



Enabling the Next Wave of Connectivity™



**Managing Mixed Use
Applications in Metro-Scale
Wireless Broadband Networks**

INTRODUCTION

Cities worldwide are building affordable metro-scale wireless broadband networks to enhance productivity and mobility, generate business, attract new residents and link the world's most remote areas to the Internet and modern communications. The key here is to provide a method of communication that is a common platform for mixed use such as public safety, public works and public access.

- Corpus Christi, Texas, uses its broadband mesh network to automate water and gas meter reading in a seven-county, 147-mile area. Residents can now view accurate up-to-date usage data online. The network also securely links police, fire, and public works departments and public safety agencies to vital information when they are in the field. Downtown residents and visitors enjoy free broadband Internet access.
- Holland's Port of Amsterdam deployed a broadband network to facilitate internal communications, circulate confidential reports and data, and link patrol vessels to the Internet.
- Bhutan, a tiny kingdom in the Himalayas, has completed a pilot to bring Voice over Internet Protocol (VoIP) communications services to remote rural areas that have none.
- Smaller municipalities like Chaska, Minnesota, outside Minneapolis, have set up wireless broadband mesh networks to implement or broaden broadband services, attract new residents and businesses, and keep people in town for shopping and entertainment. Its city-owned wireless Internet service provider, chaska.net, formed five years ago to bring broadband into schools. Chaska offers low-cost broadband services and mobile access to 7,500 homes and local businesses in an 18-square-mile area. Over the same network, the city plans to provide secure access to police, public works employees, and building inspectors while they are in the field.

DEPLOYING A MIXED-USE WIRELESS MESH NETWORK

Technology advances make it feasible for municipalities to install public/private metro networks like the ones being implemented by Corpus Christi and Chaska. Carrier-class metro-scale broadband mesh network technology cou-

pled with carrier-class software like the Pronto Networks UniFi OSS, enable network managers to cost-effectively deploy and manage large-scale wireless broadband networks. Various user groups can now share the network safely and securely. As an added benefit, new applications and services such as voice can dramatically reduce municipal infrastructure costs.

Short-range, line-of-sight, and peer-to-peer wireless networks have been available for years. However, they often are limited by low bandwidth, line noise, and transmission errors. Low-power wireless mesh networks eliminate those drawbacks. Metro-scale wireless networks add cellular network design elements and intelligent network operating systems to enhance scalability, extend coverage, and optimize performance. Indoor Wi-Fi cells and ruggedized cells mounted outdoors on buildings, telephone, traffic or light poles, form a cloud of linked wireless broadband hot zones over the metro coverage area (Figure 1).

To be economically viable, metro wireless broadband networks need to deliver a wide range of services to users with different security and access requirements. The municipality must be able to:

- Shield highly confidential public safety systems
- Restrict municipal system access to approved personnel so only authorized users can gain entry
- Charge residents, businesses and visitors for network access and services
- Assure each user group its own separate and secure network access
- Provide each group with a custom-tailored portal page, service plan and quality of service level.

BENEFITS OF A PRONTO NETWORKS SOLUTION IN MIXED-USE NETWORKS

Wireless broadband networks are attractive to municipalities looking to attract businesses and enhance worker productivity because they can be installed quickly and at a low cost. Solutions from Pronto Networks streamline deployment, minimize ongoing operations costs and provide an upgrade path for growth.

Municipalities can easily manage subscribers, control access, and bill for services

The Pronto's UniFi OSS is an open, standards-based wireless broadband service delivery platform. The plat-

form handles provisioning, configuration, authentication, access control, security, pre-paid and post-paid billing, and roaming settlement. The Pronto's UniFi OSS is a future-proof platform that evolves with industry standards and applications.

The Pronto Service Gateway (PSG), a 1U access gateway, supports up to 2,000 concurrent users. This gateway authenticates access for public safety and city employees, or whatever groups the municipality designates. The gateway also administers special service plans, splash pages and pricing for residential and business users.

