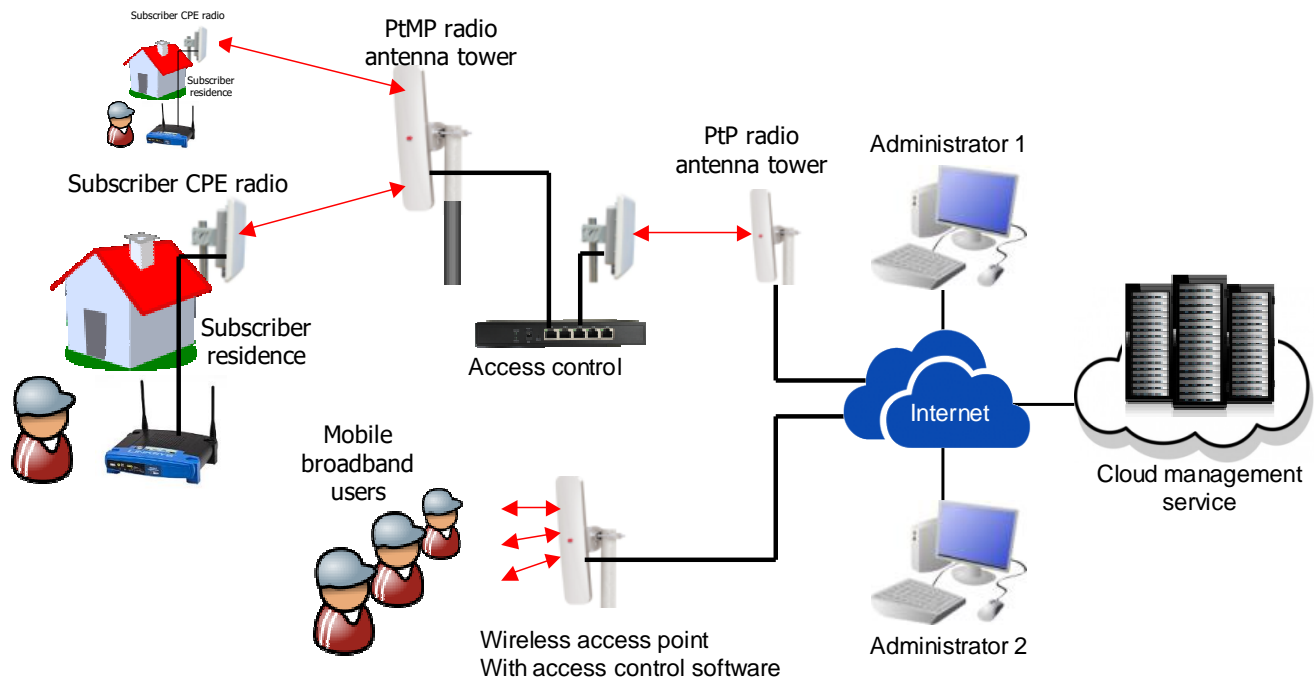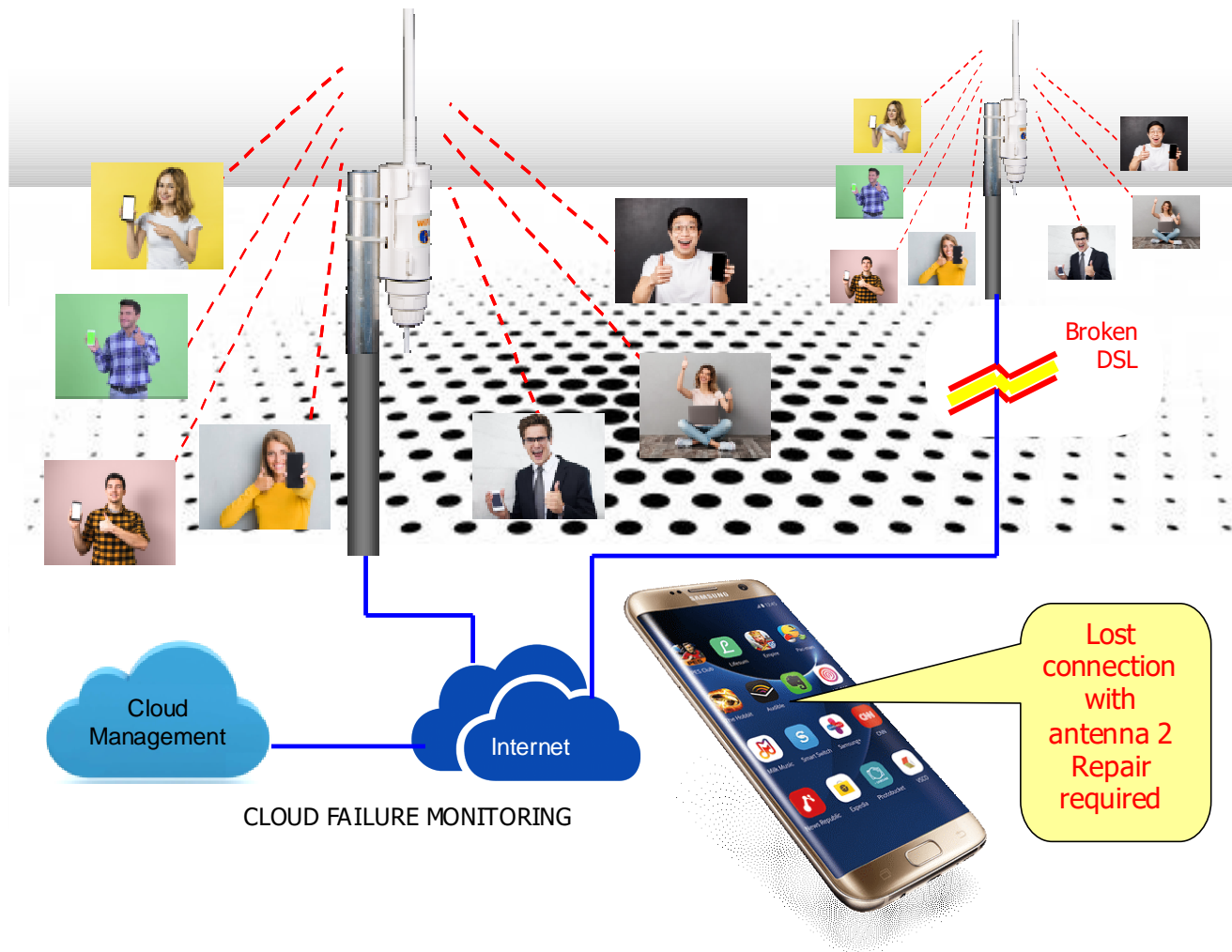
Figure 27: A network of cloud-managed equipment.

16.

Failure Monitoring of Equipment is Very Important

The wireless Internet service provider is installing equipment that will generate an income, providing of course that the equipment continues functioning. Equipment downtime is the time that the equipment is not working and therefore no income is generated. Minimize downtime by monitoring all equipments for failure and alert technical staff immediately when any equipment fails. Monitoring is done using software installed on a central computer, which communicates with each piece of equipment periodically to check the status. If the equipment does not respond then the software assumes that the equipment has failed and then sends an alert to technical staff. A popular type of equipment monitoring uses a method called Simple Network Management Protocol (SNMP). Many types of wireless and routing equipment incorporate an SNMP client, which the SNMP server monitoring software can communicate with. Equipment failure monitoring is also part of a cloud management system that a manufacturer provides for its products. The advantage of the manufacturers cloud monitoring is that there is no software to configure, just add the email address where the failure alert messages should be sent.

Figure 28: Cloud based equipment failure monitoring system.

Some of the many benefits of the cloud management of network equipment are listed below.

- Manage a large network from one central location.

- Facilitate management of a large network by several people in different locations.

- Facilitate configuration changes as the network grows.

- Remotely configure access control and wireless access points individually or as a group.

- Cloud generated access credentials permit customers to use any wireless antenna in the network; this is called mobility and permits customers to roam between antennas.

- Generate access credentials in several forms, including random alphanumeric and specified data string.

- Generate access credentials with parameters to implement different rate-plans; this includes time duration, termination date, maximum download and upload speeds, maximum download and upload byte counts, and number of simultaneous users.

- Monitor any part of the network for failure, receive a failure warning to initiate repairs, monitoring includes any device that has an IP address.

- Gather network use data for individual wireless antennas and for the whole network.

- Brand all aspects of the customer facing system, login pages, access vouchers, etc.

- Provide central banner advertising for the login pages, and sell advertising.

- Secure access to equipment configurations.

Cloud management is so important for the operation and reliability of the network that a wireless Internet service provider should not consider starting a business without implementing some type of cloud management for equipment configuration and failure monitoring. Cloud management is worth to cost, and some product manufacturers provide cloud management as a free service.

17.

Fixed Broadband Internet Access Control

A fixed broadband customer will make an agreement with an Internet service provider who will provide Internet access and receive payment at the start or end of each billing cycle. The Internet access will be enabled, or activated, during the time that the payment is made for the service. If the payment is interrupted then the access control will disable Internet access until the payment is received.

Several different methods are used for fixed broadband access control, which range from simple manual control to comprehensive billing systems with automated access control with actions determined by customer payments that are received.

A very simple MAC address access control scheme is popular with startup Internet provider businesses. This can be implemented with wireless access point products that have an authorized MAC address table, which permits the listed MAC addresses to access the Internet, and blocks MAC addresses that are not listed. The Internet service provider can login to the wireless access point remotely to add or delete MAC addresses. If the customer does not pay then the Internet service provider manually removes the MAC address.
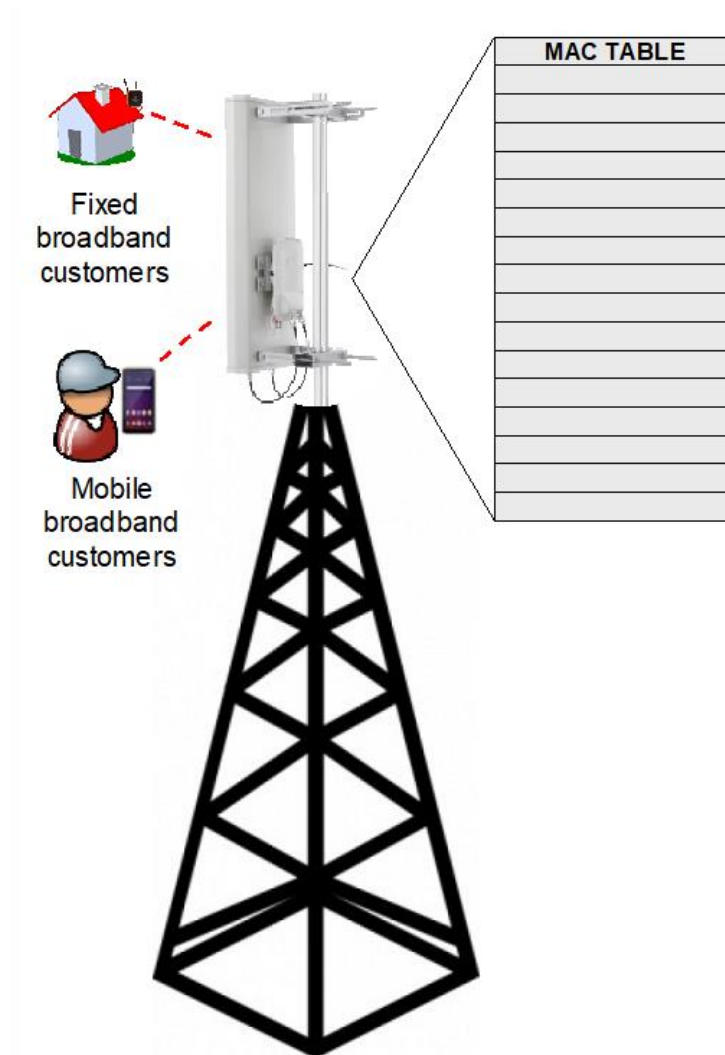
Figure 29: Simple access control, using an allowed MAC address table in the wireless access point.

The Internet service provider will install a CPE wireless at the customer's premises and then put the MAC address of the CPE wireless in the wireless access point to authenticate that customer onto the network. The wireless link will be encrypted to prevent anyone attempting to capture the MAC address and getting free Internet access.

This MAC address access control scheme has limitations but it is used by many startup Internet providers because it is simple to implement and requires little technical knowledge. There are major drawbacks are as follows;

- Although the scheme is simple adding and deleting MAC addresses requires constant administration by the Internet service provider. MAC addresses must be deleted manually when the customer payment is not received. This method might be acceptable for one wireless access point but the scheme is not scalable to many wireless access points.

- The Internet service provider has to administer the customer billing process using spreadsheets, which has high administrative overhead for an Internet service provider business. A spreadsheet will show the following customer information and account parameters.

    o Customer contact information.

    o Parameters of the customers rate-plan.

    o Value of the billing cycle payment.

    o Date when the payment is due.

    o Date when the payment was received.

    o The billing cycle day when the Internet access is suspended if the payment is not received.

- The MAC address scheme cannot be used for mobile broadband customers because the PtMP wireless is not encrypted. When the wireless access point is not encrypted it is very easy to hack the wireless communications using free 'sniffer' software. The hacker can capture a MAC address then configure a wireless device with that MAC to get free Internet access.

A much more secure and easily managed method of billing subscribers and managing the subscriber Internet access is implemented with a billing system designed specifically for wireless Internet service providers (WISP's). There are a number of billing systems that are either free or paid software, or else a cloud service.

- Free software: both open source and proprietary software can be downloaded and used, however there is a cost for operation as the software must be installed on a server which has backup power and dual Internet access, or on a reliable cloud hosting service such as AWS. Free software does not have any type of support, however there are businesses that offer support for a fee. The installation and use of free software requires a high degree of technical skill, and should not be considered by a business that does not have the skills required.

- Paid software: usually has better features than free software and good technical support, but has an annual maintenance cost which may be in the region of $1000 to $10000 depending on the number of subscribers that are being managed. Although the software installation requires specialist technical skills the paid software vendors can eliminate this issue by providing a ready configured server with the software installed that is plug-and-play.

- Cloud services will have a monthly or annual fixed fee, or will charge per subscriber, or usually both. The charge can be in the range of 5 cents per subscriber per month to $1.50 per subscriber per month. Cloud services will have good technical support and will be very easy to use because there is no server equipment to install. Some cloud services provide access control equipment that is plug and play to install, other cloud services provide router scripts which are installed on low cost routers such as those manufactured by Mikrotik.

Although technical skills are required to install router scripts, there are businesses that will provide this service.

The billing process starts with the sales employee who adds the contact and payment information for a new subscriber to the subscriber database. When the customer is added the rate plan that is chosen by the customer is assigned to the customers account. The rate plan determines what value the customer will be billed each cycle (usually 1 month) and determines the type of service provided, such as the maximum download and upload speeds. The rate plans are set and updated by the manager and will update the subscriber database after each change. The Internet service provider might charge each month in advance at the start of the billing cycle (pre-pay) or charge the customer at the end of the billing cycle that the service was provided (post-pay).

Adding a new subscriber initiates the provisioning process to install a CPE wireless at the customer's premises. A work order is generated for the installation technician.

Processes are also initiated that send messages to the access control router. The first message is activation of the new subscriber using the authentication method adopted by the system; this might be CPE MAC authentication, PPPoE or WPA2-enterprise. The second message is the rate plan information that is sent to the access control router; this will determine the speed of the Internet service and possibly the data cap (byte limit) during the billing period for that customer.

The billing engine accesses the customer information to verify the billing cycle payment receipt date. Invoices are issues as the payment becomes due and the invoice is sent to the customer. When the financial employee is notified that the customer payment has been received the receipt of payment is noted in the subscriber database. In the case where the subscriber's account becomes past due the billing engine will initiate a process to interrupt the service by requesting access control deactivation. Upon this event a command is passed to the access control router to suspend access for that customer. When the customer bill is marked paid the billing engine issues a command to the access control router that will reactivate the customer.

In addition to printing invoices, the billing engine may have interfaces to charge credit cards, debit bank accounts or initiate a cash payment process using a gateway such as Oxxopay in Mexico.

The manager can supervise the billing process through a financial report showing the status of each customer's account and the monthly receipts.

With most billing systems, there are four staff members who use the system; sales, accounting/financial, technician and manager, who each have a login. The login process records times of use and restricts access only to those parts of the system that are relevant to their jobs.

A typical Internet service provider fixed broadband billing system process flow is illustrated in the figure.
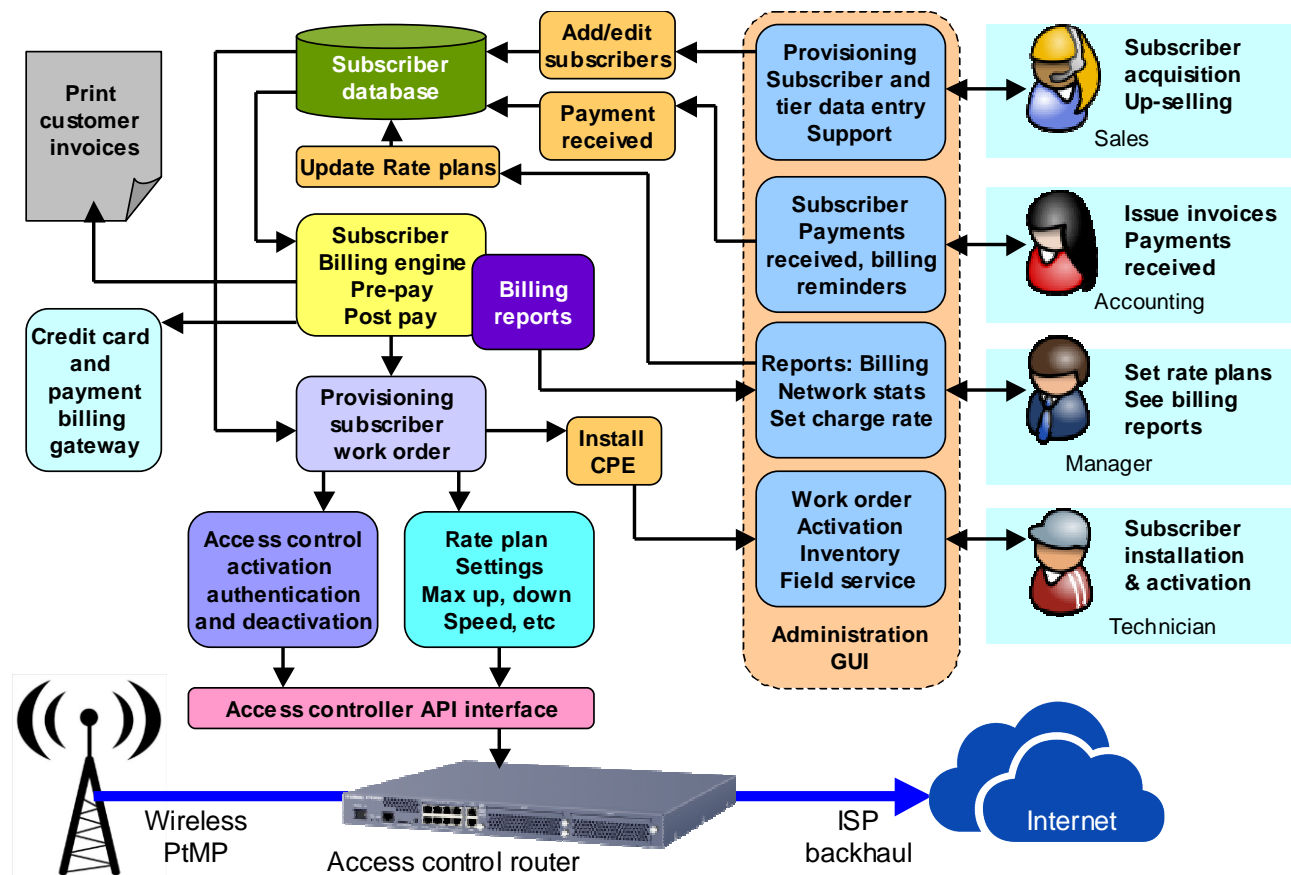
Figure 30: Fixed broadband billing and access control.

18.

Mobile Broadband Internet Access Control

Mobile broadband access control employs a different billing and access control procedure to that used for fixed broadband subscriber billing. Mobile broadband customers purchase Internet access on-demand; with the Internet service provided for a specific duration, with specific conditions of use.

Selling Internet access to mobile broadband customers requires a 'paywall' between the customer and the Internet. The 'paywall' is a switch that allows customers to connect to the Internet after presenting a valid credential or purchasing access. The 'paywall' disconnects the customer when the credential time has expired.

The mobile broadband customer is anonymous; there is no database of customers. The 'paywall' authentication is made using an access key credential, which is usually a numeric or alphanumeric sequence. The access key is distributed to customers using several methods listed below.

- On-line purchase using a credit card.

- Purchase of a pre-printed voucher with the access key.

- Purchase of a scratch-off card with the access key.

- Etc.

The access key code has information encoded that tells the access control system about the type of authorization that is allowed for the key, this is equivalent to the fixed broadband rate plan.

- Duration of access after first use, 1day, 1 week, 1 month, etc.
- Optional date when the access code duration will terminate.
- Maximum download and upload speeds.
- Optional data cap, maximum download and upload data byte count.
- Permission for the customer to use the code serially on several devices.
- Permission to use the code by several people simultaneously.

- Etc.

Fixed broadband customers who prefer to pay for Internet access on-demand may also use the 'paywall' method of access control.

The method of accepting and validating the access key credential code is a captive portal, sometimes called a splash page or login page. The captive portal also requires a code validation mechanism. There are commercially available products such as RADIUS, which maintain a database of access codes or passwords, and then authenticate any code presented to the captive portal. If the code is validated then the visitor is allowed access to the Internet with the conditions embedded into the code. If the code cannot be validated then the visitor cannot pass the login screen. Most of the commercially available authentication systems are proprietary and combine a captive portal with code generation, code database, code authentication and access switch. The basic design of the access control mechanism is shown in the next figure.
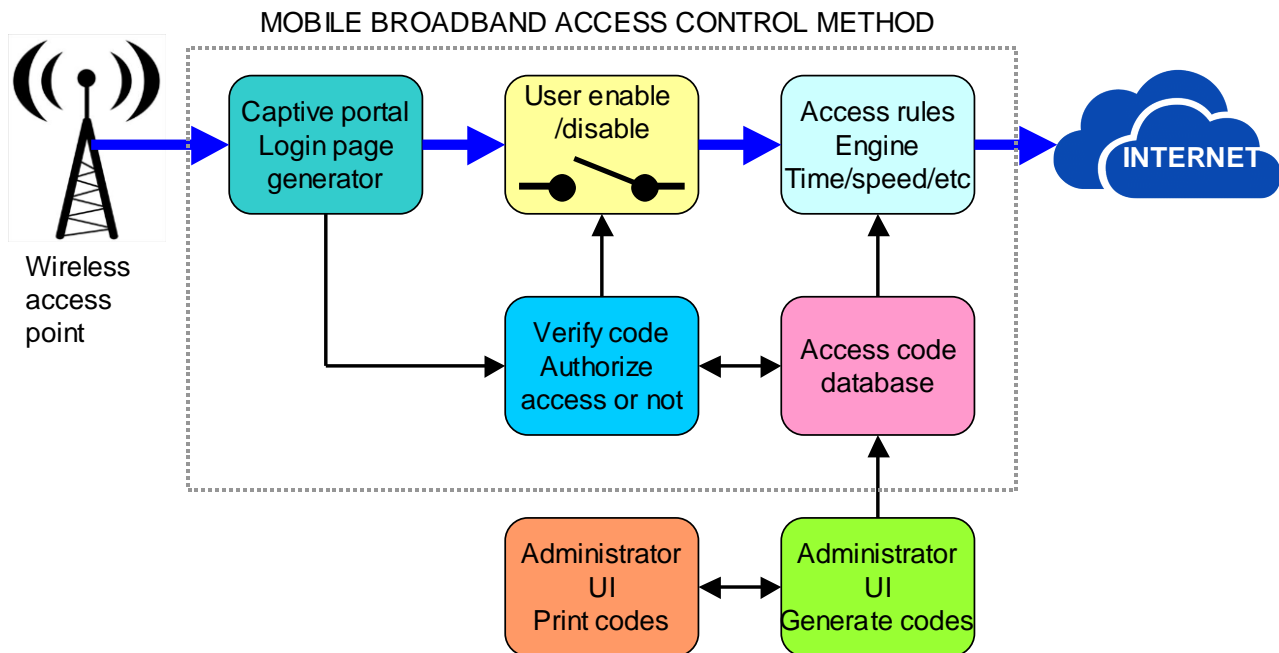
Figure 31: Mobile broadband access control functionality.

The mobile broadband access control function has six components.

- Login page generator that the browser displays and receives the access code.

- Access code verifier, verifies if the code provided by the user is valid and if so checks the parameters.

- Enable/disable switch to connect or disconnect each user.

- Rules engine, which imposes the rules of access as specified by the code provided to each user. Users can each have different rules imposed, or else all users can have identical rules imposed.

- Database of codes that have been generated and have not expired; codes that have expired are removed from the database.

- User interfaces (UI's) that permit the Internet service provider to generate and print the access codes.

The captive portal is a small web server that provides login pages. The customer opens a browser then opens a new tab and types the name of the captive portal, which is then displayed in the browser window. The captive port is the first step of the authentication process. The captive portal design must be responsive, as it will be displayed on many different mobile devices.

An example of a captive portal browser page is shown in the following figure.

Figure 32: Example of a captive portal login page with a box to type the access code.

The captive portal page can have a number of different login and authentication options, however the simplest is to request a code, which was previously generated by software and given to the customer. The code is then authenticated using the access control database. If the code is valid then

the customer can access the Internet. If the code is not valid then the customer has no Internet access. The authentication process has the following steps.

- Generate an access code that can be sold to a customer then assign characteristics to the code, such as the Internet access duration of the code and add to a database.

- Display a captive portal page that is used to enter the code.

- Check the entered code against a database of codes and verify that it is authentic.

- If authentic then allow the customer to access the Internet for the duration of time and conditions specified by the code.

There are four popular methods of implementing access control for mobile broadband customers. Each method has a captive portal with access code authentication; these methods are listed below;

- A wireless access point that has a captive portal feature can interface with a RADIUS server, which is used to authenticate the customer. This method requires technical knowledge to configure the RADIUS server. A software interface has to be programmed to create access codes in the RADIUS database. By adding software to the authentication process it is possible to add a duration characteristic to the code (time that the Internet can be used before the code expires) and other characteristics such as maximum download speed for the code.

- The wireless access point connects to a router (e.g. Mikrotik) that has programming (scripting and macros) to implement a captive portal and provide the authentication service using a RADIUS server. Programming the router requires specialist technical skills, however skilled people are programming routers to sell them configured for use as captive portals, for people who don't have the required technical skills.

- Wireless access points are available from manufacturers like Ubiquiti Unifi that can be configured with a captive portal and an access code generator for a Hotspot application. The product can also have a third party credit card billing gateway. These products require a lot of technical experience to configure and the login page design requires programming skills.

- Any wireless access point can be connected to a dedicated access controller that includes the captive portal, the access code generator and the authentication database, such as the products manufactured by Guest Internet. A dedicated access controller also includes many features that improve performance of the business. Dedicated access controllers are very simple to set up and use, and they do not require technical skills to configure and operate. Some dedicated access control products like Guest Internet include free cloud management making it possible to build a large network with roaming for mobility; this is the ability for a customer to move between antennas and continue to get Internet service. A dedicated access controller can add multiple parameters to the access code; in addition to the code duration, parameters such as maximum download and upload speed, maximum download and upload byte count, and number of users permitted to use the code can be added. The dedicated access controller is a very popular method to install a captive portal with authentication for mobile broadband applications.

- Wireless access points are available that have software which includes the captive portal, the access code generator and the authentication database. Guest Internet manufactures such wireless products. The wireless access point installation is simple, as no additional access controller is required. The all-in-one Guest Internet wireless products are very simple to use and include free cloud management to make operation of the network very easy. The wireless access controller can add multiple parameters to the access code; in addition to code duration parameters such as maximum download and upload speed, maximum download and upload byte count, and number of users permitted to use the code can be added. Cloud management adds mobility by permitting the customer to roam between many wireless antennas that are managed by the same account. A wireless access point that includes access control software is the lowest cost solution to implement a wireless Internet mobile broadband service.

When the access code is being generated the rules described previously are selected and added to the access code for decoding during the authentication process. The rules include duration of the code and the maximum download speed. The codes determine the rate-plan that the customer will purchase; this describes the service that is provided and the charge for that service. Some examples are listed below.

- Charge $5.00, 1 week of Internet access with a maximum download speed of 10Mb/s.

- Charge $20.00, 1 month of Internet access with a maximum download speed of 15Mb/s.

When the access codes have been generated they are distributed to customers who purchase them. There are several methods of providing access codes for customers.

- Scratch-off cards; the codes are downloaded as a CSV file and sent to a scratch-card printer. The codes are printed under an opaque film that is scratched off by the customer who purchased the card in order to read the code and type it into the login page.

- Printed vouchers: the code creation software can design a voucher and then print a selected number of vouchers on a letter printer in 4 x 4 format. The vouchers are then cut up and each voucher is sold to a customer. The customer then reads the code on the voucher and types it into the login page.

- Text message codes; codes are sent out by text messages to the person who purchased the code; the code is then entered into the login page to get Internet access. The text message can also be sent to a reseller who purchases the code and sells it to a customer for a profit.

19.

Contention Ratio Planning to Maximize Profits

The contention ratio describes how an Internet service provider can oversell the backhaul capacity. Overselling backhaul network capacity will increase the profit of the Internet service provider business. All Internet service providers oversell capacity and there are rules that should be followed to determine the contention ratio.

The following example explains the meaning of contention ratio.

A wireless Internet service provider tower has a backhaul of 100 Mb/s. The Internet service provider sells rate plans of 2 Mb/s to subscribers. This means that when 50 subscribers are connected to the network and each is using their maximum data capacity of 2 Mb/s then the backhaul circuit will be operating at the maximum data capacity of 100 Mb/s. In practice not all subscribers will be connected at the same time, and many of the connected subscribers will not be using the maximum data capacity. Data capacity use depends on the type of application being used. Email will generate a very low aggregate data rate while video streaming will generate the maximum data rate. Voice over IP (VoIP) applications like Skype will generate a medium to high data rate.

Knowing the data use characteristics of subscribers it is possible to oversell the backhaul capacity by a factor of 5:1 or 10:1, this factor is the contention ratio. With a contention ratio chosen of 5:1 then the 100 Mb/s backhaul capacity can be sold as 500 Mb/s capacity. This means that 250 data rate plans of 2 Mb/s can be sold to subscribers
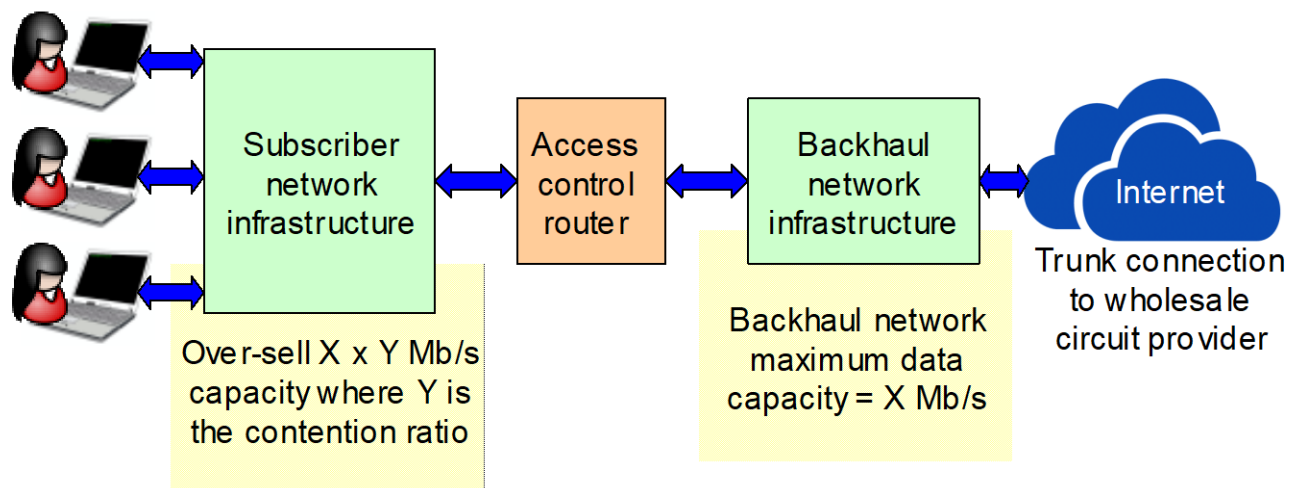
Figure 33: The contention ratio, overselling backhaul capacity.

There are simple rules for maximizing the contention ratio in order to improve the business profitability.

The rate plan that is sold to subscribers must be a very small fraction of the backhaul capacity. For example, with a backhaul of 100 Mb/s then it is not possible to sell the service to more than one subscriber if the rate plan is 100Mb/s. The contention ratio can only be 1:1 as adding a second subscriber will cause the data rate of the first subscriber to fall considerably.

However if the Internet service provider sells data rate plans of 1 Mb/s then there is a high probability that not all subscribers will be connected, and not all connected subscribers will be using high data rates. The Internet service provider can then sell a 1 Mb/s service to many more subscribers than the theoretical 100, possibly to 500 1Mb/s subscribers with a contention ratio of 5:1. In practice the Internet service provider will offer several rate plans, from low cost low speed plans to high-speed high cost plans. The Internet service provider should try to concentrate sales to more customers at the low cost low speed end of the scale so that the contention ratio can be increased which will increase profits. The Internet service provider can also set priorities for different types of data traffic (streaming, VoIP, etc) in order to improve the contention ratio.

20.

Service Rate Plans (service tiers)

The Internet service provider pays for a high speed wholesale (or retail) Internet data connection and then resells the data connection to customers in fractions of the wholesale speed. The cost of the wholesale data connection is proportional to the data speed of the circuit therefore the cost of the data circuit for the customer must also be proportional to the speed of the data circuit.

The cost of the service to the customer is calculated as:

Customer charge = fraction of wholesale cost + fraction of operating cost + profit

Where the fraction of the wholesale cost is determined by the speed of the customer's data circuit and the contention ratio applied to all customers.

This calculation applies for both fixed broadband and mobile broadband customers.

There is no single data circuit speed that is appropriate for all customers. Some customers want the least possible cost for the Internet service and are satisfied with a slower data speed. Some customers want a fast data speed and can afford to pay for that service. There are also customers who seek a service at points in between these two extremes.

To offer a range of services that will meet the needs of customers it is necessary to develop a range of service rate plans, sometimes called service tiers. The service rate plan applies to both fixed broadband and mobile broadband customers. Both types of customers have data speed limits and sometimes data byte limits imposed. The difference between the two is that the fixed broadband customer has continuous service for the duration that payments are received, whereas the mobile broadband customer purchases a plan that has a limited duration.

The service rate plans that the Internet service provider implements will depend on a detailed analysis of operating costs and research with prospective customers. Service rate plans can be adjusted as feedback is gained from the prospective customers and as more precise operating data is obtained.

Examples of service rate plans for fixed broadband customers are as follows.

- 2.5Mb/s download /100Kb/s upload speed, $6/month.

- 5Mb/s download /500Kb/s upload speed, $10/month.

- 10Mb/s download /1Mb/s upload speed, $18/month.

- 25Mb/s download /2,5Mb/s upload speed, $40/month.

Having several data rate plans (tiers) permits up-sell marketing to persuade a customer to move up to the next higher price-tier to increase revenue per customer. It might be advantageous to incorporate a cost saving with increased speed increase as an incentive to persuade prospective subscribers to move up to the next tier to improve revenue per customer, provided that there is a large data bandwidth available from the wholesale service provider. It is usually the case that the wholesale provider bandwidth is limited and so the guidelines of the contention ratio plan should be followed.

Mobile broadband customers have similar service rate plans as those of fixed broadband customers with the addition of an access code duration value, which determines the length of time that the access code is valid before it expires. The rate plan parameters for mobile broadband customers are embedded into the access code that is printed on the voucher, which is sold to the customer. Examples of service rate plans (access code vouchers) for mobile broadband customers are as follows.

- 1-day duration, 5Mb/s download /500Kb/s upload speed, $2.

- 1-week duration, 5Mb/s download /500Kb/s upload speed, $10.

- 1-month duration, 5Mb/s download /500Kb/s upload speed, $30.

- 1-day duration, 10Mb/s download /1Mb/s upload speed, $4.

- 1-week duration, 10Mb/s download /1Mb/s upload speed, $15.

- 1-month duration, 10Mb/s download /1Mb/s upload speed, $45.

For fixed broadband customers the service rate plan parameters are part of the customer record that is stored in the billing database. The Internet service provider can change the customer's rate plan at any time in function of the customer wishing to pay a higher or lower cost or requiring a faster service. The typical service parameters that can be configured for fixed broadband customers are as follows.

- Set maximum download and upload speed limits.

- Optionally set the maximum download and upload byte count (data cap).

The billing system can be configured to suspend the customer's Internet access if the payment is not received by the end of the billing period.

The service parameters that can be configured for mobile broadband customers (on-demand charges) are listed below. There are more variables for mobile broadband than for fixed broadband,

and all are encoded with the access code. The time allowed to access the Internet is usually a fixed period, and there will also be other limits imposed.

- Time period that the access is activated for; e.g. 1 day, 1 week, 1 month, etc.

- Instruction to start the code period when first used and terminate after the period.

- Option to start the code period when first used and set the date at which the code will terminate.

- Option to stop/start the code to extend the time that the code will terminate on completion of the period.

- Set maximum download and upload speed limits.

- Optionally set the maximum download and upload byte count (data cap).

- Option to allow the customer to use the access code with one device or many devices when used serially.

- Option to allow more than one customer to share the same access code concurrently (shared code).

On-demand payments can also be provided for fixed broadband customers when this is required to meet market conditions.

The fixed broadband billing system will usually add a customer relationship management (CRM) portal where the customer can login and look at the status of the account, download past invoices and also open a support ticket. A CRM portal is not applicable for anonymous mobile broadband customers however it can be provided for mobile broadband subscribers.

21.

Methods to Charge Customers for Internet Access

The methods of charging customer for the wireless broadband Internet service are determined by the payment services available in the country of installation and the methods of payment available to customers. Some prospective customers have bank accounts and credit cards that can be used for payments. Some countries might have prospective customers who do not have bank accounts or credit cards but can pay cash and so other methods of receiving payments will be necessary.

Customers have two types of services that determine how the payment is made.

- Pay for limited time or data use as required (on demand charge), usually for mobile broadband. The customer purchases a credential (token or voucher) that gives Internet access for a limited period of time, or for limited data access, or both. This type of service is popular for mobile broadband but can also be offered for fixed broadband.

- Pay monthly for a continuous service (periodic charge, pre-pay or post-pay), usually for fixed broadband. The customer is permanently connected to the Internet and pays monthly for the service. In the case that the payment is not made the service is suspended. This type of service is popular for fixed broadband but is also offered by some mobile broadband service providers.

Some methods of receiving payments are listed below.

- Credit card payment for monthly service of for mobile service.

- Bank check posted to pay monthly service.

- Bank account direct debit.

- Cash payment received at retail point.

- Cash payment sent over a payment network (e.g. Oxxopay in Mexico).

- Cash payment collected by agents selling vouchers.

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Install Internet Wireless Equipment and Sell Vouchers for Cash Payments with Minimum Investment and Limited Technical Knowledge

The wireless Internet service provider should implement one or more payment schemes that are convenient for the population of customers and potential customers that will be served by the service.

22.

Selling Internet Access for Cash Payments

In many parts of the world people don't have credit cards or bank checks to pay for Internet access but they can pay with cash. The Internet service provider can receive cash payments for both fixed and mobile broadband. Cash payments are used to purchase a code that provides limited access to the Internet. This is similar to the rate plan provide for fixed broadband subscribers that pay monthly for the service. The Internet service provider has several methods available to receive cash payments when providing an Internet service.

- Receive cash payments at a retail store for the sale of Internet access vouchers.

- Sell vouchers through an agent who will receive cash payments.

- Receive cash payments through a payment processor (e.g. Oxxopay in Mexico).

- Sell Internet access scratch cards in retail stores for cash payments.

In each case customers want to purchase something tangible for the cash payment and this can be a voucher with a printed code that is used to access the Internet service. This voucher can be provided in several forms.

- Printed scratch-off card, similar to those used for a lottery.

- Printed voucher using a receipt printer.

- Printed voucher using a letter printer then cut from 4 x 4 vouchers per sheet.

- Send the voucher file to a printing company to print in any format.

Although the scratch card is more expensive (10 to 20 cents each) than printing vouchers the product gives the appearance of being manufactured by a professional organization. The scratch card manufacturer will have a high minimum quantity however, which may be 1,000 or more cards, at 10 cents to 20 cents per card.

When the access codes are generated each will have parameters that determine the type of Internet access provided for the customer. The code parameters are very important to prevent a customer abusing the service or using all the available bandwidth. Examples of the code parameters are listed below.

- Duration of the code from the time of first use, this can be hours, days or months.

- Set a date at which the code will terminate after first use.

- Maximum download and upload data speeds permitted, this is very important to share the limited bandwidth available.

- Maximum download and upload data byte count permitted, this is important to prevent abuse of the service. Where the Internet service provider is using a satellite backhaul then the satellite provider will charge by the Gbyte.

- Maximum number of customers permitted to use the code concurrently, the default is one, but can be any number up to unlimited users.

- Determine if a customer can use the code with only one device or with several devices.

Printing vouchers using a letter printer. Use the software to create access codes with the required parameters then create a printer file of vouchers in a 4 x 4 per page format. Send the file to the printer and cut the page into individual vouchers, each with a unique access code. The voucher also shows the duration of the code.
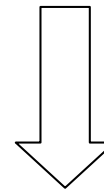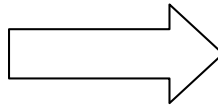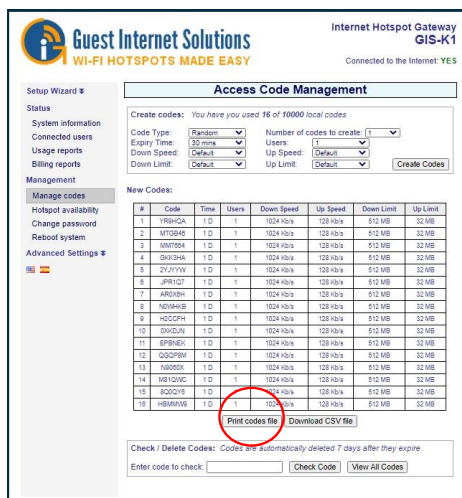
Create up to 10,000 access codes using the Internet-por-ficha software and send to the printer

Print the sheets of fichas using a letter size printer
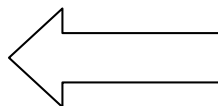
Cut up the sheets of fichas to have individual fichas for sale, each ficha has a unique access code

Figure 34: The process to print vouchers using a letter size printer.

Printing vouchers-on-demand using a receipt printer. Configure the receipt printer software for up to ten different types of access codes. Print a voucher on demand with the parameters requested by the customer. The voucher is sent to the thermal receipt printer and given to the customer. This configuration is popular for an Internet cafe point-of-sale for and similar applications.
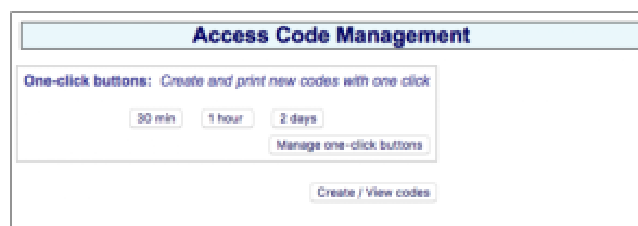
Configure the code options that are to be printed

Select the access code option that will be printed on the ficha
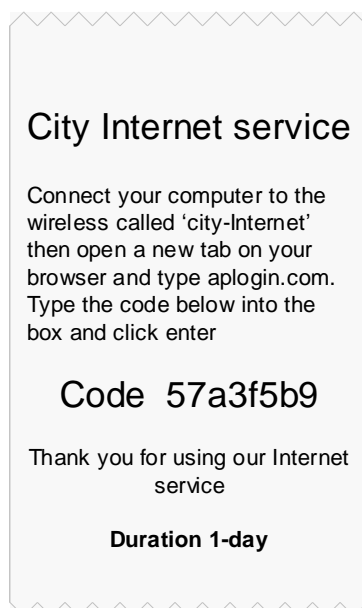
Each printed ficha has a unique access code

Print the ficha on-demand using a thermal receipt printer

Figure 35: The process to print vouchers using a thermal receipt printer.

Printing scratch-off cards. Most people are familiar with scratch off cards. Such cards are purchased for phone call minutes and also for lottery sales. Companies print scratch-off cards using special equipment. Each card has a unique code with access parameters. A list of codes is generated by the software and downloaded as a CSV (comma separated value) file then sent to the printer via email. The printer puts a thin plastic film over the access code that can be scratched off with the edge of a coin. The printer can use artwork given by the Internet service provider, or can create the artwork. The scratch-off card printing process is illustrated in the figure below.

Create up to 10,000 access codes using the Internet-por-ficha software and download the CSV file

Send the CSV file to the printing company via email or flash stick

The printer makes scratch-off phone cards and scratch-off lotto cards, and can print the Internet scratch-off cards

Each scratch card has a unique access code covered by a material that is scratched off
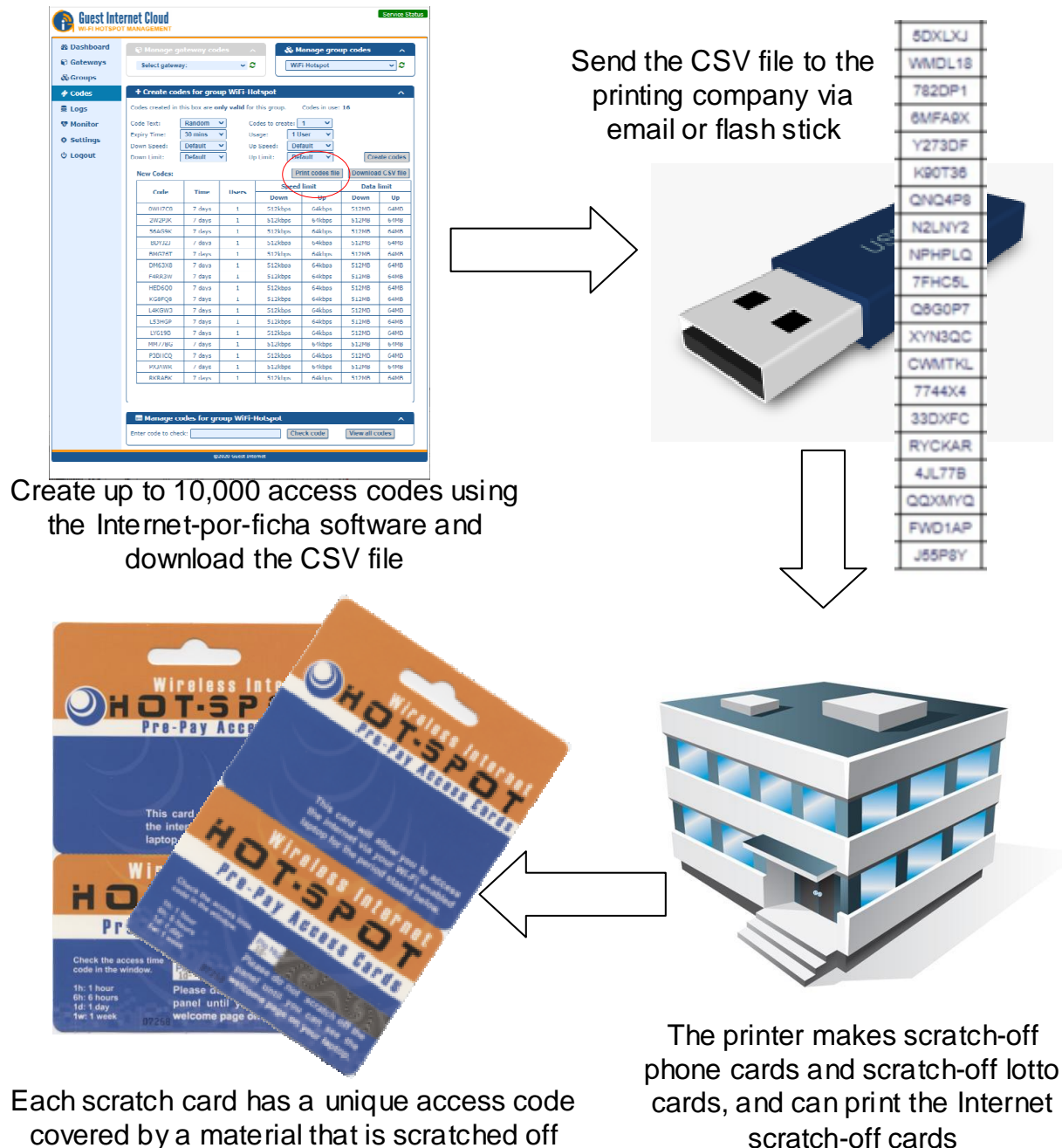
Figure 36: The process to print scratch-off cards.