For municipalities that want to offer businesses and merchants individual, custom-tailored hotspots within the citywide hot zone, Pronto offers the Pronto Service Controller (PSC), a highly-integrated access point and gateway in a single plug-and-play device. Located at the venue, the PSC supports up to 100 concurrent users. The PSC can provide street-corner branding and tailored service plans for individual locations.

There is no need for subscribers to change device configurations

Municipal employees, public safety workers, residents, visitors and businesses might use laptops, PDAs and a host of other devices to access the Internet via the wireless network. These devices could have fixed IP addresses, Domain Name Server (DNS) settings, or other network settings. The PSG accommodates these settings automatically, making it simple for people to use the network and its services. For added security, Pronto uses SSL-encrypted registration and authentication. Subscribers who need encrypted access to a corporate

LAN can establish a secure VPN session with a user-name and password.

The network supports enterprise customers

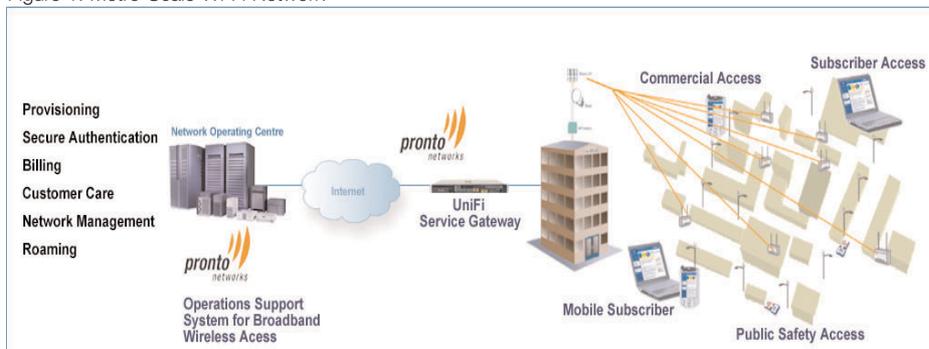
Enterprises may opt to use a public IP address and host their own Web servers within the network. A company does not need to install a T1 line. Instead, it can set up a hot spot and access bandwidth from the hot zone. When the network assigns a public IP address for an enterprise customer, the municipality can create the same remote network management levels and network characteristics that wire line networks provide by using Pronto's quality of service and service level agreements, and Network Address Translation at the PSG.

Network reliability and redundancy are built in

The Pronto solution can be deployed so that the mesh network attaches to the wired network and to the Internet at multiple points. Each PSG connects to the Internet and is considered an Internet Point of Presence (POP). Linking multiple gateways to multiple POPs increases the total amount of bandwidth available to network subscribers. If one of the Internet links fails, the subscriber's service is not affected because the traffic reroutes automatically.

The Pronto's UniFi OSS authenticates users centrally, which makes it extremely efficient to manage and bill customers. Couple this with Pronto's capacity for allowing a network to scale to hundreds of thousands of customers, services can be offered seamlessly as one PSG automatically picks up subscribers who were connected to a failed gateway or Internet link. The net result - higher network availability and lower downtime.

Figure 1: Metro-Scale Wi-Fi Network



This diagram shows Pronto Networks components configured in a metro-scale wireless network.

HOW PRONTO NETWORKS COMPONENTS WORK IN THE NETWORK

The Pronto's UniFi OSS and PSG provide services over a wireless mesh network (Figure 1). The Pronto's UniFi OSS, installed in a Network Operations Center, is the central repository for all subscriber and access-point service branding data. The UniFi OSS also provides billing data, reporting, and integration to other back-office systems.

The gateway manages subscriber services for the wireless network. The gateway also manages traffic for the wide area network (WAN) interface. It also manages quality of service for hot zone subscribers by efficiently managing the available bandwidth at the user level.

Multiple PSGs can be engineered into the wireless network. With numerous WAN interfaces into the hot zone, the municipality can offer additional services and provide subscribers with more network reliability and redundancy.