23.

Stop Hackers Getting Free Mobile Broadband Access

The fixed broadband wireless uses data encryption (WPA2 or WPA-enterprise) between the point-to-multipoint wireless access point and the client premise equipment (CPE) wireless. The encrypted wireless connection makes a connection impossible and hackers will not attempt to access the connection. It is important to keep the encryption key secret.

Mobile broadband installations that charge for the Internet service do not use data encryption. If they did then the key would have to be given to everyone therefore data encryption cannot be used. A mobile broadband Internet service is therefore a target for people who try to hack into the wireless to get free Internet access.

Hackers can use a wireless 'sniffer' tool, which is free software that is downloaded from the Internet. An example of a 'Sniffer' tool is 'Wireshark' listed below.

- https://www.wireshark.org/

The 'Sniffer' software allows a computer to capture data packets that permit the hacker to see IP addresses and MAC addresses of legitimate users. The hacker will then 'spoof' the IP address or MAC address in order to gain free Internet access. Spoofing means to configure the hacker's computer with the IP address and or MAC address of a legitimate user.

The access control unit must implement measures to prevent hackers getting free Internet access. Some prevention measures are listed below.

- Encrypt login information using SSL to prevent the access code being seen.

- Check MAC addresses for duplications, block any MAC address that is being duplicated.

- Authenticate a customer with both IP and MAC addresses, block any data packet with a different IP or MAC address.

- Generate IP addresses randomly so that the hacker cannot presume that the IP address following the one read is valid.

- Block any attempt to scan ports.

There are occasions when the security measures may conflict with customer device operation.

One example is the iPhone operating system, version iOS14 and higher randomizes the device MAC address for security purposes. Apple calls this a 'private address' feature and it is turned on by default. Allowing an iPhone with iOS14 to have access to the mobile broadband service with hacker security protection would require the authentication configuration to be changed to IP only and this would represent a security risk. The iPhone users must therefore be made aware how to disable the 'private address' random MAC feature before using any mobile broadband service.

24.

Products that can be used to Implement Internet-with-vouchers

There are several technical solutions for implementing a mobile broadband service that permits the operator to print vouchers and to sell the vouchers to customers who want Internet access. Four methods of implementing Internet-with-vouchers are described here.

A wireless access point with a RADIUS server interface:

Some of the wireless access points have a feature that permits customer access to be authenticated by a RADIUS server. A RADIUS server is a database of access credentials that is installed on a Linux server in the WAN network of the wireless access point. The RADIUS server can check a credential sent by a wireless access point and reply that the credential is valid or not valid. If valid the wireless access point permits access to the Internet. The installation of a RADIUS server requires specialist skills for the installation and configuration of Linux and the RADIUS software. There is a free open-source download of RADIUS, however most of the RADIUS distributions require payment. The credentials or login codes must be generated by another software then uploaded to the RADIUS server. The wireless access point with RADIUS server has the following characteristics.

- The authentication method requires a wireless access point that supports RADIUS.

- RADIUS software can be downloaded for free or purchased, specialist technical skill are needed to configure the software and the Linux software that it requires.

- A credential (login code) is stored on the RADIUS server and used to authenticate requests from wireless access points.

- Roaming/mobility is possible if all wireless access points are connected to the same network where the RADIUS server is installed, or else the wireless access points can remotely to a RADIUS server installed at a data center.

- Additional software is required to generate the credential.

- There is no login page.

- There is no feature to print the credential as a voucher.

- There is no feature to set the download and upload speed limits.

- There is no feature to set the download and upload byte limits.

- There is no feature to set the number of users per access code.

- There is no feature to charge for the access code using a credit card.

- There is no hacker protection.

- There is no failure monitoring and alerting.

- There is no feature to provide a record for statistics of data use.

- If technical support is required then the RADIUS software should be purchased from a vendor that provides support. There are many training courses available to teach the Linux operating system, which has to be installed for the RADIUS software.

Ubiquiti Unifi:

The Ubiquiti Unifi products are popular for Hotspot applications but require a degree of technical skill to install and operate. These products are not for the beginner. The features provided by Ubiquiti Unifi products that can be used for Internet voucher are very limited and are listed below.

- Low cost high performance wireless devices that are generally reliable.

- Medium level technical skills are required to configure and manage Unifi products.

- Unifi supports authentication of a login code that is generated by the Unifi device.

- Roaming/mobility (using a code with many different wireless access points) is not possible as the access code can only be authenticated on the Unifi device where it was generated.

- A login page can be programmed, however this requires specialist-programming skills.

- There is no feature to print the login codes as a page of vouchers, a separate software is required to do this.

- There is a feature to set the download and upload speed limits, however this will apply to all users, it is not possible to set different speed limits for each access code, a feature that is required for different rate plans.

- A third party gateway that can be configured to charge for the access code using a credit card however configuration requires a high level of technical skill.

- The Ubiquiti Cloud Key software can provide a record for statistics of use.

- Ubiquiti provides free software upgrades over the products limited lifespan. When products have been replaced further software upgrades are limited.

- There is no feature to set the download and upload byte limits.

- There is no feature to set the number of users per access code.

- There is no hacker protection.

- There is limited failure monitoring through the Ubiquiti Cloud Key software and no failure alerting.

- Ubiquiti does not provide any type of technical support and there is no means of contacting the company for help. There is a user forum where people may ask questions of other users.

Mikrotik router and wireless access points with WISPhub software installed:

Mikrotik products when used with software such as that developed by WISPhub are popular for wireless Internet Hotspot applications but require a high level of technical skill to install and operate. Fortunately there are companies that pre-configure Mikrotik products with software and provide technical support so that the products can be used by people with limited technical knowledge.

The Internet voucher features provided by Mikrotik products with WISPhub software are listed below.

- The WISPhub software can be installed on low cost high performance Mikrotik wireless devices.

- The WISPhub software can be installed on Mikrotik routers so that any type of wireless access point can be connected to the router and used to provide a wireless Internet voucher service.

- Very high level of technical skill is required to configure Mikrotik products however vendors do the configuration work and sell the product pre-configured.

- Each Mikrotik product supports authentication of a login code that is generated by that Mikrotik product.

- Roaming/mobility (using a code with many different wireless access points) for multiple routers is not possible as the access code can only be authenticated on the Mikrotik device where it was generated.

- Roaming/mobility is possible if many wireless access points are connected back to one router through a wireless distribution network.

- A login page can be programmed, however this requires programming skills.

- The WISPhub software has a feature to print login codes as a page of vouchers using a computer that is connected locally or remotely to the router.

- There is a feature to set the download and upload speed limits, however this will apply to all users, it is not possible to set different speed limits for each access code that is required for different rate plans.

- The WISPhub software maintains a record for statistics of use.

- WISPhub and product vendors provide technical support.

- WISPhub has an annual license charge for use of the software

- There is no feature to set the download and upload byte limits.

- There is no feature to set the number of users per access code.

- There is no hacker protection.

- There is no failure monitoring or alerting.

- Mikrotik provides excellent training courses for reasonable fees for those people who wish to learn how to configure their products.

Guest Internet:

The Guest Internet voucher product range offers excellent features to implement a mobile broadband Internet service with Internet-with-vouchers. The products are economical and very easy to install and operate so no special technical skills are required. Guest Internet also provides free technical support to help customers with installation and operation questions.

The Internet voucher features provided by Guest Internet products are listed below.

- Guest Internet has a range of low cost wireless products that include all software to generate and print vouchers.

- Guest Internet has a range of low cost gateway products that include all software to generate and print vouchers that can have an unlimited number of wireless access points of any type connected.

- No special technical skills are required to configure Guest Internet products and free on-line technical support is available for people who need help.

- Each Guest Internet product supports authentication of a login code that is generated by that Guest Internet product.

- Each Guest Internet product has an interface for with third-party credit card processors to charge for the access code using a credit card. Currently PayPal is available and OxxoPay will be added soon to receive cash payments.

- Roaming/mobility (using a code with many different wireless access points) is implemented with the free Guest Internet Cloud service where an unlimited number of guest Internet products can be assigned to a code generation group. A countrywide network of wireless

access points can be installed with one access code providing Internet access at any one of the access points.

- There are several login page options. The setup Wizard auto-generates a login page, which takes a few seconds. Uploading a JPG figure will customize the login page background. A login page can be filly customized and linked to the Internet providers website as a walled garden with simple HTML and Javascript programming. Banner advertising can be added to the login page with banners loaded from a remote server.

- Guest Internet products have seven login options for all types of applications.

  - Access code entry (use for Internet voucher applications).

  - Agree to the terms and conditions of use (used by bars and restaurants that provide free Internet).

  - Access without login page but firewall rules are applied (popular with condominium associations).

  - Access when providing up to three personal parameters, which are send to the business owner (use to collect contact data from customers).

  - Access with providing social media (Facebook) credentials (used to access the customers Facebook profile and have the user like the business Facebook page).

  - Access when purchasing an access code using a credit card.

  - Two-tier access with a slow Internet speed provided for free and a fast Internet speed provided with the purchase of an access code (popular with hotels that have to provide 'free Internet' but want to recover costs).

- Guest Internet products have an Application Programming Interface (API), which can be used by third party software to extend the functionality of the system. Applications included interfacing with a retail point of sale (PoS) system and interfacing with a hotel property management system (PMS).

- Each Guest Internet product can have a thermal receipt printer connected, which prints vouchers on-demand. This configuration is popular with Internet cafes.

- Each Guest Internet product has a feature to print the login codes as a 4x4 page of vouchers using a computer that is connected locally or remotely to the product.

- The Guest Internet Cloud has a feature to print the login codes as a 4x4 page of vouchers, which can be used with any Guest Internet product that is part of the Cloud group.

- There is a feature to set the download and upload data speed limits for all users, which is overridden by access code data speed settings.

- Each access code has a feature to set the download and upload speed limits, which allows rate plans to be developed for a range of charge and speed combinations.

- There is a feature to set the download and upload data byte count limits for all users, which is overridden by access code data limit settings.

- Each access code has a feature to set the download and upload count limits, which allows rate plans to include data caps.

- There is a feature to set the number of users per access code, and the number of devices that each user can connect concurrently with one access code.

- There is a feature to permit a customer to use several different devices sequentially.

- There is comprehensive hacker protection to prevent anyone getting free Internet access.

- The Guest Internet Cloud account provides failure monitoring for all Guest Internet products supervised by the Cloud account. A free failure alerting service sends an alert email to the business owner and field service technician.

- Guest Internet products have a failure-monitoring feature for wireless access points and wireless CPE products that are install at fixed broadband customers.

- Each Guest Internet product maintains a record for statistics of use and the Guest Internet Cloud maintains statistics of use for all units assigned to the Cloud account.

- All guest Internet products have port forwarding to provide remote access to any wireless access point or wireless CPE products.

- Guest Internet does not charge for software upgrades, the Cloud service, or technical support, all services are free after product purchase.

- On-line technical support is provided free of charge by Guest Internet.

25.

The Guest Internet voucher Product Range

Guest Internet products are designed to implement a mobile broadband service for businesses that provide Internet access to the public. Guest Internet products can be used to provide both mobile and fixed broadband services where network use is on-demand. Guest Internet does not store a database of subscriber information therefore if a fixed broadband service is required with a subscriber database then this is described in a later section about the cloud4WISP product. Guest Internet products are divided into three categories.

- Wireless products that have Internet voucher software with models for outdoor and indoor point-to-multipoint installations and with different types of antennas.

- The business gateway product range that has Internet voucher software and can have any type of wireless access point connected.

- The professional gateway product range for large installations, resorts, airports, sports stadiums, etc.

The Guest Internet product range is summarized in the table below.

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Install Internet Wireless Equipment and Sell Vouchers for Cash Payments with Minimum Investment and Limited Technical Knowledge

FEATURE	WIRELESS				BUSINESS			PRO			
	GIS-K1	GIS-K3	GIS-K5	GIS-K7	GIS-R2	GIS-R4	GIS-R6	GIS-R10	GIS-R20	GIS-R40	GIS-TP1
Hotspot custom login, 6 login procedures	●	●	●	●	●	●	●	●	●	●	
Content filter (block access to Websites)	●	●	●	●	●	●	●	●	●	●	
PayPal® & Credit Card Billing	●	●	●	●		●	●	●	●	●	
PCI DSS compliant firewall (PoS protection)	●	●	●	●	●	●	●	●	●	●	
2 Wan fail-over							●	●	●		
4 WAN fail-over										●	
LAN ports	4	1	1	0	4	4	3	4	4	2	1
Wireless access point 11/N, 300Mb/s	●	●	●	●							
Ethernet speed	10/100	10/100	10/100	10/100	Gb	Gb	Gb	Gb	Gb	Gb	10/100
FREE Cloud management	●	●	●	●	●	●	●	●	●	●	
Ticket printer and 4x4 voucher printing	●	●	●	●	●	●	●	●	●	●	●
Limit of Concurrent Users	no	no	no	no	no	no	no	no	no	no	
Throughput	60Mb/s	75Mb/s	75Mb/s	75Mb/s	100Mb/s	150Mb/s	200Mb/s	400Mb/s	600Mb/s	1000Mb/s	

Figure 37: The Guest Internet range of products.

Guest Internet products have several different login features that are used to charge customers for the mobile broadband service. A popular method of selling mobile broadband services uses the Guest Internet voucher feature of printing access codes onto vouchers, which are then sold to the customers. The Guest Internet on-demand voucher printing using the Guest Internet ticket printer is also popular. Guest Internet products also have failure monitoring which alerts the Internet service provider when a device or circuit fails. Failure monitoring is extremely important to maintain the quality of service to avoid customer complaints. When the business is not providing Internet service then it is not making money. A summary of the Guest Internet product features is presented below.

Setup wizard: Technical knowledge is not necessary to install and operate Guest Internet products. When the product is first used it presents a setup wizard that automatically creates a login page and configures the unit ready to receive access codes to login. The login page can be created for any language.

Mobile broadband login options: Guest Internet products have several types of login configurations, which are listed below. The login options listed cannot be used concurrently; the equipment is configured for one of the options.

- Controlled access, enter a valid access code in the login page to be authenticated and given Internet access. The access codes are generated in many different formats. See the section describing access codes. Many mobile broadband service providers use this mode of access.

- Registered access, provide personal contact information in the login page to be authenticated and given Internet access.

- Social media login, enter a valid Facebook credential in the login page to be authenticated and given Internet access. Facebook requires a valid website domain name in order to approve this type of access.

- Unlimited access, the user agrees to the terms and conditions in the login page to be authenticated and given Internet access.

- Open access, there is no login page and the user is connected to the Internet, however all rules of access are applied, such as the maximum download and upload speed settings.

- Pay-on-demand access, the user requires a credit card to purchase the access code to get Internet access. Mobile broadband service providers use this form of access at locations such as airports and hotels.

- 2-tier voucher/CC, controlled access requires either the purchase of a voucher then enter the code from the voucher, or else a customer with a credit card can purchase the voucher code on-line and begin using the Internet immediately. Many mobile broadband service providers use this form of access.

- 2-tier free/pay, the user gets free Internet access at a slow speed setting and can purchase high speed Internet using a credit card. This mode is very popular with hotels that have to offer "free Internet" but want to recoup the cost of operating the service.

Guest Internet also has specialized login options such as Xbox login for people who play computer games. This type of login is appropriate for hotels.

Login page configuration options: The captive portal login page can have one of four configurations. The four configurations are listed below.

- Wizard auto-generated login page, during the wizard-setup procedure the administrator provides information about the service and selects a few options; the login page is then automatically generated. The auto-generated login page requires no technical skill to create.

- Auto-generated login page with uploaded background, the Internet service provider can upload a background picture to customize the screen display. The uploaded picture must be JPG format and not exceed 196KB in size. The background picture can be a photograph of the location of a graphic design produced by the Internet service provider.

- Custom design, the Internet service provider can create a custom login page design with HTML. Guest Internet provides a login page design simulator to test the design. Javascript can be programmed to interface with the device API or other external servers and extended the functionality of a design.

- Walled garden design, the custom designed login page is taken from the business website with the business website domain installed in the allowed URL/IP table. The design permits the user to move between the login page and the website transparently. When the user opens a different website then the login box is displayed to request the access code. The walled garden design can also incorporate banner advertising downloaded from the business website.

With any one of these configurations there are further options.

- After a successful login force a specific website to open, overriding the users home page setting.

- Enable a pop-up window that will permit the user to log out by clocking on the 'logout' button. To get Internet access again the user will go to the login page.

- The user can logout at any time by opening a browser tab with 'aplogin.com' and then clicking the 'logout' button. To get Internet access again the user will go to the login page.

The code duration starts when the code is first used and continues until the code duration terminates. There is also a feature to logout and suspend the code duration then continue the code duration after returning.

Access code generation options: There are four access code formats, with parameters assigned to each access code format. The access code formats are listed below.

- Random alphanumeric code, this is a six-digit code. The quantity of access codes to be generated is specified between 1 and 10,000.

- Add a description for one randomly generated alphanumeric code.

- Specify a custom access code using up to 10 digits in an alphanumeric sequence. One access code is generated.

- Authorize access using a device MAC address. One access code is generated.

The parameters that can be assigned to any of the three code formats are listed below.

- Duration that the code will allow access to the Internet after first use, from 1 hour to unlimited.

- Optionally specify the date at which the code will terminate.

- Maximum download and upload speed limits.

- Maximum download and upload data byte limits.

- Number of users who can use the code concurrently, 1 to 6 or unlimited.

- By default a code can be used by only one device, an option can permit the code to be used with unlimited devices serially (only sequentially, the user has to logout of one device to use the next device).

Access code printing options: When the access codes have been generated they are stored in the access code database. The codes can be printed for use in any of four formats.

- Print the codes from the HTML screen in ASCII format on to a letter printer.

- Download a CSV file with the list of access codes. The codes can be printed on any medium such as scratch-off cards.

- The access codes can be printed as vouchers in a 4x4 format on a letter printer, up to 10000 vouchers, or 625 pages of vouchers can be printed at one time.

- Access codes can be generated and printed on-demand using the Guest Internet ticket printer.

Printer configuration: There are two printer configurations and either can be used for voucher printing.

- Print a voucher on-demand using the GIS-TP1 printer. The voucher text information and up to 10 voucher options are programmed before voucher printing.

- Print vouchers in batches. Generate up to 10,000 access codes and print as vouchers in a 4x4 page format. The voucher design format is pre-configured before printing.

Equipment failure monitoring: Guest Internet provides two levels of failure monitoring so that all components of the network can be monitored.

At the top level the Guest Internet Cloud monitors all Guest Internet wireless and gateway products, and sends out an email alert when a product does not respond. A failure may be an equipment failure or a WAN link failure. The GIS Cloud monitoring service is free to use and provides a valuable insurance for any business that sells Internet services to minimize losses when an unexpected equipment or communications link failure occurs. The Guest Internet Cloud is a tool for managed service providers.

At the second level each Guest Internet wireless and gateway product can monitor third party products that are connected to the LAN network. This feature is extremely valuable in many situations. For example if a Guest Internet gateway is connected to a PtMP wireless access point, which in turn is communicating with several CPE radios installed at client premises, the Guest Internet gateway can monitor and detect a failure with the wireless access point and also with each one of the CPE devices.

A summary of the monitoring features for both levels is presented below.

- Cloud level monitoring.
  - Check all Guest Internet wireless and gateway products assigned to the account periodically.
  - When a product fails to respond for a predetermined time period then a "device down" message is sent to the administrator via email.
  - When a product begins to respond after a period of not responding then a "device up" message is sent to the administrator via email.
  - The failure email message can be formatted as a repair work order for a field service technician advising what device has failed and where it is located.
  - The monitoring display shows the status of all Guest Internet products that are being monitored.

- Gateway level monitoring.
  - Any device connected to a gateway LAN port or wireless product WLAN port can be monitored for failure, the only requirement is that the device has an IP address.
  - Most devices have management IP's, which must be changed to an IP address within the Guest Internet LAN subnet, but outside the LAN DHCP range. The Guest Internet LAN settings may require adjustment.
  - Each device entry has a corresponding description string to identify the failed device when the email notification is sent out.
  - When a product fails to respond for a predetermined time period then a "device down" message is sent to the administrator via email.
  - When a product begins to respond after a period of not responding then a "device up" message is sent to the administrator via email.
  - The failure email message can be formatted as a repair work order for a field service technician advising what device has failed and where it is located.
  - The monitoring screen shows the status of all products that are being monitored.

Cloud remote management: Guest Internet Cloud management has a broad range of features to manage individual Guest Internet products and manage groups of Guest Internet products.

Cloud device management features are listed below.

- Add and delete gateways from the cloud account.
- Gateway status, MAC and IP addresses, and uptime.
- Chart showing number of users connected, select view from 1 hour to 1 week.

- Chart showing WAN circuit usage, one chart for each WAN port for dual WAN configurations, select view from 1 hour to 1 week.

- List of authenticated users.

- List of connected users.

- Allowed MAC list.

- Blocked MAC list.

- Login page settings.

- Change the device administrator password.

- Create access codes for a device.

- View logs for the gateway, logins per day, last logins (select the number).

- Monitor the gateway for failure, set the time to wait before alerting, set the email(s) that the alerting message is sent to. Note that an alert is sent when a unit goes offline and a second alert is sent when a unit comes back online.

- Gateway remote firmware upgrade.

Cloud group management features are listed below.

- Add and delete groups.

- Add a registered device to a group.

- Create access codes for a group (access codes will be authenticated by any device in that group for roaming).

- View logs for the group, logins per day, last logins (select the number).

Administrative features are listed below.

- Voucher design for voucher access code printing for units or groups.

- Change the Cloud administrator password.

User Verification: After an access code is authenticated it is associated with the users MAC address and the IP address allocated to the user by the DHCP service. The user is verified each time that a data packet is sent using the packet IP and MAC address. There is an option on the login page settings to verify the data packet using IP only. This feature is to be used only when the wireless distribution network cannot be configured with WDS. Using this feature reduces the security of the login process making an attack by hackers easier. The user verification process includes detecting and blocking hackers by identifying the use of duplicate MAC and IP addresses.

Specify the maximum download and upload speeds for all devices: The maximum download and upload data speed setting in Mbit/sec is applied to all devices that are connected to the gateway.

If a maximum download and upload data speed is specified by an access code then it will override this setting.

Specify the maximum download and upload data limits for all devices: The maximum download and upload data limit setting in MBytes is applied to all devices that are connected to the gateway. If a maximum download and upload data limit is specified by an access code then it will override this setting.

Mobility with roaming: An essential feature for a mobile broadband service is the ability for a customer to roam between different wireless access points that are part of the Internet service providers network. This feature is called mobility and permits a customer to purchase an access code voucher and then connect to any wireless access point within the Internet service providers network. The customer can leave one wireless site and connect to the Internet at a different wireless site using the same access code. The section on mobility describes this process in detail.

Guest Internet implements mobility with the free Cloud management account. The Internet service provider business can install many wireless access points over a large area and add them to a Cloud group. The Internet service provider can then print a big volume of vouchers using the Cloud to sell in many retail outlets. The voucher codes will give access to any wireless access point that is part of the cloud account group. There is no limit to the number of Guest Internet voucher wireless WiFi Hotspots that can be managed by the Guest Internet Cloud account group. Guest Internet cloud management monitors the status of all Guest Internet voucher wireless devices and alerts the Hotspot owner if any device fails. The Guest Internet voucher Cloud is very easy to use and can be managed from a smartphone. The features of Guest Internet mobility are summarized as follows.

- The Guest Internet Cloud management service permits many WiFi Hotspots to be managed.

- Access codes that are created using the Guest Internet Cloud can be used at any WiFi Hotspot that is part of the Cloud account group.

- There is no limit to the number of WiFi Hotspots that can be managed by the Guest Internet Cloud account.

- Guest Internet Cloud management monitors the status of all devices and alerts the administrator if any fail.

- The Guest Internet Cloud management service is free; there is no charge.

Port forwarding: When Guest Internet products are installed for fixed broadband on-demand applications then it is necessary to have remote access to the CPE device to make configuration changes. All Guest Internet wireless and gateway products have port forwarding to allow remote access to devices on the LAN or WLAN network. For port forwarding a device requires a static IP that is configured within the LAN or WLAN subnet range, but outside the DHCP range.

URL and IP allowed list: It is sometimes necessary to allow free access to websites even though the user does not have a credential, or did not login through the login page. A typical application might be a trade show that gives free access to bus timetables and airport flight information. Guest

Internet products have a website allowed list which required either the domain name or the IP address of the website to be added to the table.