THE PRONTO PLATFORM'S KEY CAPABILITIES FOR CITYWIDE DEPLOYMENTS

The muni network securely supports a mix of uses and organizations

In Corpus Christi and Chaska, the police and firemen are on their own separate virtual network; city employees are on another; and local businesses, residents and visitors are on yet another. All share the same wireless network infrastructure. The Pronto's UniFi OSS makes it possible for municipalities to securely separate the network and tailor services for each user group.

With the Pronto platform, municipalities can:

- **Assure network security.** The Pronto platform supports VLANs that permit the network to be separated for public and private use. For added security, municipalities can associate these VLANs with multiple service set identifiers (SSIDs).
- **Control network access.** Pronto offers flexibility in handling various access levels for different user groups. It can also set network privileges ranging from simple Internet browsing to corporate VPN access or network administrative rights. (In some of these scenarios, service flexibility will be even greater if a PSC is added to the location.)
 - **City employees** who need instant network access can be authenticated automatically by the MAC address of their laptops or PDAs. Residents and visitors can be permitted access only if they enter a valid username and password.

- **Small and medium businesses** with public IP addresses and their own hot spots can choose to have employees authenticated automatically without requiring a username and password.
- **City and public safety workers in the field** can securely access wide area data networks from anywhere within the hot zone. Pronto supports automatic login methods where the user's credentials are stored on a USB key or Java card. When a Web browser detects these devices, it automatically retrieves the user's credentials, checks them against the central database repository in the UniFi OSS, and grants access to the Internet and other authorized services, such as enterprise applications.
- **Users** can also be authenticated against existing LDAP databases, and depending on the city's existing infrastructure, usernames can also be integrated with systems for single sign-on and portal association.
- The city may elect to offer **free, unauthenticated Internet access** in public areas such as parks, courthouses, libraries, or convention centers. PSC can be configured to permit unfettered access in these areas. Free bandwidth can be limited to the bare minimum to ensure that the network's preferred users have enough.
- **Offer flexible billing options.** Corpus Christi and Chaska provide free wireless broadband services to employees and public safety groups, charge residents a monthly subscription fee and offer visitors a 24-hour pass. Pronto supports subscription plans and pre-paid cards. In Chaska, the Pronto's UniFi OSS seamlessly posts service charges to residents' utility bills, which is convenient for residents and saves the community money.
- **Manage bandwidth.** Pronto does not force municipalities to pre-partition bandwidth. Instead, bandwidth allocation is subscriber-based and part of the service level agreement. Like utilities, municipalities can borrow unused capacity from power users, such as the police, and allocate it to user groups with premium-level access.
- **Provide custom portals.** Pronto's multiple SSIDs sup-

port enables each user group to have its own custom splash page. The municipality can brand the initial splash page and offer users free, unauthenticated access to selected municipal web sites, such as the city council, schools, and water department through walled garden sites.

- **Supply brandable hot spots within the hot zone.** By setting up an access controller with a public IP address, a business can also offer wireless services that fit their business plans. For example, a coffee shop might sell pre-paid Wi-Fi cards that work at all of the shop's in-town locations. This service offering would be available only at the chain of coffee shops, and with proper RF planning, would not conflict with the citywide wireless broadband service.
- **Content Filtering.** Content-sensitive user groups, such as schools, may want to filter some or all Internet content through their own proxy servers, or they may ask the municipality to direct IP traffic to the city's proxy servers. Pronto's UniFi OSS provides the framework to accommodate both scenarios.

Municipalities can easily add valuable services and applications

Pronto's standards-based platform allows municipalities to cut operational costs and generate revenues by offering a wide range of additional services on top of the wireless network. These are just a few examples.

Voice services: Healthcare workers, park service employees, utility workers, or any group the municipality designates can use Wi-Fi handsets to make calls inside the mesh network. The municipality can also offer revenue-generating subscription voice services. The PSC and the PSG enable voice services with service-level guarantees. Service-level agreements, such as minimum upstream and downstream bandwidth allocation, can be defined for each user and assigned when a subscriber purchases a price plan. Handsets register with the network automatically and the subscriber is charged only for VoWLAN or VoIP calls.