The URL and IP allowed list is also used for applications where users are allowed access only to specific web sites. One example of this application is churches who use on-line bible study classes. In this case the custom login page does not have the box to enter the access code, but instead has buttons, each with a hyperlink, to the allowed website. The domain name of each allowed website is added to the URL/IP allowed list. The user has access only to the allowed websites; all other websites are blocked.

URL and IP blocked list: Some businesses that provide Internet services may want to block access to specific websites for various reasons. For example a library might want to block access to social media websites so that Internet resources are free for library users who are searching for information. In another example, a hotel might want to block Netflix to avoid overloading the bandwidth of the hotel Internet circuit with video streaming. To block a website add the domain name or IP to the URL/IP blocked table.

Content filtering: The purpose of content filtering is to block a category of websites. For example an Internet service provider may want to block access to adult websites in order to provide a child-friendly service. There are many categories that can be blocked including violence and weapons. A third party content database subscription is required to implement this service.

MAC allowed list: A device can be permanently authorized to access the Internet by adding the device MAC address to the allowed list. This is useful for support technician devices and also for customers who have devices that need a permanent connection to the Internet. For example, some types of wireless access points have a management device connected in the same network that requires Internet access. Some business owners may want to use the same public network for IP cameras and have a permanent connection for a DVR product. An option permits MAC devices to access the Internet with or without firewall rules.

MAC blocked list: A connected device may be moved to the MAC blocked list if it infringes any one of the firewalls checks, for example if the device is used to transfer data files with Torrent when Torrent blocking has been selected. The administrator can also transfer any connected device to the MAC blocked list if that device is seen to be abusing the service, for example downloading very large volumes of data. A device can be removed from the MAC blocked list at any time.

Hacker detection and prevention: A mobile broadband public Internet service has susceptibility due to the wireless access points being configured without encryption. See the section about hacking. People will attempt to get free Internet access and Guest Internet products have several measures to prevent hackers getting free Internet. Some of the measures are listed below.

- Randomize IP addresses, prevents hackers assuming a sequence.

- Detect and block duplicate IP's.

- Detect and block duplicate MAC's.

Firewall for event detection and blocking: Guest Internet products have a firewall that provides specific protections for Internet service providers.

- Detect and block any computer with an active DoS virus, if an active DoS computer is allowed access to the Internet it will cause network congestion over the WAN circuit and prevent other users accessing the Internet.

- Detect and block any computer using Torrent P2P data transfer, in some countries downloading of copyrighted material is illegal and the Internet service provider can suffer financial consequences through a lawsuit.

- PCI DSS compliant firewall will protect equipment that is installed in a private network behind the Guest Internet gateway.

- Block router option blocks a customer connected router to prevent one access code being used by several people simultaneously.

Remote management: Guest Internet administrators do not have to connect to the device locally to change configurations; all Guest Internet devices can be managed remotely using two methods, that can be used simultaneously.

- Remote access to the Guest Internet product through the firewall by authorizing remote access in the firewall and designating a port number, remote connection using encryption is preferred. Remote access must be enabled to use port forwarding. If the product WAN port is connected to a public IP then browser access is made using; *WAN-public-IP: port-number,* followed by the administrator login. If the Guest Internet product WAN port is connected to a router then the router must have a port forward rule installed.

- The Guest Internet Cloud provides remote access to any Guest Internet unit that is assigned to the cloud account. For security reasons the cloud does not permit modification of Ethernet port addresses. The cloud can provide group update functions where all products assigned to a group can be updated simultaneously.

Cloud management: Guest Internet Cloud management has a broad range of features to manage individual Guest Internet products and manage groups of Guest Internet products.

- Device management.
    - Display usage statistics for the device.
    - Modify device configuration settings.
    - Remote firmware upgrade.
- Device group management.
    - Generate access codes that can be authenticated by any device in the group to implement mobility.
    - Print vouchers with access codes that can be authenticated by any device in the group.
    - Display usage statistics for the group of devices.

Application Program Interface (API): The Guest Internet API is an interface that can enable third-party software to control the Internet access of a user. The API is used by hotel Property Management System (PMS) software and by Point of Sale (PoS) software. Any software that has been developed by an Internet service provider can use the API. Some API commands are listed below.

- The password for codes must to be created first.
- If not logged in to the codes interface at http://aplogin.com/codes, the password should be passed as an argument.
- Codes can be added to the system via a single HTTP call.
- Call for a normal, single user code with a specified duration.
- Get list of allowed MACs.
- Get list of blocked MACs.
- Block a MAC. The MAC address needs to be written in the colon separated format.
- Allow a MAC. The MAC address needs to be written in the colon separated format.
- The IP of the GIS device can also be used instead of the hostname.
- Enable Remote Management. Substituting the WAN IP address of the gateway for 'aplogin.com' for is used for remote access.

Product applications: Internet service providers and businesses that provide a mobile broadband or Hotspot service install guest Internet products to control access to the Internet service. Some of the businesses and administrative entities that provide an Internet service for guests, clients, residents and visitors are listed below.

Motels	Airports	Retailers	Shopping malls
Hotels	RV parks	Hospitals	Multi-unit buildings
Resorts	Campgrounds	Dental offices	Sports stadiums
Restaurants	Churches	Clinics	Gyms
Coffee bars	Trade shows	Marinas	Schools
Internet cafes	Municipal offices	Trains	Libraries

Costs and charges: Guest Internet products contain all the software that is required to provide a mobile broadband service for customers. Wireless product pricing starts at less than $100. The product software is free, there is no annual license fee, technical support is a free on-line service, use of the cloud management system is free, and software upgrades are always free. Guest Internet products are the only mobile broadband solution that has no on-going cost after the product is purchased.

Guest Internet Products: Guest Internet manufactures three ranges of Internet gateway products, called wireless, business and professional. Wireless products are low cost and very popular with Internet service providers who install them at the sites where Internet has to be provided. The business gateway products are used by Internet service providers to connect multiple wireless access points and also by businesses like motels and hotels who provide Internet for guests. The professional gateway products are installed at installations where up to thousands of people have to be provided with Internet access.

Guest Internet wireless products are listed below.

GIS-K1: The GIS-K1 is an indoor long-range high power single 2.4GHz band wireless router with omni-directional antenna and voucher design and printing software included. The LAN ports can be used to connect additional wireless access points to extend the transmission range and increase the area of coverage for voucher sales.

GIS-K3: The GIS-K3 is an outdoor long-range high power single 2.4GHz band wireless access point with directional antenna. The product includes the voucher design and printing software.

GIS-K5: The GIS-K5 is an indoor long-range high power single 2.4GHz band wireless access point, with omni-directional antenna. The product includes the voucher design and printing software.

GIS-K7: The GIS-K7 is an outdoor long-range high power single 2.4GHz band wireless access point with omni-directional antenna that includes all software for the design and printing of vouchers.

Guest Internet business gateway products are connected with any combination of wireless access points to sell Internet access using vouchers. There is not limit to the number of access points that can be connected. Vouchers are generated on the gateway or using the Cloud group code feature.

GIS-R2: Controller for multiple wireless access points suitable for Internet circuits up to 100Mb/s. The controller can print pages of vouchers on a letter printer or print vouchers on demand using a thermal receipt printer.

GIS-R4: Controller for multiple wireless access points suitable for Internet circuits up to 150Mb/s and includes credit card billing. The controller can print pages of vouchers on a letter printer or print vouchers on demand using a thermal receipt printer.

GIS-R6: Controller for multiple wireless access points suitable for Internet circuits up to 200Mb/s and includes credit card billing. The GIS-R6 has dual WAN for load balance and failover with independent LAN circuits.

GIS-TP1: The GIS-TP1 is a thermal receipt printer that connects to any Guest Internet gateway product and is used to print vouchers on-demand. This product is ideal for used on an Internet café business when combined with a tablet to make a point-of-sale configuration. Guest Internet has a data sheet describing the configuration of the GIS-TP1 for an Internet café point-of-sale application.

Guest Internet professional products are suitable for very large installations, such as resorts, airports, sports stadiums and trade shows. With Internet backhaul speeds up to 1Gb/s thousands of customers can connect to the Internet. These products use the voucher feature available with the Guest Internet Cloud.

GIS-R10: Gateway controller for multiple wireless access points suitable for Internet circuits up to 400Mb/s and has dual WAN with load balance and fail-over. The controller includes credit card billing and can print pages of vouchers on a letter printer or print vouchers on demand using a thermal receipt printer.

GIS-R20: Gateway controller for multiple wireless access points suitable for Internet circuits up to 600Mb/s and has dual WAN with load balance and fail-over. The controller includes credit card billing and can print pages of vouchers on a letter printer or print vouchers on demand using a thermal receipt printer.

GIS-R40: Gateway controller for multiple wireless access points suitable for Internet circuits up to 1000Mb/s and has quad WAN with load balance and fail-over. The controller includes credit card billing and can print pages of vouchers on a letter printer or print vouchers on demand using a thermal receipt printer.

Guest Internet voucher software is FREE, on-line technical support is FREE and the Cloud management service is FREE. There are NO annual software fees and NO other charges for using Guest Internet products.

26.

Using Guest Internet voucher to Sell Internet Access

G uest Internet products provide all features required to sell Internet access with a mobile broadband service. The access code generator can create a database of access codes in various formats, with various parameters. See earlier sections. The four popular methods of printing and selling mobile Internet access using Guest Internet products are as follows.

- On-line access code purchase using a credit card, CC purchasing uses the PayPal gateway and the broadband service provider must have a business Paypal account to receive credit card payments. This method is popular in the USA and EU, and also in International airports. However it is not popular in countries where few people have credit cards.

- Printing vouchers on demand using the Guest Internet GIS-TP1 receipt printer. This method is popular for applications that require a point-of-sale for Internet service, such as Internet cafes or trade shows.

- Printing vouchers in batches is very popular. A volume of access codes up to 10,000 are generated and then printed as pre-designed vouchers in a 4x4 format using any letter printer. The voucher page is then cut into 16 vouchers. Each voucher has a unique access code printed on it. The duration of the access code can optionally be printed on the voucher.

- Printing scratch-off cards is popular with some Internet service providers because detailed information about the Internet service can be included on the front and back of the card. Although the cost of a scratch-off card is higher (10cents to 20cents) than printing batches of vouchers, the scratch-off card product is suitable for sale in supermarkets and other points of sales where phone cards and lotto tickets are sold. The duration of the access code is printed on the scratch-off card.

The method of selling the access codes depends on the format chosen to print the codes and the types of channels through which the codes are sold. There are many options and a few are listed below.

- Sell scratch-off cards at supermarket checkouts.

- Sell vouchers at magazine stands.

- Print vouchers on-demand at a retail store.

The access code has embedded parameters describing the duration and download speed, etc. When the code is used to login by the customer, the login page shows the time remaining for the duration of the code. The customer can open the login page at any time using 'aplogin.com' to see the time remaining.

The Appendix provides a detailed presentation showing the process of creating, printing and using access code vouchers with Guest Internet products.

27.

A Fixed Broadband Subscriber Database for Monthly Billing

This book is primarily focused on the mobile broadband service and the fixed broadband service with pay-on-demand billing. Mobile broadband has a high demand in many parts of the world and the information provided in this book will help people who wish to start a business providing a mobile broadband Internet service. There is a big market for subscription services for both fixed broadband and mobile broadband subscribers, which is the subject of another book by this author. This section and the following one provide some information about subscription services. The Internet service provider has many business benefits when selling a subscription service vs. and on-demand service. These benefits include a guarantee of recurring revenue and direct customer marketing to increase sales.

Mobile broadband on-demand customers are anonymous; they purchase an access code in one of several formats to get access to the Internet for the duration permitted by that access code. The Internet service provider has no information about these customers.

It is desirable to have contact information about the mobile broadband customer so that the Internet service business can market products and services to the customer, with special offers to encourage the customer to become loyal to the brand and to persuade the customer to bring other new customers through a referral program.

The mobile Internet service provider can offer a subscription program where the customer pays monthly to get a discount with the mobile broadband service. The customer must provide contact and payment information for the subscription service. A software subscriber database is required to manage subscribers. When the Internet service provider has the customer information then marketing can be used to increase the sales to that customer and to get referrals to new customers.

Fixed broadband customers are subscribers and are billed each month for the Internet service. The same subscriber database system that is required for fixed broadband subscribers is also used for mobile broadband customers who become subscribers to a mobile broadband service.

There are several cloud systems and software products that implement an easy to maintain database of subscribers and to bill subscribers at the end of each billing period, usually each month.

Most of the cloud management systems are expensive however and charge in the range of $1.00 to $1.50 per subscriber per month to use the subscriber database and billing system and to invoice subscribers. There are free and open source software packages available but these require a very high level of technical knowledge to use and do not eliminate the operating cost because they have to be run on secure servers with storage and power backup, or hosted in a cloud such as that provided by AWS.

Several cloud billing system providers are listed below, these services charge up to $1.50 per subscriber per month.

- http://visp.net/

- http://www.ispbilling.com/

- http://www.billmax.com/

- http://powercode.com/

- http://www.azotel.com/

- http://swiftfox.net/

Two free billing system software providers are listed below; these software packages require technical knowledge to install and have a hosting cost for operation.

- https://unms.com/crm   ;for use with Ubiquiti wireless equipment.

- https://www.freeside.biz/freeside/   ;for use with any wireless equipment.

There are two very low cost cloud services that charge in the range of 5 cents to 20 cents per subscriber per month; two of these cloud services are listed below.

- WISPhub, a Spanish only service that charges between 10 cents to 20 cents per subscriber and also takes a percentage of customer payments. Specialist technical knowledge is required to implement this system as it uses Mikrotik routers that must be programmed.

- Cloud4WISP with easyWISP access controllers supports English and Spanish languages with others to be added soon. The cloud account is free with each easyWISP controller (tower site), and the management of multiple controllers requires a monthly payment of $25 plus 5 cents per subscriber. There is no fee taken for subscriber payments and the Internet service provider is free to use any payment method to receive subscriber payments, The cloud4WISP system with easyWISP access controllers is plug and play and requires no specialist technical knowledge to implement and operate.

The cloud4WISP service is able to reduce cost per subscriber because the cloud4WISP servers process only batch tasks. All transaction processing is done by each easyWISP smart gateway, which maintains a local subscriber database and manages subscriber authentication, applies each subscriber rate plan, and monitors the network equipment for failure.

28.

Managing a Fixed Broadband service with Cloud4WISP

loud4WISP is a world-class cloud-based WISP management system that incorporates industry best practices. The cloud4WISP technology was built with the design requirements listed below, to enable an entrepreneur to start a successful WISP business, with minimum technical knowledge and minimum investment.

- Multi-language system, English and Spanish is essential and other languages can be added quickly.

- The system has a very small investment cost for the WISP, less than any alternative.

- The product has distributed Cloud managed topology so that the WISP can eliminate the centralized NOC.

- Zero subscription charges for using cloud4WISP with a single tower, cloud4WISP is free with each easyWISP access controller.

- Multiple towers are managed for a cost less than any alternative system where total cost per subscriber is the lowest in the industry.

- The product is built on a robust platform that has a long life expectancy and has been used with other management products for many years.

- The product design uses industry best practices for OSS/BSS systems with powerful WISP management features that cover all aspects of WISP business management.

- The product is designed for deployment in locations where access to technical skills is limited, and is suitable for developing markets.

- Flexible low-cost easyWISP access control gateways are designed to operate with any type of wireless and network equipment, supporting alternative topologies to facilitate integration with existing WISP networks, and has the performance to manage many subscribers with no subscriber limit.

- The easyWISP access controllers are deployed when and where needed and so network investment is small and incremental.

- There is no limit to the number of easyWISP controllers that can be managed by one cloud4WISP account.

Cloud4WISP works in conjunction with access controllers such as easyWISP that incorporate the cloud4WISP agent software. Cloud4WISP access control can be implemented with any one of four topologies in the WISP wireless distribution network.

- The easyWISP EZ-100G access controller is installed at each PtMP tower site.

- The easyWISP PtMP wireless/ access controller is installed at each tower site.

- The easyWISP EZ-75C has access control is built in to each CPE radio.

- One easyWISP EZ-1000N access controller is installed at the central network operations center (NOC) site.

The diagram shown below illustrates the topology with the easyWISP EZ-100G access controller installed at each PtMP antenna tower. The cloud4WISP system manages all subscriber access control via the easyWISP access controllers.
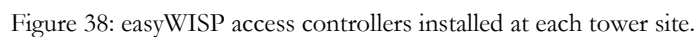
Figure 38: easyWISP access controllers installed at each tower site.

The easyWISP EZ-100G access controller is installed between the tower PtMP wireless access point and the backhaul, which can be a PtP wireless link to the telecom point of presence (PoP) or a landline. Each easyWISP controller operates autonomously as it downloads the customer database for that tower. The easyWISP will continue to function even when contact is lost with cloud4WISP for any reason. Each easyWISP access controller communicates with cloud4WISP to get subscriber updates and send data transmission statistics and any failure alerts to cloud4WISP. There is no limit to the number of wireless access points that can be connected to the EZ-100G. The easyWISP EZ-100G is very easy to install and operate, and also costs less than many PtMP wireless access points. The easyWISP EZ-100G is a popular product as it is very easy to upgrade an existing WISP to cloud4WISP network using this product.

The easyWISP PtMP wireless access controller combines the easyWISP access control software with high power PtMP wireless access points, the EZ-75W and the Z-100W. These products provide the lowest cost method to implement a wireless Internet service provider (WISP) business. The diagram shown below illustrates the combined access control and PtMP wireless access point topology installed at each PtMP antenna tower. The cloud4WISP system manages all subscriber access control via the easyWISP wireless access controllers.
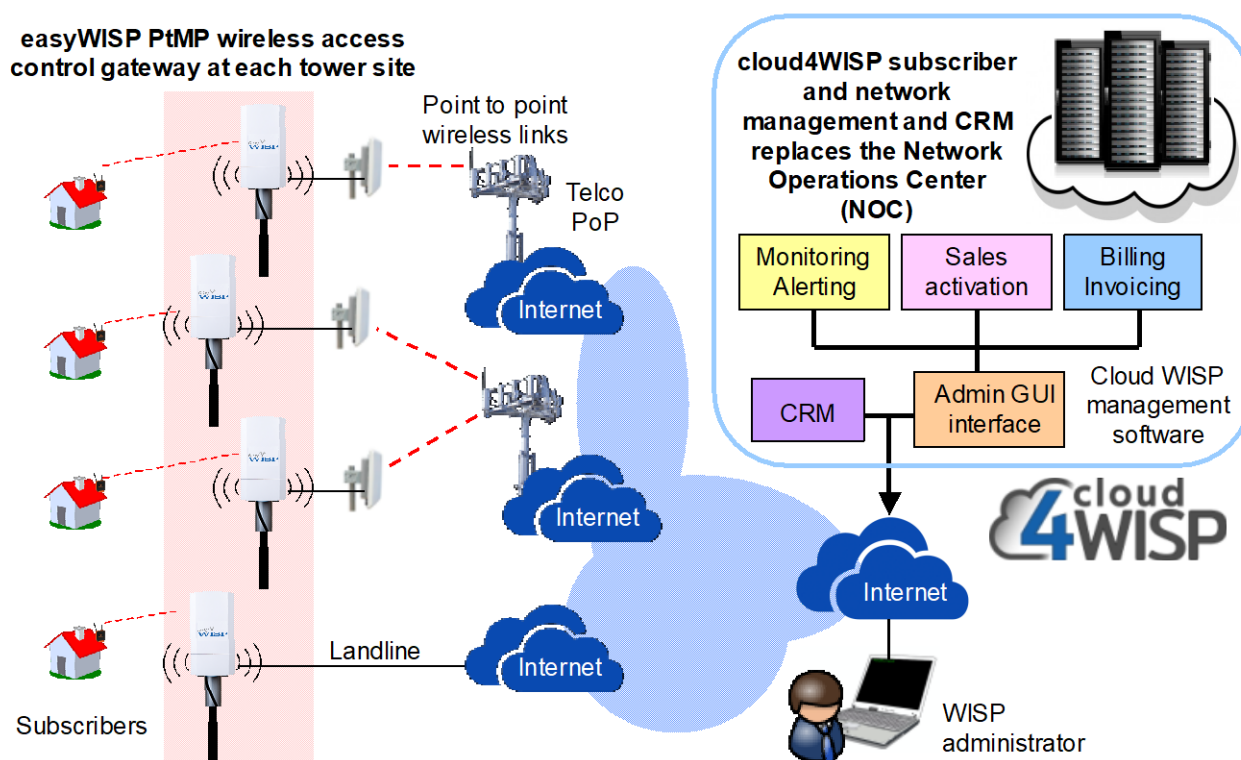
Figure 39: easyWISP PtMP wireless access controllers installed at each tower.

Many established WISPs who have installed wireless towers with a backhaul wireless distribution network connecting the towers to the network operations center (NOC) wish to implement the could4WISP system but to not want to modify the equipment configuration at the wireless towers. EasyWISP has developed the EZ-1000N access control and network management product, which

is installed in the Network Operations Center (NOC). The EZ-1000N has 1Gb/s throughput and has four WAN ports with load sharing and failover that can connect to multiple wholesale trunk circuits from different providers. The cloud4WISP replaces the WISP's management system to provide all the features that the WISP needs to manage the business at a much lower cost than the WISP is paying for subscriber billing and management. The next diagram illustrates the easyWISP EZ-1000N installed at the network operations center. The cloud4WISP system manages all subscriber access control via the easyWISP access controller.
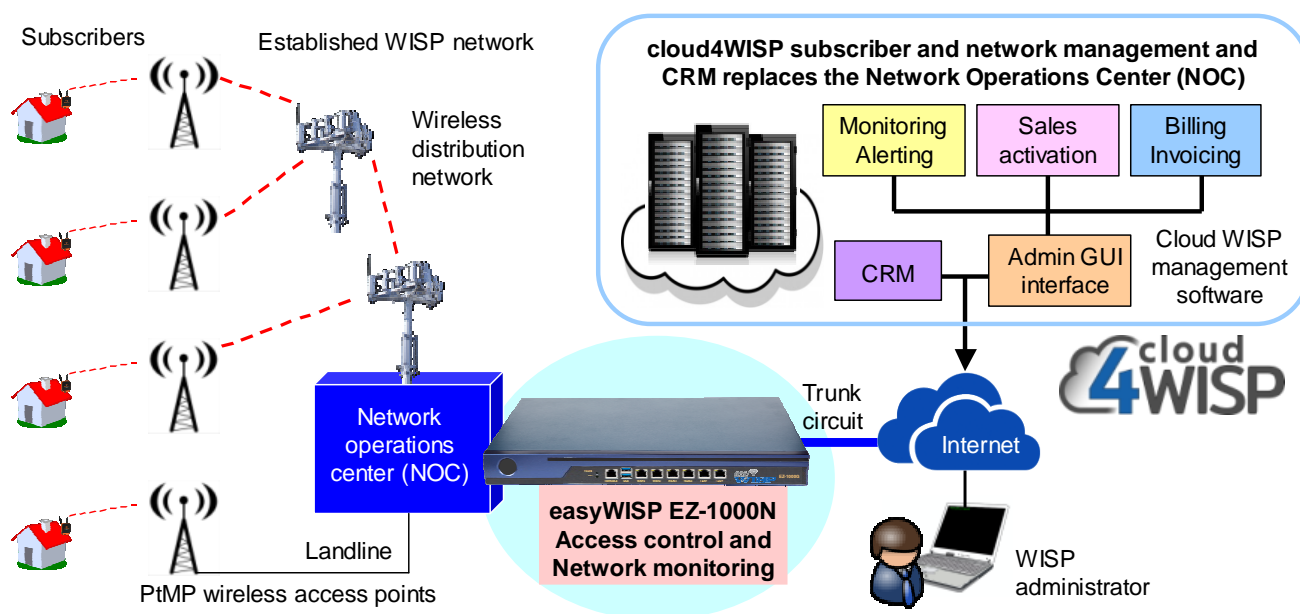
Figure 40: easyWISP access controller installed at the existing NOC.

The fourth easyWISP network topology provides a technical solution for WISP's who do not want to modify current network operations software, but want to manage new subscribers using the cloud4WISP system as they are added to the network.

EasyWISP manufacturers the EZ-75C wireless Client Premise Equipment (CPE) product that is managed by the cloud4WISP system, and includes customer access control, application of the subscribers rate plan and monitoring of the network for failures. The CPE also has an additional features not provided by other easyWISP access controllers, the EZ-75C can control access of the client devices that can connect to the network at the level of MAC addresses, limiting the number of concurrent users.

The EZ-75C is beneficial for start-up WISP's that have to minimize investment costs, and is compatible in price with any other low cost CPE product, but adds cloud4WISP functionality as subscribers are added to the network. The WISP's network can be built with any type of PtMP wireless access points, routers, switches and point-to-point backhaul wireless connections. Making the WISP's network build-out simple and trouble free.

The following diagram illustrates the easyWISP EZ-75C CPE wireless installed at the subscriber residence or business. The cloud4WISP system manages all subscriber access control via the easyWISP CPE access controller.
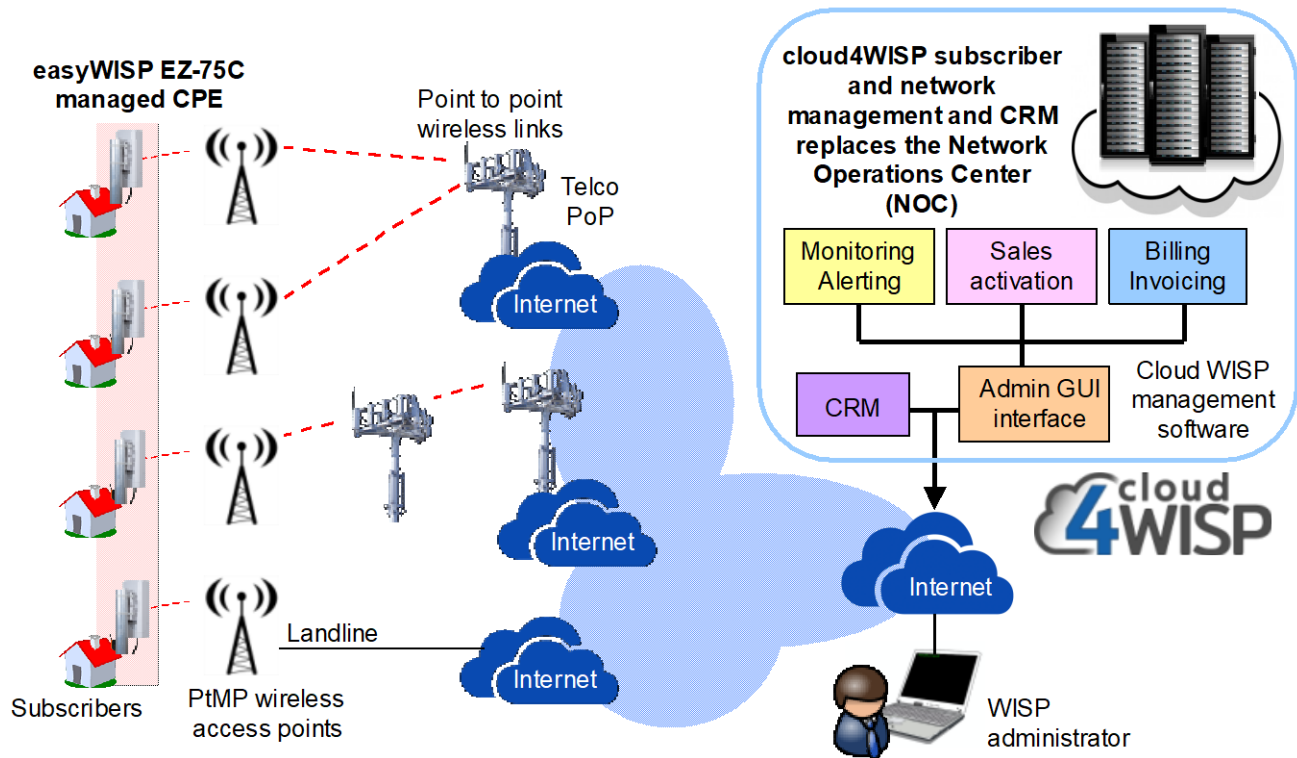
Figure 41: easyWISP CPE access controllers installed at each customer site.

The cloud4WISP cloud management system incorporates the following WISP business functions to support the WISP's business management.

- **Sales**: A new subscriber entry is created in the cloud4WISP database. The subscriber information also contains the rate plan chosen (download/upload maximum speeds and monthly charge for this service). The WISP can create several different rates determined by the WISP's decision when planning the service. The subscriber information can also be modified when a change occurs; change of address, etc. A subscriber can also be hidden from view when the subscriber decides to terminate the service but is not removed from the database.

- **Provisioning**: The new subscriber entry generates a work order for the field service technician to initiate the subscriber's installation process. The new subscriber entry also creates an entry in the billing database. The subscribers billing cycle starts on the date of activation.

- **Activation**: Activation is the process of enabling the subscriber to use the service. First the field service technician will install the CPE radio and wireless router at the subscriber's residence or business and verify that the subscriber has a network connection. On

completion of the installation the technician will add the CPE MAC into the subscribers account to authenticate the subscriber and set the start date of the billing cycle.

- **Billing**: The financial staff uses the billing engine to issue invoices to subscribers requesting the monthly payment. Subscriber payment plans can be either pre-pay or post pay, or a mix of the two. The financial staff must post subscriber payments to the billing system upon receipt. If a payment receipt is not posted and the account becomes past due the billing engine disables the subscribers Internet access until the payment receipt is notified.

- **Hotspot**: This mode provides authentication and billing for mobile broadband anonymous users who wish to pay-on-demand. The hotspot mode has an access code generator to download and print up to 10,000 access codes. The WISP may wish to install a public wireless Internet service in an airport or hotel and this feature eliminates the necessity to have a separate product to manage anonymous mobile broadband Internet users. An easyWISP access controller can authenticate both mobile broadband access codes and manage fixed broadband subscribers.

- **Traffic management**: This section includes several features that the WISP may need to manage data transmission over the network. Traffic management includes applying the rate-plan required for each subscriber; the data speed settings per user for download and upload, and optional download and upload byte limits per user. In addition web content filtering is provided by an IP/Domain allowed-list and blocked-list. There is also a MAC allowed-list and blocked-list. An allowed MAC device will always be authenticated and a blocked-MAC list device can never be authenticated.

- **Network management and monitoring**: Network management features permit the WISP to manage and monitor each easyWISP access controller. When the failure monitoring sub-system of cloud4WISP looses connection with an easyWISP access controller an alert message is sent to the network administrator and also to a field service technician to initiate the repair process. When the easyWISP controller comes back online a message is sent to the network administrator advising this. The circuit through to the customer CPE can also be tested by customer support in the case where the customer calls due to no Internet access. The CPE test will determines if the problem is with the network or with the customer's installation.

- **Inventory**: The network inventory is the report listing all easyWISP access controllers managed by the cloud4WISP account, with the network statistics and on-line/off-line status of each access controller.

- **Reporting**: The following reports are generated by the cloud4WISP system.
  - Reports for billing.
    - List of subscribers.
    - Subscriber status enabled/disabled, billed date, due date.
    - List of invoices issued to subscribers.

- o Reports for maintenance.
  - ▪ Monitoring status of all access control gateways on-line/off-line.
  - ▪ Check subscriber CPE circuit status.
- o Reports for data traffic, time graphs can be selected from 1-hour to 1-week.
  - ▪ Time graph of connected and authenticated users.
  - ▪ Time graph of access control gateway performance as a %.
  - ▪ Time graph of backhaul/WAN usage in Mb/s.
  - ▪ Authenticated user login information.
  - ▪ Connected user login information.
- o Report for support.
  - ▪ List of support ticket requests via the CRM portal.
  - ▪ List of outstanding work orders with status.

- **Customer Relationship Management (CRM)**: CRM is a subscriber portal that permits the subscriber to view account details with payments and to open a customer support request for information or to report a problem. The subscriber receives an email response to the ticket.

- **Multi-language UI:** The cloud4WISP user interface can switch between English and Spanish language options. More language options will be added soon.

The cloud4WISP system has five business role logins where each business role has access to limited modules of the cloud4WISP system that are relevant to that role. The managerial login has access to all cloud4WISP modules.

- **Managerial**: The responsibilities of the manager with cloud4WISP are to set the subscriber billing rate plans, monitor reports, and monitor billing operations.

- **Technical**: The responsibilities of the technical staff are to follow work orders, subscriber installation, tower PtMP installation, network monitoring, network repairs, and network maintenance. As the WISP business grows technical staff may be divided by function; for example tower installers, subscriber installers, network maintenance and repair.

- **Customer service**: The responsibilities of customer service are responding to subscriber questions, which may come via the CRM portal, or a customer may call by phone, and passing potential existing or new customer leads to sales staff. Some WISP businesses may have a retail office that is staffed by sales and customer support staff.

- **Finance**: The responsibilities of financial staff are bookkeeping, accounts receivable; issuing invoices, receiving customer payments and entering the payment into the billing system, and to follow up with late billing payments. The WISP back office system does not have financial bookkeeping as many parameters such as taxes, vary from country to country and state to state. The WISP should acquire a financial management software package that is configured for the WISP's fiscal requirements. For example a WISP in the USA must pay the appropriate telecommunications taxes.

- **Sales**: The sales person is responsible for acquiring new subscribers and up-selling to existing subscribers. The sales person will enter the new subscriber information into the database. As part of the customer data entry the sales person will add the rate plan tier that is agreed with the customer.

Cloud4WISP is built around four sub-systems with the business roles corresponding to the respective subsystems.

- Sales, provisioning, activation

- Billing

- Network management, monitoring

- Customer relationship management (CRM)

The sales, provisioning, and activation subsystem is used to add and edit subscribers. New subscribers are forwarded to a provisioning process, which adds the subscriber to the billing database, and initiates a work order to proceed with the subscriber installation. At the end of the installation the subscriber is activated onto the network and the billing cycle is initiated.

Using the billing subsystem the financial staff will determine when subscriber payments are due. The staff will then print and issue invoices to subscribers requesting payment. When the payment has been received the financial staff notify the billing system that the account is paid. If the subscriber's account is not notified of payment then the billing engine would disable the subscribers Internet access when the account becomes past due.

The network monitoring and management subsystem has a UI that is used to manage each easyWISP access control gateway that is assigned to the WISP's account. The subsystem creates a new subscriber work order and the field service technician has to login daily and print out the work orders. The detection of a failure with one of the easyWISP access controllers will initiate a failure alert that will advise the field service technician that a network repair is required, and advise details about the nature of the failure.

The final subsystem is the customer relationship management (CRM) module. This is a WISP branded website that the subscriber can access for information. When a new subscriber is added a CRM portal login is generated for that subscriber during the provisioning process and sent to the subscriber via email. The support staff is responsible to login on a daily basis to read customer support requests and take the necessary action, then respond to the subscriber. The subscriber has the following features in the WISP branded portal.

- See the status of the subscribers account.

- Access and download past invoices.

- Initiate a customer support request.

- Purchase on-demand access using a credit card.
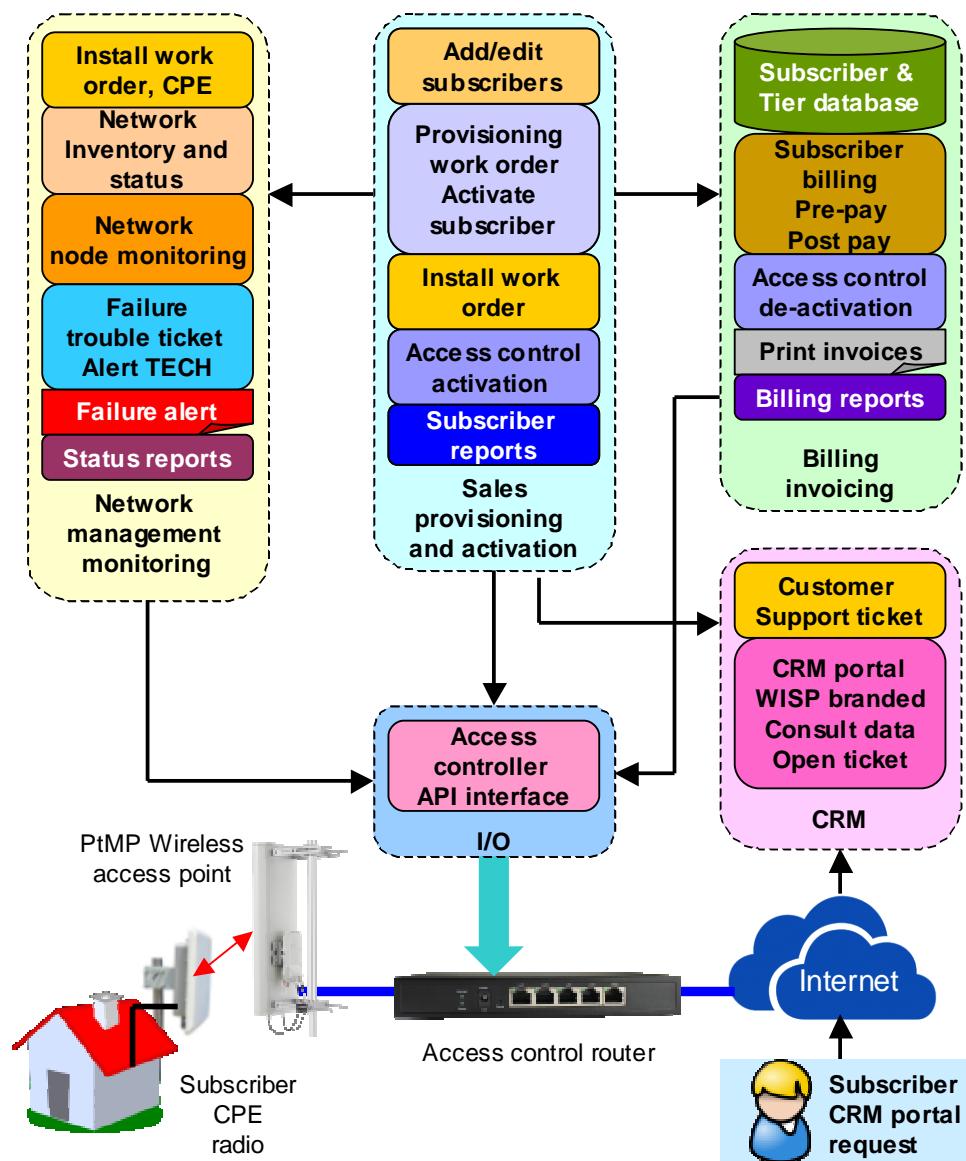
Figure 42: cloud4WISP four modular subsystems.

The cloud4WISP process flow follows telecom best practices for OSS/BSS management systems. Cloud4WISP was designed to distribute processing between the cloud and the access controllers to minimize cloud overhead and reduce cloud operating cost for the WISP. Cloud4WISP is a batch-processing engine incorporating subscriber processing, daily billing, equipment supervision and reporting. Transaction processing tasks are partitioned into the easyWISP access controllers, subscriber authentication, rate-plan enforcement, and equipment failure monitoring and alerting.

The cloud4WISP process flow diagram is illustrated in the following figure.
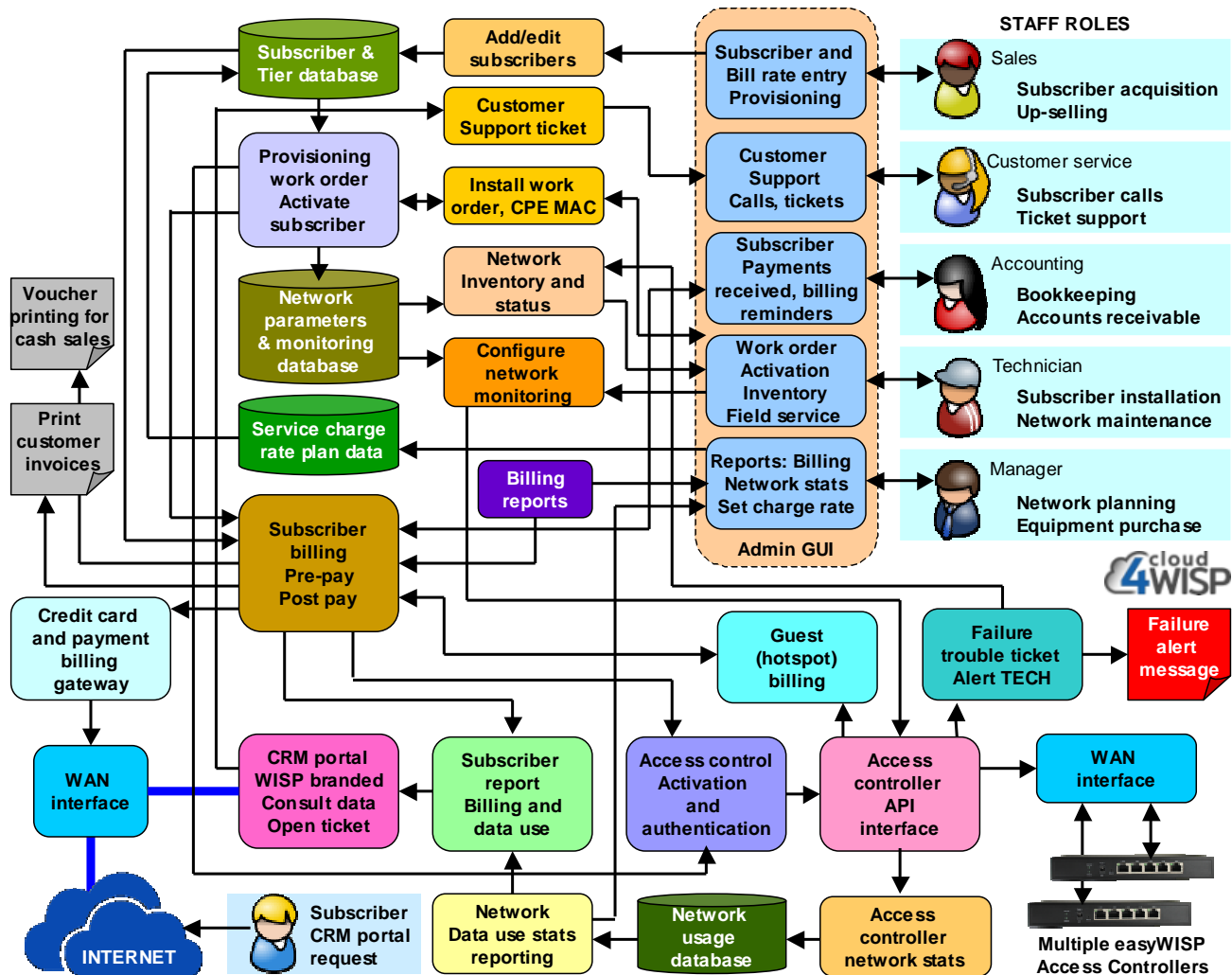
Figure 43: cloud4WISP process flow.

Each easyWISP access controller has different features, depending on the model.

- Tower site access controllers, EZ-100G (100Mb/s throughput) and EZ-1000G (1Gb/s throughput) with dual WAN for two backhauls.

- Tower site combined access control and 2.4GHz wireless, EZ-75W (directional antenna) and EZ-100W (omni-directional antenna).

- Network operations center (NOC) central access controller EZ-1000N (1Gb/s throughput), with 4 WAN's that have load balance and failover.

- Client site CPE (client premise equipment) 2.4GHz EZ-10C (directional antenna).

The functional diagram of the easyWISP controllers is illustrated below.
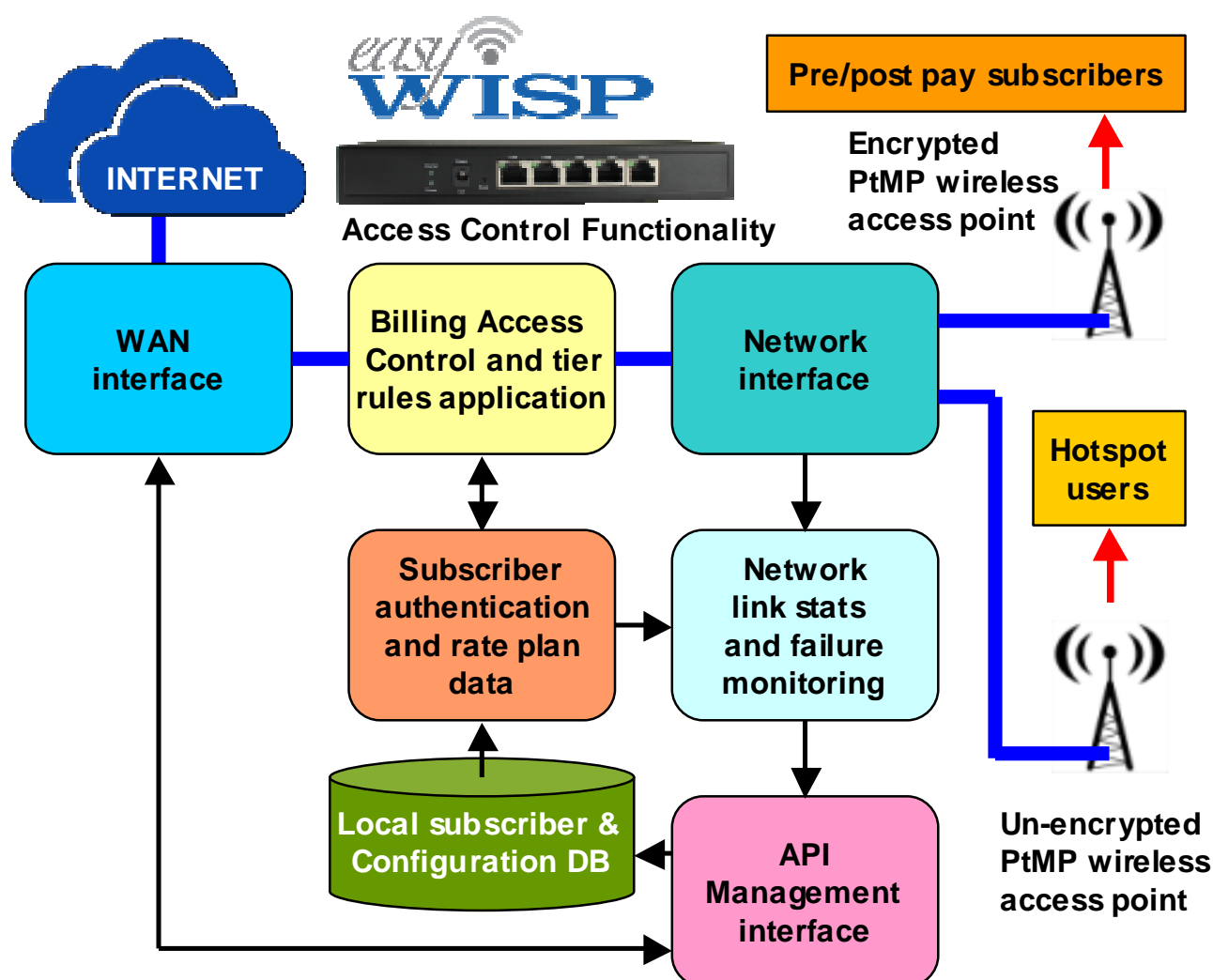
Figure 44: easyWISP access controller subsystems.

The tower site (EZ-100G and EZ-1000G) and NOC site (EZ-1000N) access controllers will support any type of wireless equipment used by the WISP and are suitable to build out a new network or upgrade an existing network. The wireless access controllers (EZ-75W and EZ-100W) are designed for start-up WISPs where the lowest possible cost is very important. The CPE access controller (EZ-10C) is a low cost alternative to having the access control at the tower or at the NOC, and is suitable for both start-up and established WISPs.

The cloud4WISP billing and payment process is simple and can be implemented anywhere in the world as the payment methods are provided by third party providers. The financial staff issues a paper or electronic invoice as the subscriber billing cycle becomes due. The subscriber uses a preferred payment method to make the payment. The WISP may choose to use a local cash payment gateway or payment that includes receiving checks and cash. The financial staff is responsible to check receipts on a daily basis and notify the cloud4WISP-billing engine as payments are received. Clould4WISP does include two popular payment gateways PayPal and Oxxopay, to facilitate payments. As clud4WISP and easyWISP products are used in over 50 countries it is not possible to include local payment gateways for each country.

Although some management systems require the WISP to use specific payment gateways and take a percentage commission from each payment, this is not the case with cloud4WISP. The WISP can use whatever payment system is convenient for the business.