Lawful Intercept for CALEA: Pronto's UniFi OSS supports CALEA (Communication Assistance for Law Enforcement Act) using its "in-session intercept" capabilities. This allows the service provider to lawfully intercept subscriber communications and collect information relevant to the sites visited by a user.

Integrated with Context based Advertisements: Pronto UniFi OSS also provides support for service providers to insert context-based advertisements while a subscriber is browsing. This feature displays ads relevant to the webpage requested by the wireless customer at the location. It is enabled by linking the Pronto UniFi OSS solution to an external Ad engine server. The service provider can now select which service plans and users receive these context sensitive ads. Ads can be inserted for free, paid, authenticated or unauthenticated users. This can potentially provide an additional revenue stream for the broadband access service provider, by sharing the ad revenue between third party ad server provider and the wireless service provider.

E-mail and other value-added services: Municipalities can bundle other services, such as e-mail, into the city-wide network with Pronto's Subscriber Application Programming Interfaces (API). The APIs allow subscriber information to be securely shared in real-time between the Pronto's UniFi OSS and other external systems. Users can register for third-party applications and access them through one easy interface and process.

Pronto's UniFi OSS Benefits

- Enhance worker mobility and productivity
- Deliver low-cost Internet services
- Manage subscribers and billing from a central location
- Scale to hundreds of thousands of simultaneous users without service deterioration
- Provide a range of authentication options: automatic, username and password, USB key based
- Offer different price plans for different users
- Carve out revenue-generating hot spots for businesses
- Assure reliable service with built-in redundancy
- Deliver value-added services and applications

Municipalities can generate revenue by wholesaling bandwidth

A large Wi-Fi carrier or Internet service provider can offer its own branded services within the municipality's hot zone. Pronto's support for Virtual Network Operators (VNO) and multiple SSIDs makes several subletting options possible. VNOs can simply buy bandwidth and offer subscribers a custom-tailored splash page. The Pronto system will authenticate the user against the service provider's subscriber database and integrate with the provider's billing system so the subscriber receives a single bill for the service.

THE ROI FOR METRO-SCALE BROADBAND NETWORKS

Cities that have invested in low-cost broadband mesh networks report getting their investments back quickly. They also report enhanced productivity, efficiency and quality of life because municipal employees, public safety workers and residents can access information when and where they need it.

It cost Chaska \$600,000 to construct a mesh network across the city's 16 square miles. Even charging residents just \$15.95 for the service, 60% lower than commercial broadband services, the city expects to have positive cash flow in three years, a year earlier than projected.

In Corpus Christi, where enhancing productivity is the goal, the wireless broadband network automates meter reading. Meters now are read daily, not monthly; cus-

tomers complaints are down; and the city can better manage gas and water demand and its utility fleet. Putting broadband in the field means workers keep working because they don't have to return to the central office to input or look up data. Police with laptop-equipped vehicles gain several hours of street time, as do building inspectors, utility workers and road crews.

Some returns are intangible, such as the benefits Philadelphia, Chaska and other communities large and small expect to gain when they equip everyone, rich or poor, rural or urban, with broadband access to Internet learning tools. A 2003 study of computer projects in low-income areas from Harvard's Joint Center for Housing Studies concluded that Internet access improved education, employment and quality of life for residents in these areas. Philadelphia plans to install 4,000 wireless antennas across the city and charge \$15 to \$25 a month for broadband service and less for low-income users.

CONCLUSION

Pronto Networks UniFi OSS enables municipalities to enhance worker mobility and productivity and deliver low-cost Internet services to citizens. With the Pronto platform, municipalities can easily manage subscribers, assure security, bill for Internet services, and provide content filters. The Pronto service delivery platform also makes it easy to include value-added services such as voice, content and e-mail. Municipalities can sublet the network to other operators to increase revenue and return on investment.



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