The diagram below shows the invoicing and payment process.
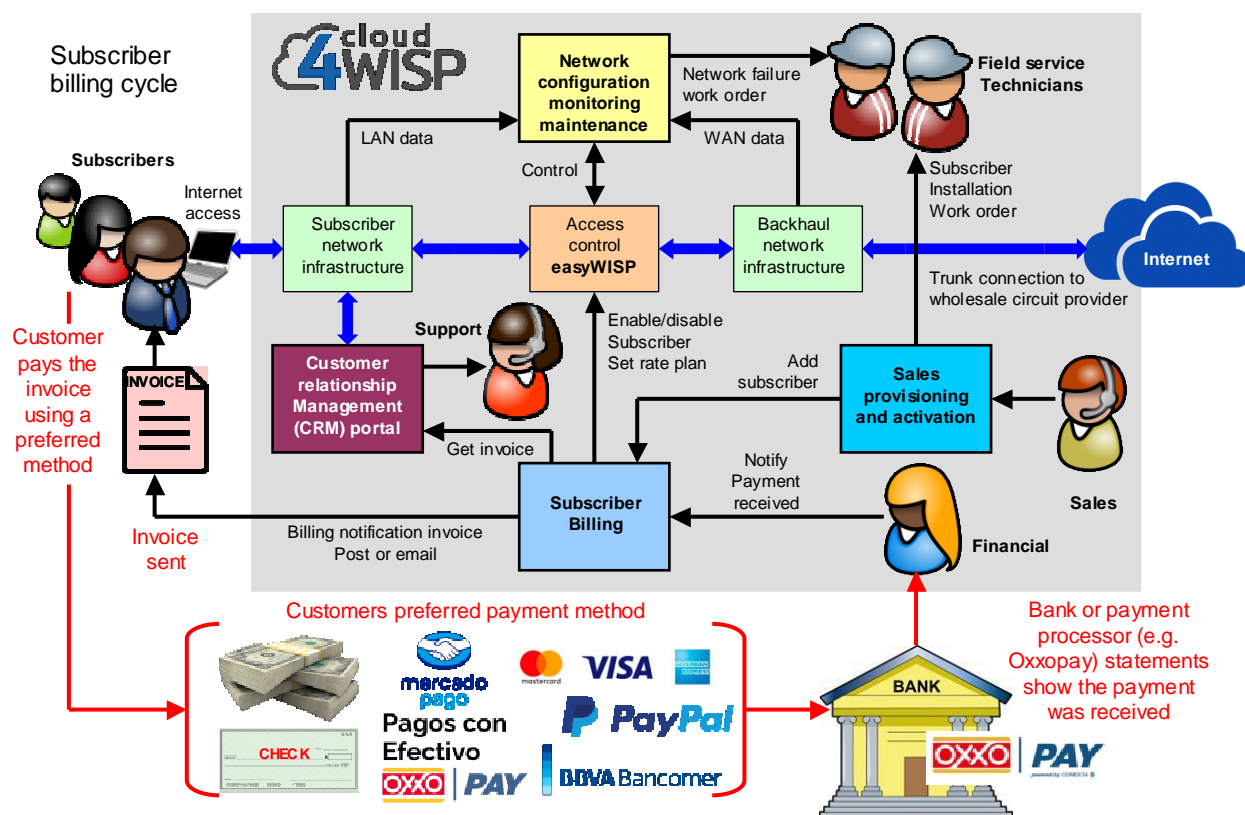
Figure 45: cloud4WISP subscriber payment process.

The cloud4WISP and easyWISP products are plug-and-play; this means that no special networking skills are required to install and operate the products. The cloud4WISP management system has a graphic user interface (UI), which is very easy to use. The UI provides a secure login for five different roles in the company. The administrator's dashboard is shown in the figure below.
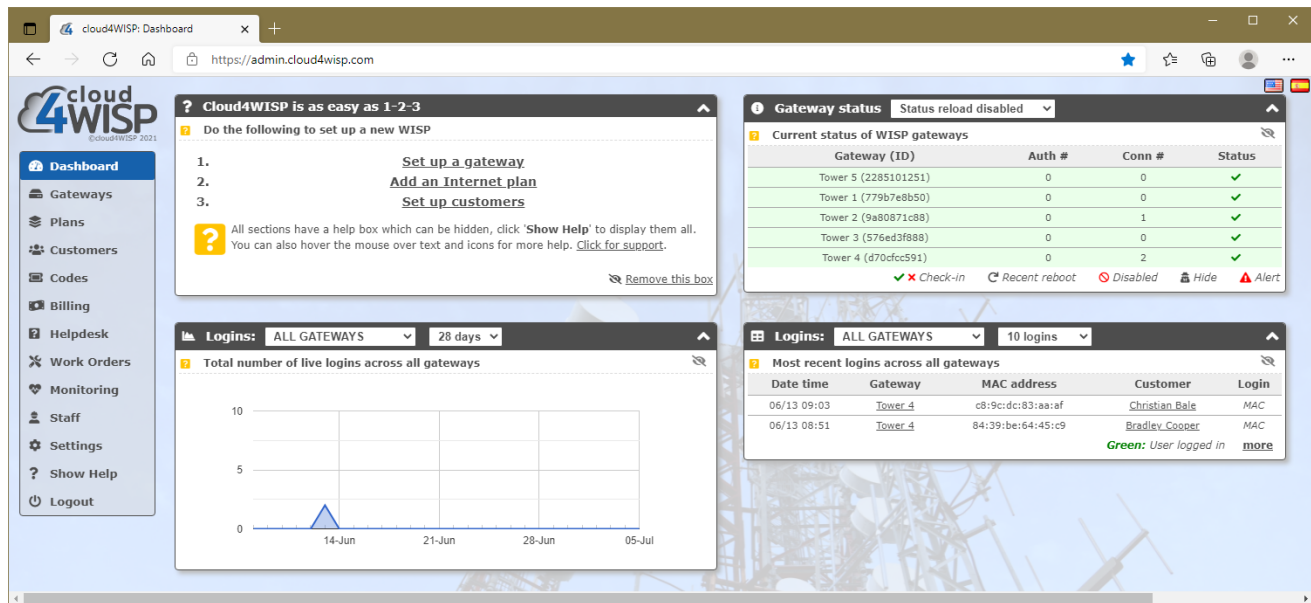
Figure 46: cloud4WISP administrator interface.

The UI menu items are explained below.

- Dashboard; status overview of all access controllers .

- Gateways; select and manage an access controller.

- Plans; create rate plans for subscriber assignment.

- Customers; add / edit a subscriber.

- Codes: generate access codes for mobile broadband.

- Billing; check status, issue invoices, confirm payments.

- Helpdesk; subscriber help requests from the CRM.

- Work orders; add a new subscriber, maintenance.

- Monitoring; monitor access controllers for failure.

- Staff; configure logins for five staff roles.

- Settings; configure CRM portal page, billing gateway.

- Show help; show or remove information boxes.

- Logout; exit the system.
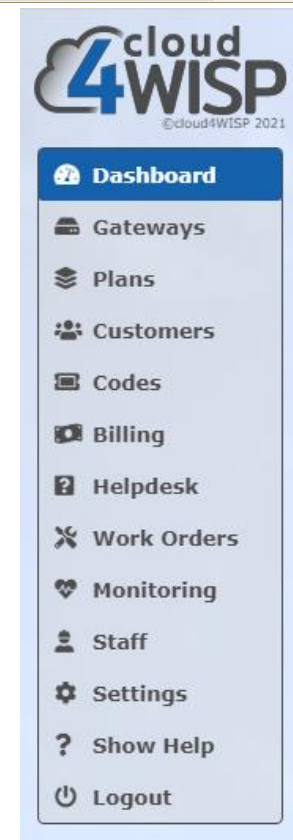
Figure 47: cloud4WISP administrator menu.

During the billing period the subscriber has full access to the Internet.

- With the restrictions set for the customer's rate-plan or tier, maximum up/down data speeds, optionally maximum up/down byte count.

There are situations where the subscriber will not have access to the Internet.

- The account is past due, Internet access is suspended until payment is received, however the customer can purchase an access code (pay-on-demand) via the CRM portal to restore access.

- If a maximum up/down data limit has been set and has been exceeded then Internet access will be suspended, however the customer can purchase an access code (pay-on-demand) via the CRM portal to download extra data.
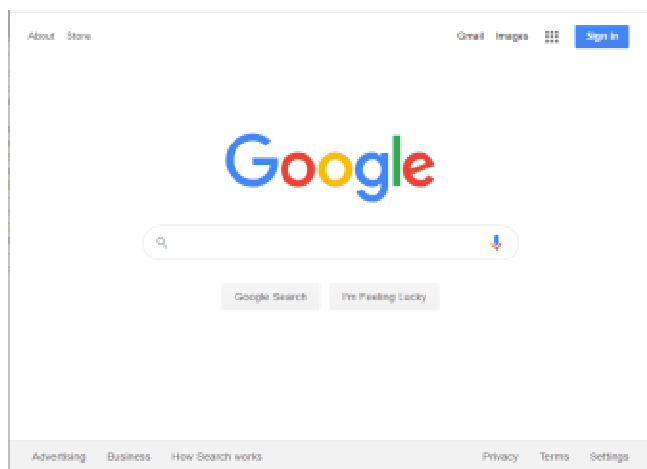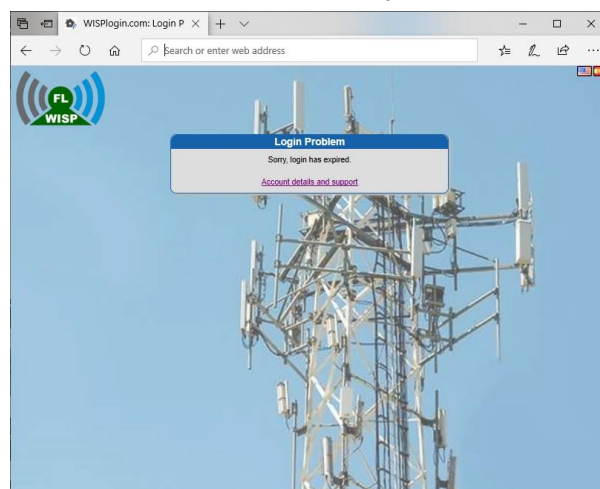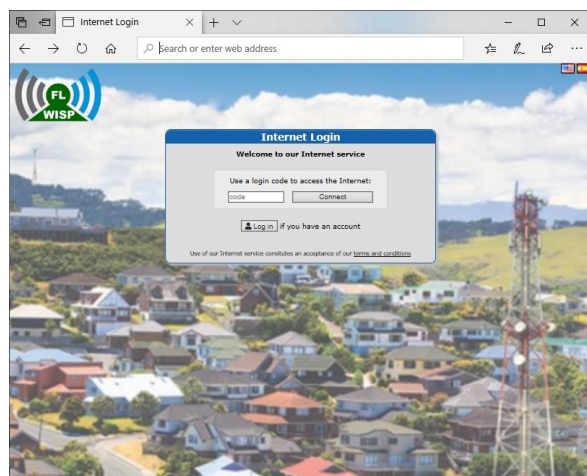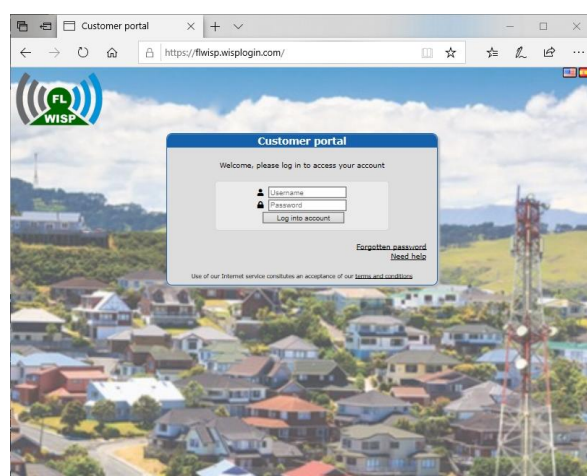
Figure 48: The subscriber's view of the Internet service.

Each subscriber has access to the CRM portal (customer relationship management). The portal has a branded domain name. For example the portal domain for a WISP business called FL WISP is shown below:

https://flwisp.wisplogin.com/

The subscriber logs in with the credentials that were provided when the subscriber's account was created and selects one of the options from the menu.

- Customers account status.

- Review past invoices and download an invoice.

- Request customer support.
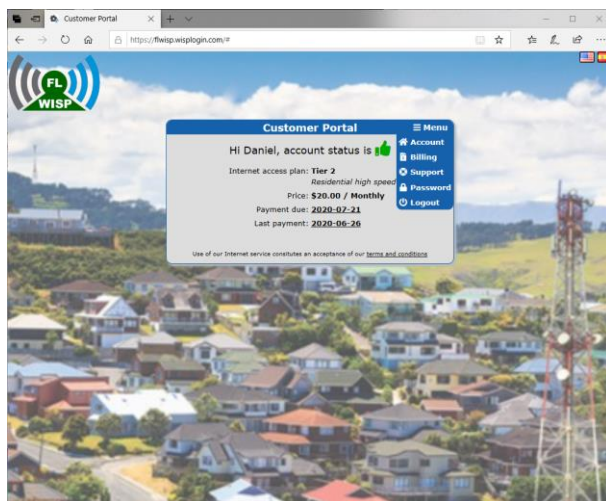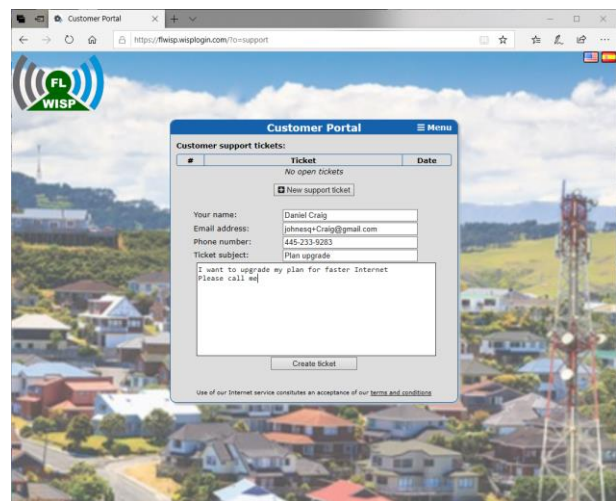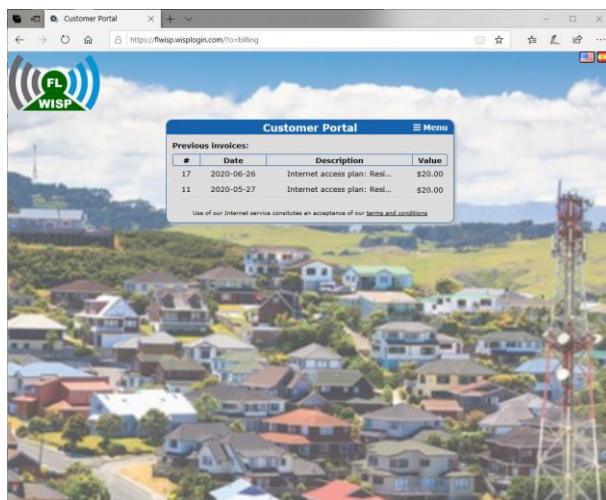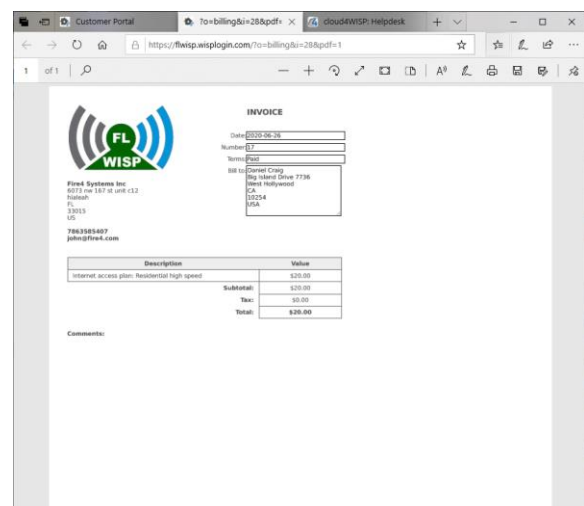
Figure 49: cloud4WISP subscriber account management via the CRM Portal.

The cloud4WISP management system with easyWISP access controllers is a popular solution chosen by WISP's to manage subscriber billing with network monitoring, while providing a branded CRM portal for subscribers.

- Investment is lower than for any other system, the centralized NOC and some backhaul infrastructure is eliminated.

- Operating cost is lower than for any other system; many operational costs are eliminated and the cost per subscriber is the lowest in the industry.

- Deployment time and time to see revenue is faster than for any other system; the WISP can begin selling services sooner.

- The technical knowledge required is much less than for any other deployment.

- Management of subscribers, billing and network is very simple.

- Business growth can be faster because the infrastructure can expand quickly.

- Reliability is greater because cloud4WISP is fully redundant which means fewer outages; there is no single point of failure unlike most WISP networks which have a Network Operations Center (NOC). EasyWISP access controllers continue to function normally even when communication to cloud4WISP is lost.

- Lower operating cost and shorter investment amortization permits the WISP to increase profits or lower prices to undercut the competition.

- MULTI-LANGUAGE: cloud4WISP software and manuals have both English and Spanish languages, and more languages are being added.

- SUPPORT: on-line technical support is free with 1 business day response time.

- WARRANTY: the easyWISP 1-year warranty starts from the first day it is used.

- cloud4WISP does not take a percentage of any fee paid by customers.

- cloud4WISP has no subscriber limit, keep adding subscribers.

- cloud4WISP has no access controller limit, keep adding easyWISP controllers.

By purchasing easyWISP access controllers with the cloud4WISP management system, the WISP's total management system cost per subscriber is 5 cents per month, or 60 cents per year per subscriber. This is an incredible cost reduction for the WISP.

The WISP eliminates the cost of building and operating a NOC, and part of the cost of wireless backhaul point-to-point circuits connecting towers to the NOC. The potential savings for the WISP can be $10,000's in investment costs by implementing the easyWISP and cloud4WISP system. The low startup cost of the easyWISP / cloud4WISP technology will empower many thousands of potential WISP entrepreneurs to start and grow WISP businesses.

Individuals with limited technical knowledge and limited financial resources can start a WISP business and grow it successfully. The easyWISP / cloud4WISP technical solutions will ensure that potential WISP owners have no obstacles to impede them when establishing and growing their WISP businesses.

29.

The Action Plan to Begin an Internet voucher Business

W hen planning to start a business that provides Internet access services, the most important consideration is the technical ability of the founder or founders; does the founder have the ability to install and operate the equipment described earlier in this book? This book describes simple approaches that do not require a high level of technical knowledge, however some technical knowledge is required. If the founder does not feel comfortable with the degree of technical knowledge required then he or she should seek a partnership with a person who has good technical knowledge.

The second consideration when planning to start a business is the capital investment that is required to begin operations. This book has described low cost technical solutions that minimize the initial investment. In fact the entrepreneur can start a business with a few hundred dollars by following the suggestions in this book. Once the business is established, growing the business requires capital to purchase more equipment, hire staff, develop marketing plans and pay for the Internet circuits required for operation. A business can grow organically (growth is paid from profits) but the speed of growth will be limited. The entrepreneur should develop an investment plan in order to understand the degree of investment required. The entrepreneur might seek an investor who can provide the capital that is required to grow the business in return for a shareholding. However if the entrepreneur can demonstrate a profitable start-up business then banks will loan the capital needed to expand the business.

The first step before proceeding to start a business is to analyze the viability of the business plan. Evaluate the basic business parameters that will show if the business might be a success or failure.

- Estimate the type of service that should be offered; this includes mobile and fixed broadband services and rate-plans.

- Estimate the charge that can be made for each rate plan service that potential customers can afford.

- Estimate potential sales numbers based on an analysis of prospective subscribers within range of the antenna.

- Estimate the cost to generate sales. This will include advertising and sales staff. Sales also requires the cost of telephones and email addresses. Marketing requires social media accounts with staff to send information.

- Estimate the start-up costs to begin the service; this is the cost of equipment, labor, website and permits to install the equipment.

- Estimate the on-going operating costs of the business; this is the cost of the Internet service, staff and maintenance. This will include a rental fee for the tower location where the PtMP antenna is installed.

- Calculate the expected income vs. costs. Is there a profit? If not increase the charge per subscriber. Will the price increase reduce the number of potential subscribers? if so what is the new number.

The prospective business owner must do some research in the urban neighborhood or rural area where the Internet service will be offered. Using residence and business information available from the local government, discover how many homes and businesses are in the neighborhood or region and if possible how many subscribers the current provider (if any) has to estimate a percentage of homes with Internet.

The estimate for profit or loss will be approximate, but will give an indication that the proposed Internet service business might be viable. A start up business should always be very flexible and be ready to pivot to a new direction as feedback is received from prospective customers. The profit/loss calculation is an on-going process that is adjusted and updated as data is gathered from business operations.

Prepare a table like the one shown below for the estimated monthly income and monthly costs. Determine if the estimates show that the business will generate a profit or loss.

Item	Cost	Income
Potential sales		$ Estimate of monthly sales
Cost to generate sales	$ Monthly marketing cost	
On-going operating costs	$ Monthly DSL and tower rental	
Cost to scale	$ Monthly equipment investment	
TOTAL	$	$
Profit or loss?	($ Total income) – ($ total cost) = +$ (profit) or -$ (loss)	

Table 1: Estimating profit or loss.

If the business can generate a profit, calculate the time taken to amortize (recover) the initial investment.

Item	Investment Cost	Monthly Net Profit
Cost and profit	$ Equipment/labor investment	$
Amortization time?	($ Equipment investment) / ($ profit) = months to recover the investment	

Table 2: Estimating return on investment.

Decisions about charges must be made when planning the business startup; these are the customer installation charges if any, the monthly subscription if charged, and the on-demand service charges sold through vouchers or other methods. It is beneficial to create several rate plans so that the risk of making a mistake by offering customers the wrong service is reduced. Providing rate plans for the range of low cost to high performance will permit the popular services to be identified. The most popular services are called the market "sweet spot", which is found by monitoring sales of each rate plan to identify the best sellers.

When a potential fixed broadband subscriber requests service there will be a cost to connect that subscriber due to the installation of CPE wireless and network equipment at the subscriber's residence or office. The Internet service provider must decide how to manages these charges. If the Internet service provider decides on charging an installation fee then the prospective subscriber may not be able to afford the fee and so the Internet service provider will loose a potential subscriber. The alternative situation is that the Internet service provider does not charge the subscriber an installation fee but expects to recover the installation cost over several months by adding an equipment charge to the monthly bill. This is an acceptable solution only if (a) the Internet service provider has a financial reserve to cover the installation cost, and (b) the Internet service provider can rely upon the subscriber to pay monthly fees during a contractual period, for example one year, so that the Internet service provider can amortize the cost of the installation. To establish an obligation with the customer to accept a minimum period of service it will be necessary to draft a contract for the subscriber and the terms of such a contract will depend upon the laws of the location, country of state, where the Internet service provider business is located. The Internet service provider must ask a lawyer who is familiar with the local laws that determine Internet service provisioning for help to draft a subscriber agreement.

The second decision that the Internet service provider must make is regarding the subscriber billing rates. The Internet service provider has two major fixed operating costs for each PtMP tower location. These costs are listed below.

- The cost to provide broadband access for the tower; the Internet service provider will pay a monthly fee to a wholesale broadband provider (ISP).

- The cost of locating the PtMP antennas on the tower or building, this will be a rental fee for the space used, probably a monthly charge per antenna.

The Internet service provider has to divide these charges between the subscribers that are connecting to the tower, and then add to this number other fixed costs of the business. The Internet service provider therefore has to calculate a charge per Mb/s of data that the tower PtMP antenna is capable of providing, while factoring in the contention ratio. The Internet service provider will have to determine where the break-even point will be for the tower antenna installation. The break-even point is the amount of sales that will pay operating costs but will not generate a profit. With sales below the break even point the Internet service provider will loose money, with the sales above the break even point the Internet service provider will make a profit. This situation can be illustrated with the following calculation.

Using realistic figures as an example, calculate what the customer charge should be so that the break-even point is at 40% of the tower capacity.

- ISP backhaul circuit cost per month: assume $100/month for a 100Mb/s circuit.

- Tower charge per month for the antenna space rental: assume $50/month.

- Add other business operating overheads that the WISP has, divided by the number of towers: assume $150/month.

Total cost to provide up to 100Mb/s of bandwidth is 100+50+150 = $300/month.

Assume the contention ratio is 5:1, the Internet service provider can sell up to 500Mb/s bandwidth for that tower.

Choosing the tower break even at 40%, this means that the sale of 500x0.4 = 200Mb/s of bandwidth will pay the cost of the tower.

Calculate the value that the customer must be charged per Mb/s of bandwidth: 300/200 = $1.50 per Mbit/s of bandwidth.

This means that if the Internet service provider sells a subscriber a maximum download speed of 10Mb/s then the Internet service provider must charge that subscriber 10 x 1.5 = $15 per month.

In order to break even the Internet service provider must sell twenty of the 10Mb/s plans (200Mb/s for break even) to subscribers. The Internet service provider can sell up to 50 subscribers plans of 10Mb/s based on the 5:1 contention ratio, and so the 21st and upward subscriber will represent a profit for the Internet service provider. If 50 subscribers are purchasing Internet access every month then the Internet service provider will make a good profit.

The Internet service provider has one additional issue; some subscribers will have a limited budget and seek a lower cost service, whereas some subscriber's can afford to pay for a fast service. The Internet service provider must therefore elaborate data-rate plans (speed tiers) that will suit a wide range of financial abilities. Speed tiers might look like the following, charging the service at $1.50 per Mb/s of bandwidth.

- 5Mb/s for $7.50/month.

- 10Mb/s for $15/month.

- 25Mb/s for $37.50/month.

The values listed above must be modified to encourage a subscriber to move up to the next tier to get a better charge per Mb/s of data. A revised table might look like the following.

- 5Mb/s for $10/month = a charge of $2.00 per Mb/s.

- 10Mb/s for $15/month = a charge of $1.50 per Mb/s.

- 25Mb/s for $35/month = a charge of $1.40 per Mb/s.

By modifying the monthly charges the break-even point for the number of subscribers has changed. If all subscribers choose the lower cost plan then fewer subscribers are required to achieve break-even. To reach the $300 cost of operation then the minimum number of subscribers with a rate plan of 5Mb/s for $10/month is 30. Compare this with a minimum number of subscribers with the 10Mb/s rate plan is 20. Therefore selling a slower speed for a higher price per Mb/s than the minimum rate of $1.50/Mb/s will increase the profit if all customers choose the slower rate plan. Selling only slower rate plans has the advantage that the contention ratio can be increased (see the section on contention ratio) say from 5:1 to 8:1 and so the slower plan can be sold to more customers and the profit can be increased further.

If all subscribers choose the higher performance plan then fewer subscribers are required to achieve break-even, however the profit will be reduced as these customers are paying below the minimum rate per Mb/s of bandwidth and the contention ratio will have to be reduced from 5:1 to 3:1 for example.

The conclusion is that more customers buying a slower data rate will generate a higher profit than fewer customers buying a faster data rate, providing that enough slower rate customers are available to purchase the service.

The cost of subscriber acquisition may be similar for both types of subscribers, those who want to pay low fees, vs. the subscribers who want high performance. Subscriber acquisition includes the cost of sales people, advertising, retail space, etc per month, divided by the number of subscribers per month that the Internet service provider acquires. The cost of customer acquisition depends on the operation of the business and the access to local markets.

Therefore the Internet service provider will pay a higher cost to acquire more of the slow data rate customers and less to acquire fewer high data rate customers. The Internet service provider therefore has to calculate the trade off between the higher customer acquisitions costs for the slow data rate customers vs. the additional profits that slow data rate customers will generate.

In practice the subscribers will be a mix of slow data speed, low cost and high data rate subscribers, with subscribers located between the two extremes. It is important that the Internet service provider repeats the calculations described above in order to determine how the services should be priced for the subscribers to ensure that the Internet service provider does not loose money and makes a profit.

The business plan requires further consideration if there is a competitor in the same market, which may require that the startup Internet service provider has to charge lower prices. The competitor might be a wire-line ISP so the startup Internet service provider must offer lower prices in order to attract subscribers away from the service that they currently use. There is also another factor to consider when acquiring subscribers from competitors. When a subscriber has been with an Internet service provider for a long time then the subscriber is resistant to change even when a competitor offers lower prices. In fact ISPs feel comfortable to increase subscriber charges annually with the expectation that the subscriber will be resistant to move to a lower cost provider.

APPENDIX. A Guide to Selling Internet Access Using Vouchers

MAKE MONEY BY SELLING INTERNET ACCESS WITH GUEST INTERNET-with-VOUCHER PRODUCTS

Install a Guest Internet-with-voucher wireless product on a roof and connect it to the Internet.

Use the Guest Internet-with-voucher product to print vouchers and sell them to customers who want Internet access.

Sell Internet Access with Guest Internet-with-vouchers

Install a wireless access point WiFi Hotspot at a high location, the roof of a tall building or a tower. The WiFi Hotspot is connected to the Internet with a DSL service or similar. The transmission from the wireless access point can be seen by any computer or mobile device like a phone or a tablet that is near the WiFi Hotspot. The WiFi Hotspot must have software to create and print vouchers. Each voucher has a unique access code which is authenticated to access the Internet. Each access code determines the duration of the Internet connection and parameters such as the download speed and the number of bytes that can be downloaded.

The customer purchases a voucher that has information explaining how to connect to the WiFi Hotspot. When the customer connects a mobile device and opens a browser the login page is displayed. The login page has a box to enter the access code that is printed on the voucher. When the access code is typed in the user gets access to the Internet for the duration of the access code.
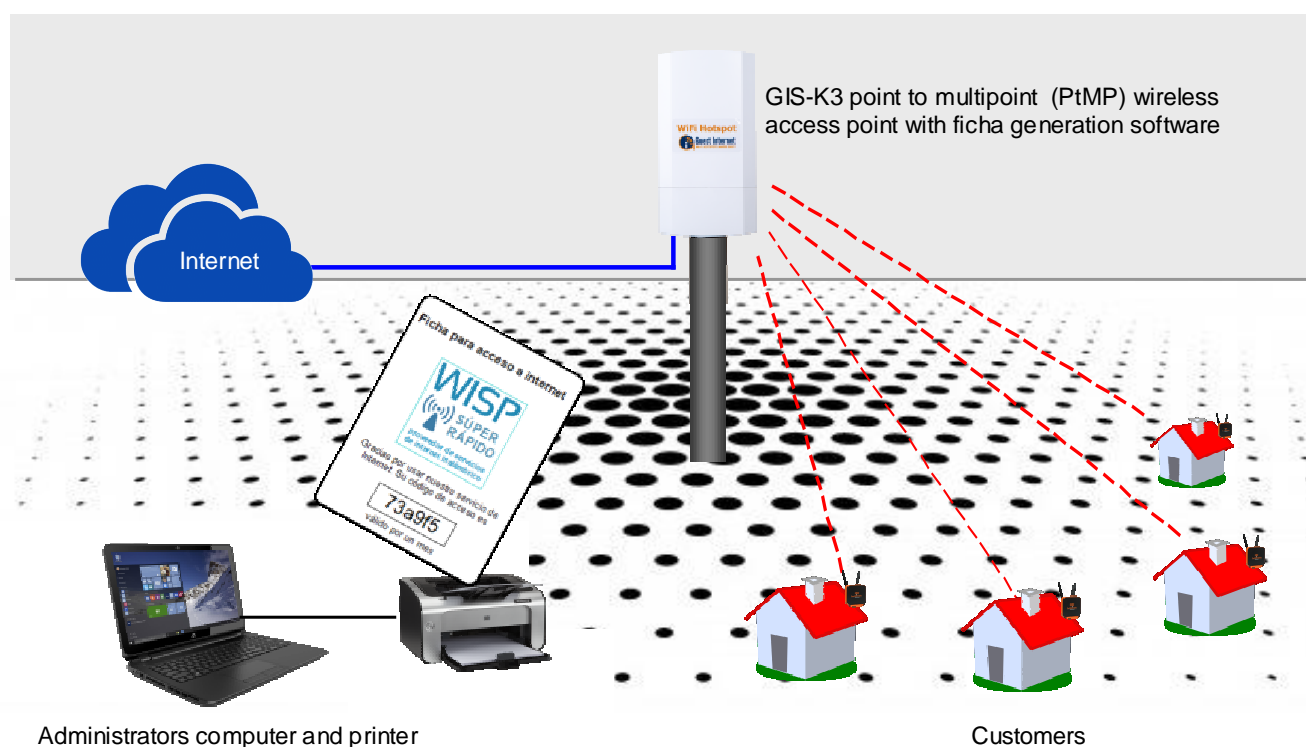
Figure A1. A Guest Internet point-to-multipoint wireless access point, with Internet voucher software.

Learn How to Make Money by Selling Internet Access

Install Internet Wireless Equipment and Sell Vouchers for Cash Payments with Minimum Investment and Limited Technical Knowledge

Customer Connection the the Internet Using Vouchers is Easy

The customer looks for wireless networks and identifies the wireless network name written on the voucher then connects the device to it.

The customer opens a browser and types the hotspot name to see the login page.

The customer types the unique access code on the voucher into the login page box.

When the code is verified the customer has access to the Internet for the duration of the code.

WiFi Hotspot name
SSID

Connect to the SSID on the ficha
Open a browser to see the login page
Type the access code on the ficha
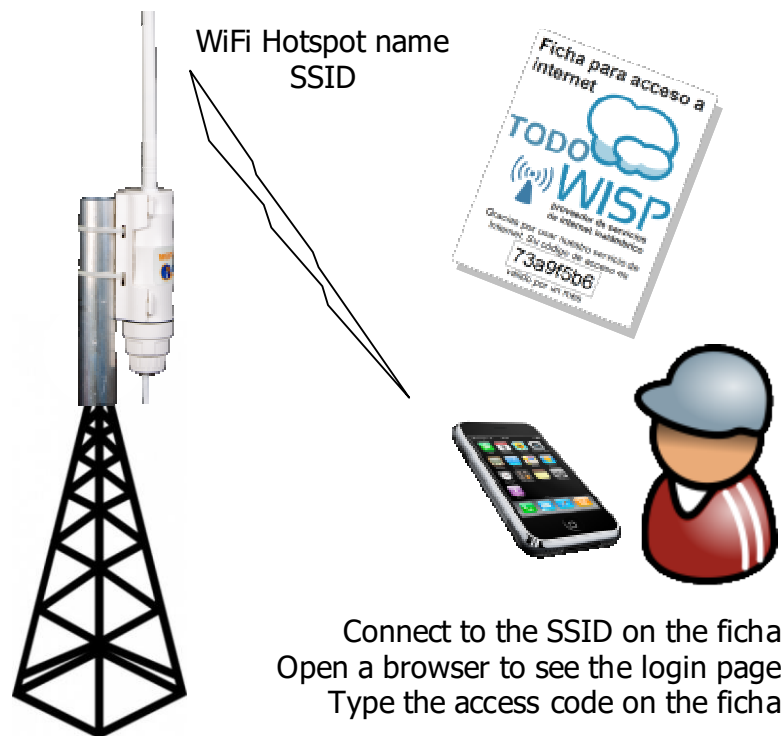
Figure A2. Guest Internet customer connection to the wireless access point.
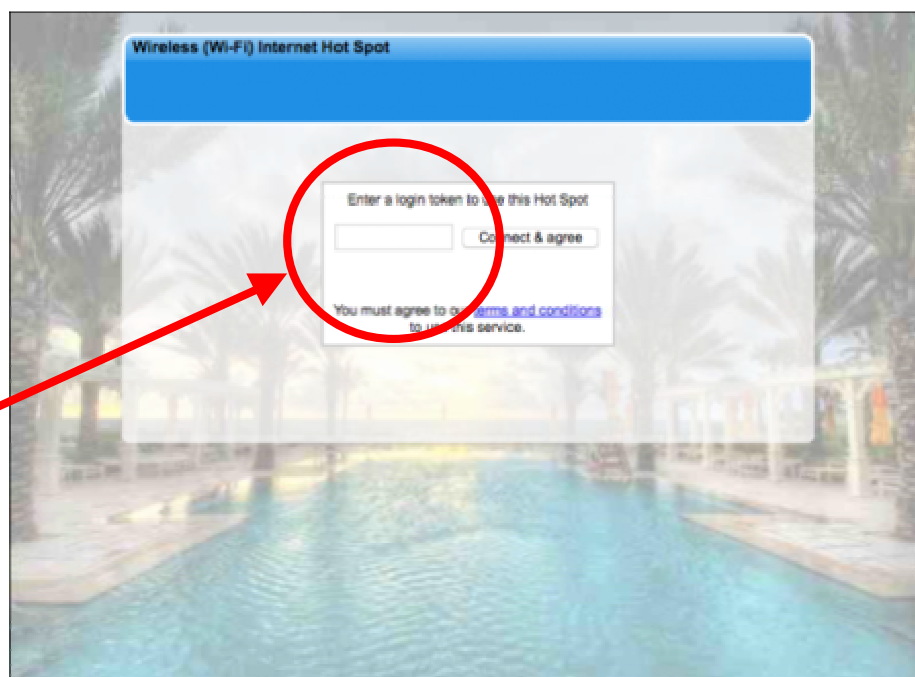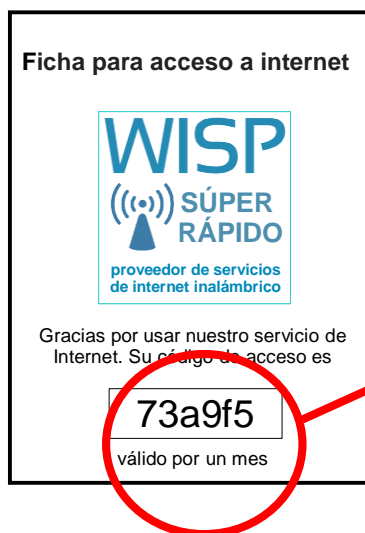
Figure A3. Guest Internet customer login, using the access code on the voucher.

GUEST Internet voucher
SETUP GUIDE

Seven simple steps are required to prepare the Guest Internet voucher product so that it is ready to start selling Internet access with vouchers. Configuration of Guest Internet products is very simple and takes less than five minutes. When the unit has been powered up with a WAN connection to the Internet then a computer can be connected to start the configuration process. If the Guest Internet unit is a wireless product then the computer is connected via wireless to the default SSID, which is 'hotspot'. If the Guest Internet product is a gateway then connect the computer via an Ethernet cable.

STEPS:

- Quick start Wizard: select login page parameters.

- Quick start Wizard: enter the parameters to auto-create the login page.

- Quick start Wizard: select controlled access.

When the Quick Start Wizard has completed then reboot the unit and login as admin to finish the setup process.

- Set the wireless SSID name that you want to broadcast to users.

- If desired, create a custom login page to brand the Internet service.

- Design the voucher layout ready for printing.

- Set the firewall configuration for remote access to print vouchers at any time.

- Configure a cloud account and add the unit to print vouchers via a cloud group.

The equipment is ready to start selling Internet access using vouchers.

Setup WIZARD: configure the captive portal login page

The setup Wizard window opens the first time that the computer connects to the Guest Internet voucher product via the wireless or wired. Follow the instructions.

Provide business information for the login page settings; tell people where they can purchase the vouchers.

Figure A4. Guest Internet captive portal login page configuration.

Setup WIZARD: select controlled access

Select controlled access when requested. This configures the login page to request an access code to get access to the Internet.

See the lower option that is shown in the diagram. The text in the box will be shown on the login page. Edit text in the box to explain where to purchase the vouchers and the price of the vouchers.
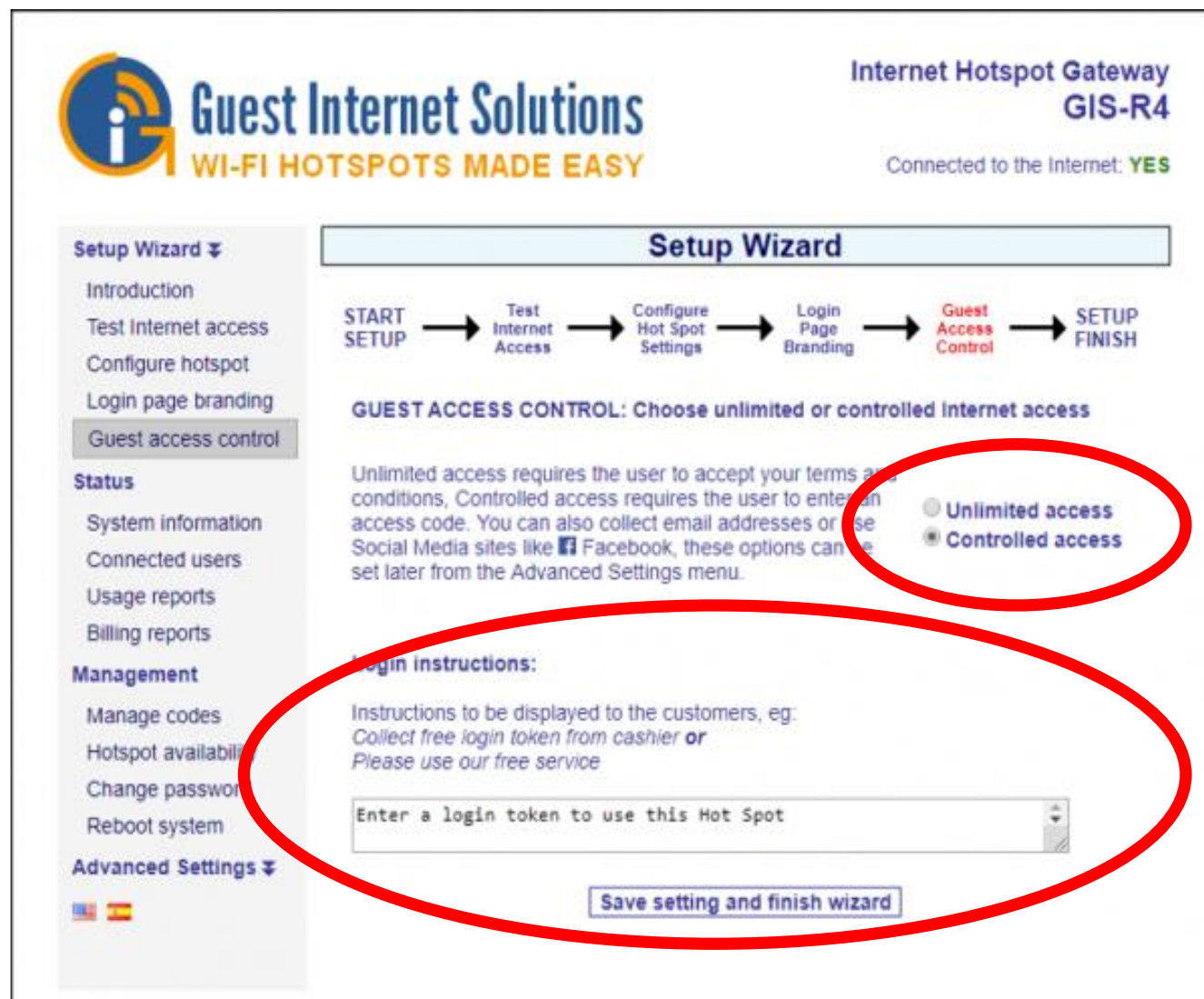
Figure A5. Guest Internet select controlled access configuration.

Configuration - customize the login page

After the setup Wizard is completed the login page can be personalized.

The easy method is to upload a JPG photo that will be used as the background for the login page. The JPG photo must be less than 196KB in size.

Alternatively, a web designer can prepare a custom login page, using HTML, which is then uploaded to the Guest Internet product.

Figure A6. Guest Internet captive portal login page personalization.

Configuration - Set the firewall for remote access

Remote access via the Internet is one option to print vouchers at any time. The firewall must be configured to permit remote access. Check the box to allow remote access then enter a port number that will be used to access the product remotely. Also check the box to use encryption (https://)

When the Guest Internet voucher product is connected to a DSL router, the DSL router must be configured with a port forward rule to allow remote access to the Guest Internet voucher product.

Figure A7. Guest Internet configuration for remote access.

Set wireless SSID

The Guest Internet product wireless is broadcast with a name of 'hotspot'. This is called the SSID.

Enter a new name for your Internet service, pick a name that people can immediately identify when searching for wireless networks.
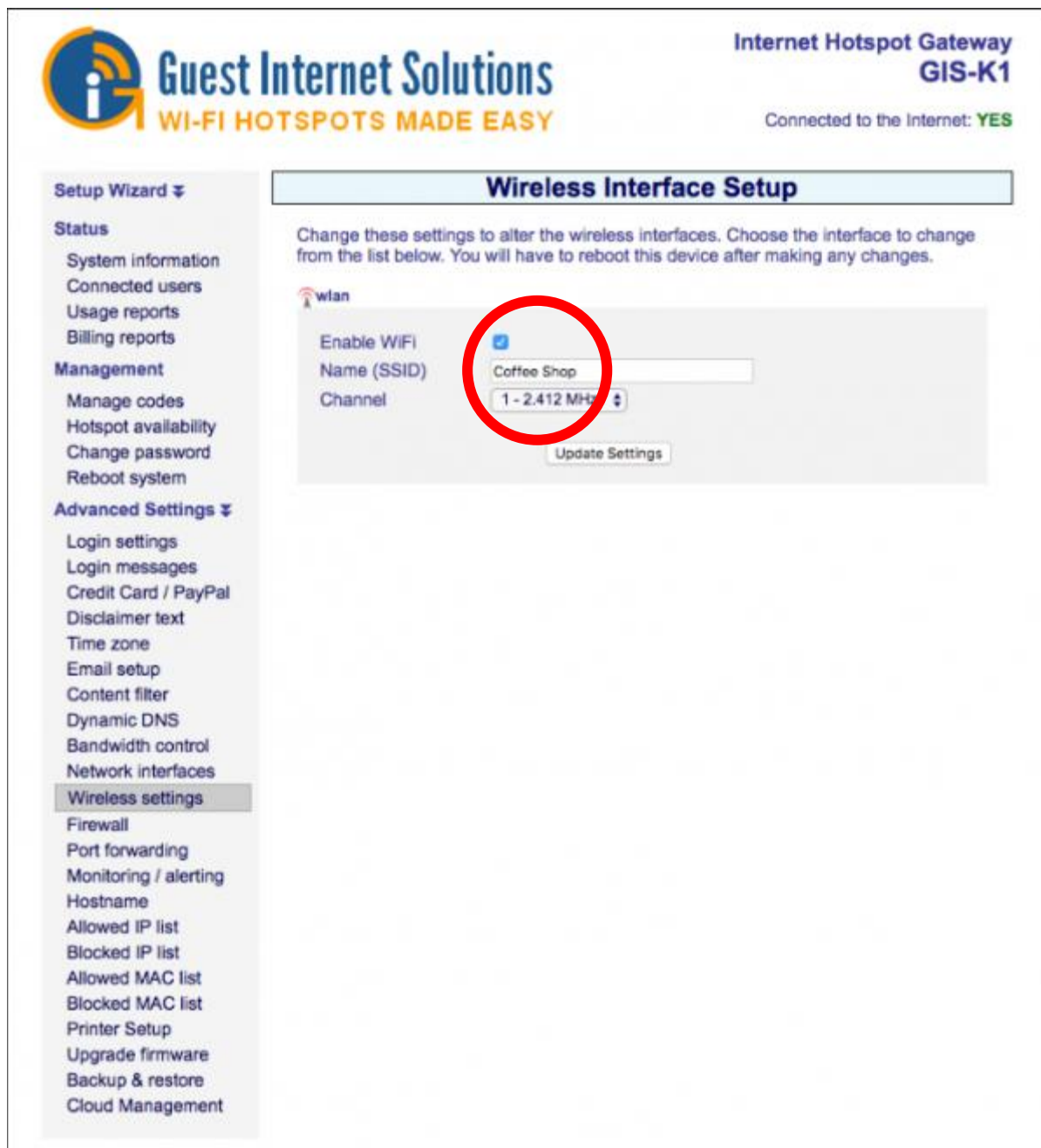
Figure A8. Guest Internet wireless broadcast name (SSID) configuration.

Design the vouchers ready to begin printing

The Guest Internet voucher product voucher is designed using the printer configuration screen.

Figure A9. Guest Internet design of the voucher.

The information is printed on the voucher as shown in the diagram. The first text box is 'titulo del ticket' and this is limited to 30 characters. This text appears at the top of the voucher.

A graphic business logo design is created and uploaded onto the voucher design using the 'logotipo del ticket' button. The JPG logo size should be square with 60pt x 60pt. If a larger logo is uploaded it will be scaled to 60pt x 60pt. The logo file size must be less than 196KB.

Figure A10. Logo design JPG to upload to the voucher.

The second text box 'texto del ticket' will provide instructions to the customer about how to use the wireless Internet service. This will include the SSID name, how to connect to the wireless access point, and how to open a browser to see the login page.
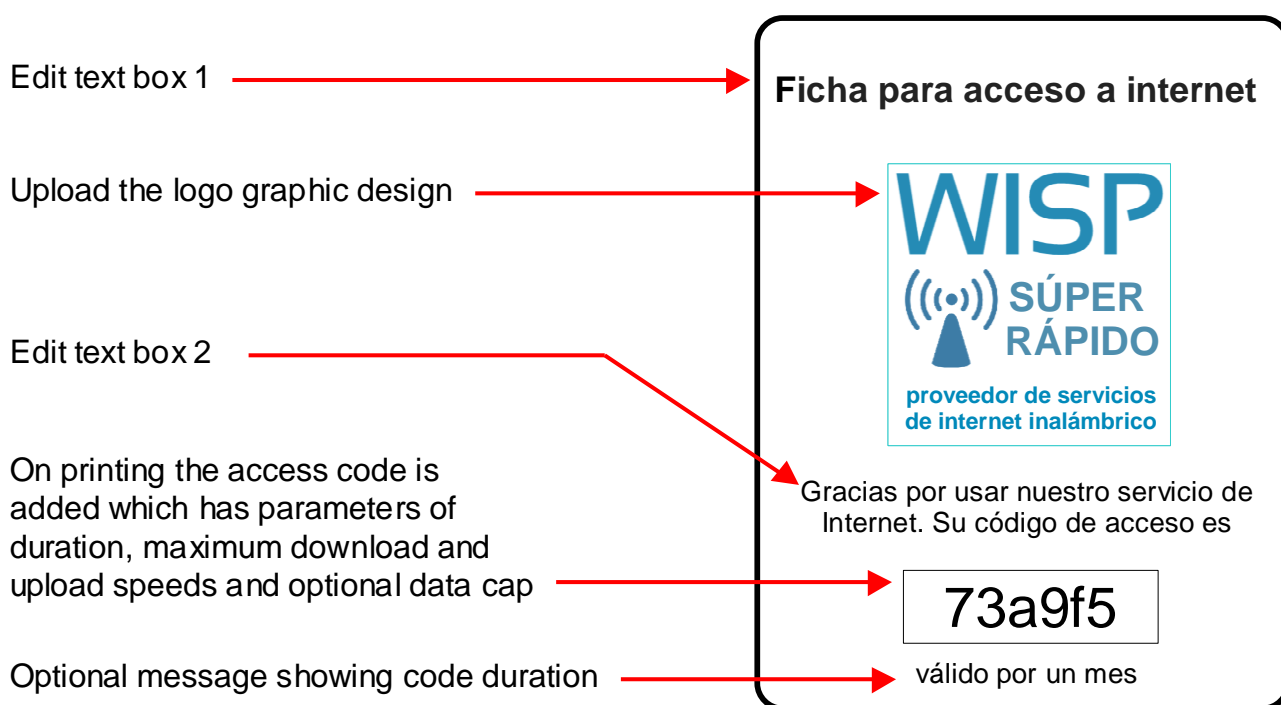
Figure A11. Guest Internet voucher design.

There is a check box for 'mostrar duracion del ticket'. When this box is checked the duration of the access code is printed at the bottom of the voucher.

When the information has been completed, click the button 'cambiar la configuracion' to save the voucher design for subsequent printing.

The software creates a voucher design and when the voucher is printed it contains the random 6-character alphanumeric access code that the customer will use to access the Internet.

GUEST INTERNET-with-VOUCHER: PRINTING VOUCHER PAGES GUIDE

———————————

Three simple steps are required to print vouchers using the Guest Internet voucher product. A computer with a letter size printer is required to print vouchers. Connect the computer via wireless to the Guest Internet voucher product, or connect remotely via the Internet as explained previously. Vouchers can also be printed via the Guest Internet Cloud, see the later section for this information.

STEPS:

- Create access codes.

- Print the sheets of vouchers.

- Cut up the sheets of vouchers to have individual vouchers.

After these steps you will have vouchers to start selling Internet access to customers.

When creating access codes, six parameters must be selected.

- Set the code type 'tipo de codigo' to random.

- Select the number of codes to generate (1 to 10,000).

- Set the duration for which the code will be valid (hours, days, weeks).

- Set maximum download data speed.

- Set maximum upload data speed.

- Set maximum download data byte count.

- Set maximum upload data byte count.

- Set the number of users permitted to use each code concurrently (usually 1).

THREE METHODS OF CONNECTING THE PRINTER

The Guest Internet software provides three methods to connect the computer and printer to print the vouchers.

- Local connection to the Giest Internet wireless, login as the administrator to print the vouchers.

- Remote encrypted connection (https://) to the Guest Internet Ehernet port, login as the administrator to print the vouchers.

- Connect to the Guest Internet Cloud to print the vouchers.

A computer is required only to print the vouchers and can be disconnected for normal operation. A letter size printer is required to print pages of vouchers. The vouchers are printed using the Guest Internet software contained in the product.
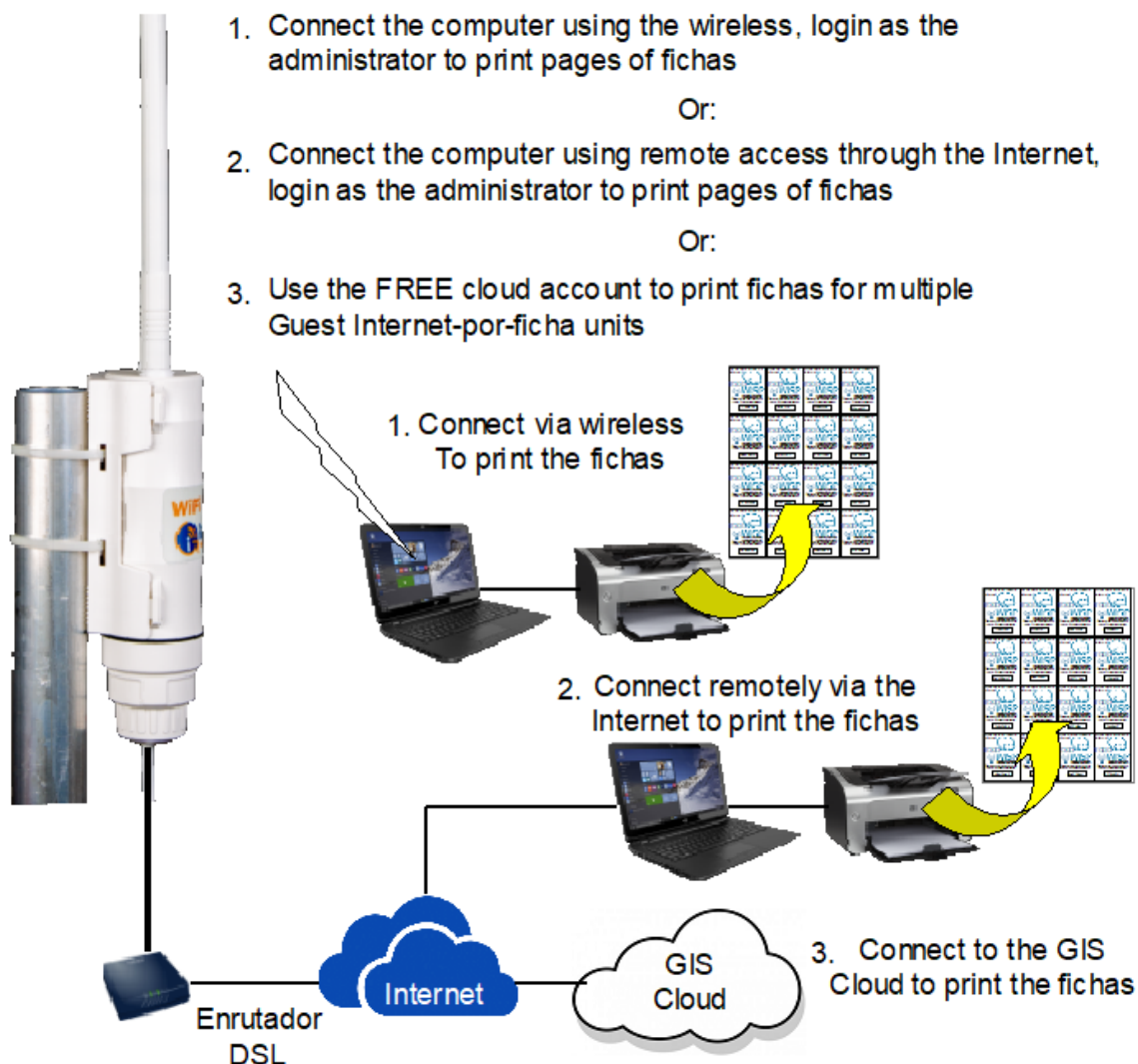
Figure A12. Guest Internet printing code voucher sheets.

Create the access codes

Set the parameters that are desired for the codes, all codes will have the parameters that are set. The vouchers are printed 16 per page and so 16 codes will be 1 page of codes, 32 codes will be 2 pages, etc.

When the voucher parameters have been entered, click the button 'create codes'.

Batches of codes can be printed with different parameters. For example, print 1000 codes of one-day duration, and 1000 codes of one-week duration. As customers use the voucher codes, they are removed from the database. This permits new voucher codes to be created.

Figure A13. Guest Internet code generation.

Print the pages of vouchers

When the codes have been created they will be listed on the page. To print the codes click the 'print codes button' shown.

Figure A14. Guest Internet print the codes that have been generated.

The sheets of vouchers are shown as a HTML format page, which can be printed and then cut into 16 individual vouchers for sale to customers.

The sheets of vouchers can also be sent to a PDF file via the printer command for printing at a later date.

Figure A15. Guest Internet codes printed on a sheet of 4x4 vouchers.

GUEST Internet voucher CUSTOMER CONNECTS TO THE INTERNET

The customer will look for the wireless access point name; this is the SSID that was configured during setup. This information should be written on the voucher.

- The customer opens a browser and enters aplogin.com to see the login screen.

- When the login screen appears then the 6-character alphanumeric access code from the voucher is entered into the login screen as shown in the screen below.
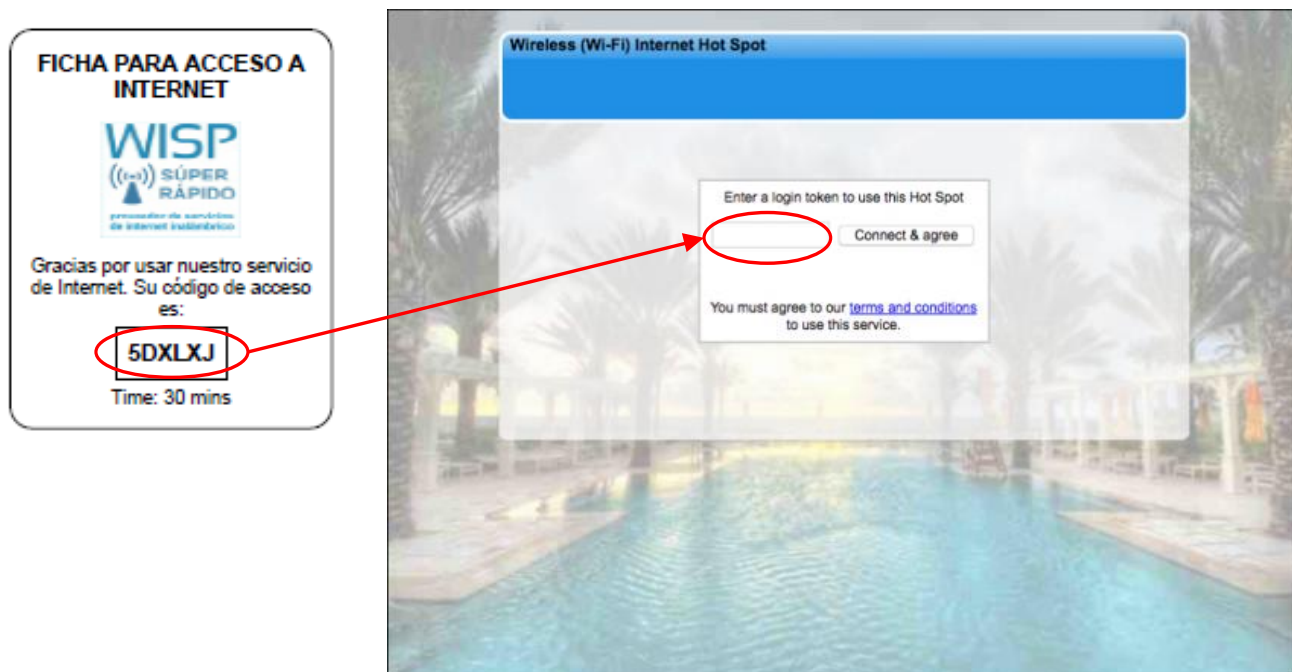
Figure A16. Guest Internet login page access code entry.

- When the code has been verified the customer has access to the Internet for the time determined by the code.

- The Internet provider has the option of first showing the customer a website for advertising purposes before giving the customer access to the Internet.

- At the end of the code duration the customer is disconnected from the Internet.

GUEST Internet voucher CLOUD MOBILITY: CREATE VOUCHERS FOR GROUP ROAMING

User mobility is implemented with the roaming feature of the Guest Internet Cloud. The owner of the Guest Internet voucher equipment creates a Cloud account; the process is described here;

https://www.guest-internet.com/QS_cloud.php
https://www.guest-internet.com/ES/guia_de_configuracion_cloud.php
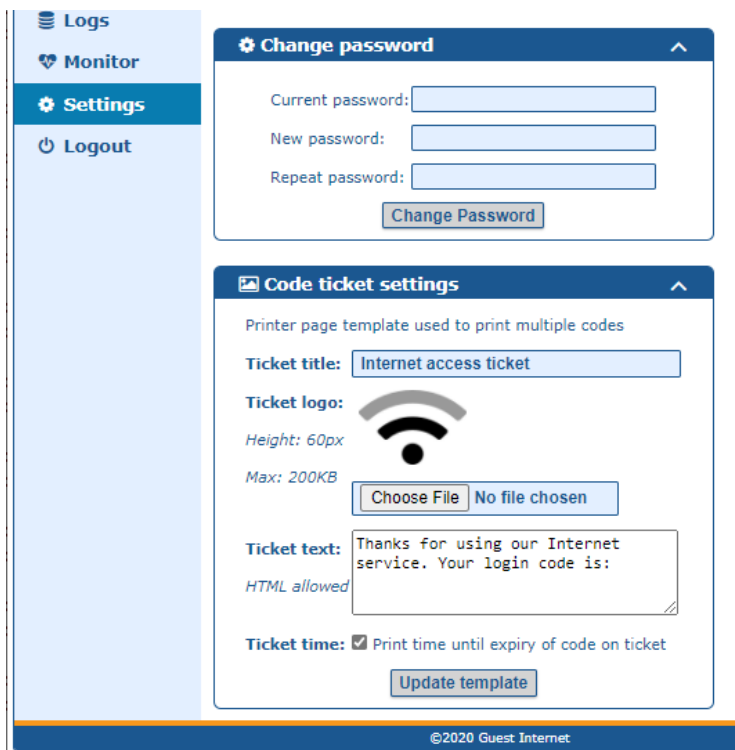
After the Guest Internet voucher wireless access points and gateways have been added to the Guest Internet Cloud, An account a group is created. Finally the Guest Internet voucher wireless access points and gateways are added to the group.

Access codes and vouchers can be generated for the group. This means that any Guest Internet voucher wireless access point in the group can accept the access code printed on the voucher. The customer can also start using the code when connected to a Guest Internet voucher wireless access points then move to a different location that has a Guest Internet voucher wireless access point and continue using the access code.

This is called roaming which gives the customer mobility to move around a large area while maintaining an Internet connection.

When the cloud account is created the voucher must be designed before vouchers can be printed. This is done in the Settings menu page, shown in the screen figure.

Figure A17. Guest Internet Cloud voucher design.

To create group codes, first login in to the cloud account as the administrator. Select the codes entry in the menu then select the group that the codes will be generated for. This is shown in the screenshot below.

Figure A18. Guest Internet Cloud select group for voucher generation.

The next step is to create the codes that will be printed onto the vouchers. The parameters for the codes (duration, speeds, bytes, users) are selected using the screen shown below. The number of codes to create will determine the number of vouchers that will be printed.

Figure A19. The Guest Internet Cloud creates voucher access codes.

When the code parameters have been selected click the create codes button to generate and list the codes as shown in the screen below. Finally click the 'Print codes file' button indicated to display the vouchers in the format that they will be printed.

Figure A20. Guest Internet Cloud print vouchers with codes.

The access codes are printed on each voucher design as shown in the screen below. The vouchers are printed 16 per page in a 4x4 format, which is designed for a letter-size printer paper. The printed pages can then be cut up into individual vouchers.
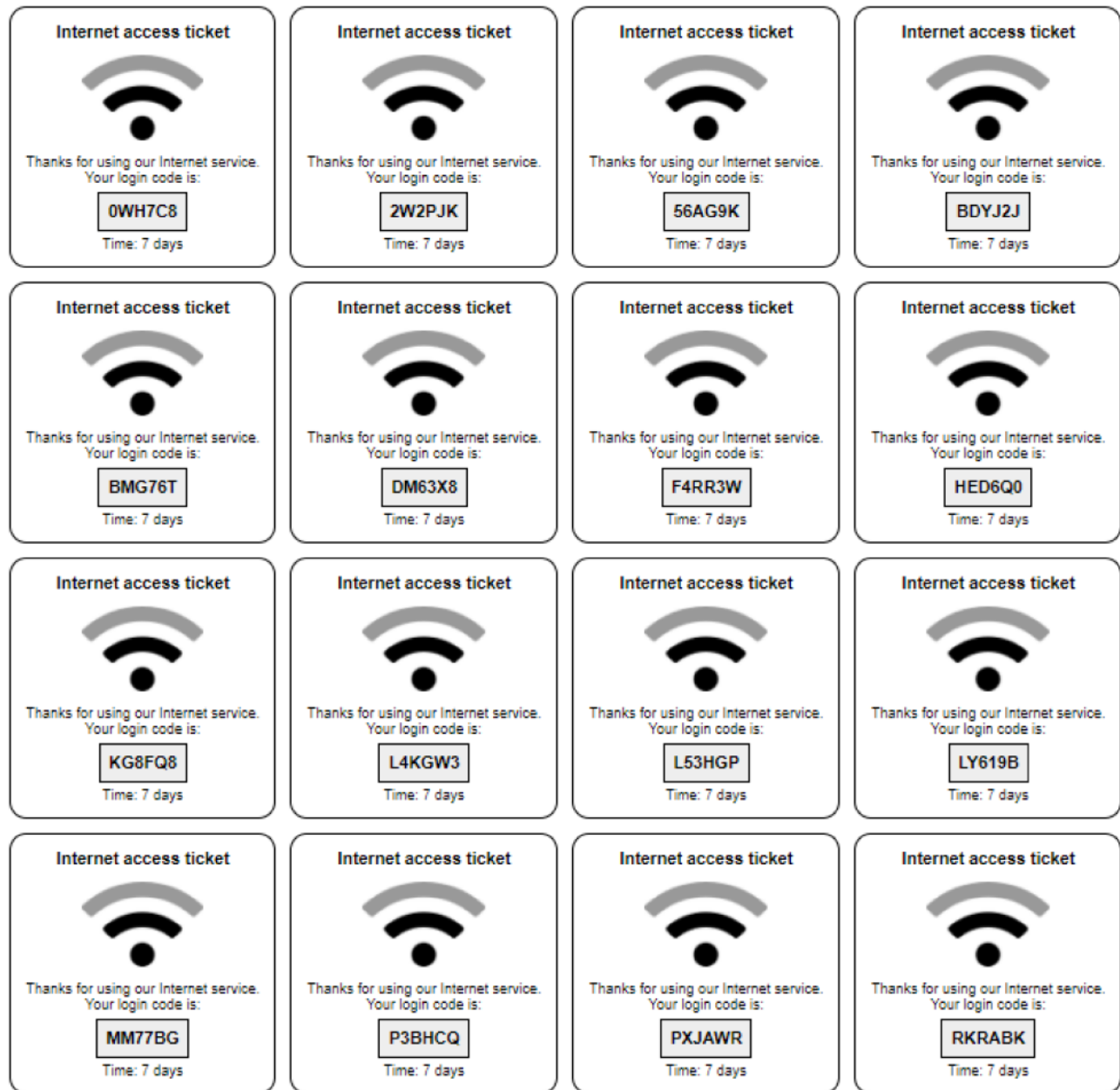
Figure A21. Guest Internet Cloud printed page of vouchers with codes.

The computer print feature is used to send the pages of vouchers to the printer that is attached to the computer.
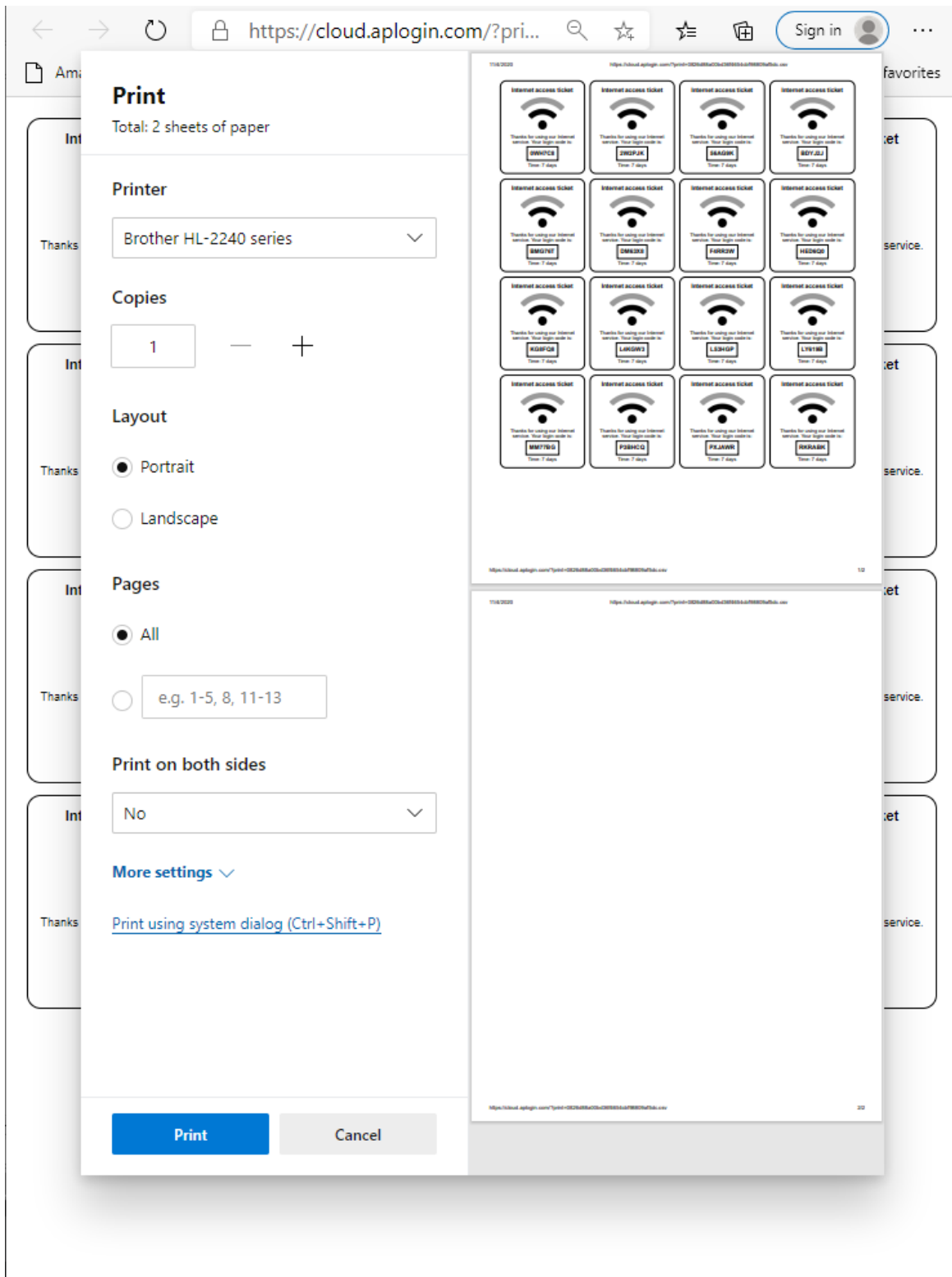
Figure A22. Guest Internet Cloud vouchers printed using the computer.

Alternatively the vouchers can be 'printed' to a PDF file and saved on the computer for printing at a later date.

Figure A23. Guest Internet Cloud vouchers saved as a PDF file.

FIGURES

APPENDIX FIGURES

TABLES

LEARN HOW TO MAKE MONEY BY SELLING INTERNET ACCESS

About the Autor

John D. Barker Ph.D. is a member of the Institute of Electrical and Electronic Engineers (MIEEE) and is a computer network design engineer who has over 40 years of experience in the computer and network industry. The author established one of the first companies to manufacture Ethernet interfaces for PC computers in the early 80's. Later while working for the consulting firm Booz-Allen and Hamilton the author advised both cable TV companies and telecom companies how to transition into the Internet service provider business segment. Following this period the author worked for Compaq Computer and Hewlett-Packard as Director of Network Services, advising Internet Service providers and Wireless Internet Service Providers about the applications of technologies and assisting them with network design projects. In 2005 the author established a company together with partners to develop and manufacture products for both mobile broadband and fixed broadband service providers, and continues with this project to the present date.

The author graduated from Leeds Municipal University, UK, in Electronic Engineering and was awarded M.S. and Ph.D. degrees in Electronic Engineering and Computer Science from Cranfield University, UK.

Contact the author at the email address: john@fire4.com