Multi-Dwelling Unit Networking White Paper

Innovative, Swift Enablement of Video, Voice, and Data in Multi-Dwelling Units

Executive Brief

Ubiquitous, reliable access to information services such as IPTV, VoIP and data within homes and businesses has never been more sought after than today. Business corporations, large or small, rely, expect, and demand high-speed Internet access and simplified swift deployment for new offices. Multi-dwelling tenants expect convenient access to broadband capabilities in their apartments. It has become a competitive advantage of property management companies to offer these access capabilities without tenant disruption and thereby creating tenant loyalty.

No Building Re-Wiring Required

An ideal solution is based upon the networking technology and products by Corinex. Using the existing electrical or coaxial cable wiring infrastructure throughout the building walls to provide high-speed Internet connectivity. A 600 Mbps backbone to the entire building supports the infrastructure deployment. No laborious, dirty, and disruptive building refurbishing projects are necessary.

Cost-Effective, Fast Deployment

While the deployment of Corinex broadband access products are swift and reliable, the installation will prove cost-effective and will work with any Internet signal entering the multi-dwelling building or brought to the building via the low voltage utility powergrid.

Corinex Anywire™ Connectivity Deployments for:

- Multi-Dwelling Units
  - Hotels
  - Apartment Complexes
  - Condominiums
- Hospitals
- Educational Buildings
- Recreational Facilities
- Military Housing
- Assisted Living Facilities
- Government
- Municipal Facilities (Libraries and Community Assemblies)
- Exhibition and Convention Centers
- Large Vessels
- RV Parks

Benefits

- Triple play capability for users
- Low cost installation
- Speedy, simple installation
- Time to revenue for the building owner
- Competitive advantage for the operator
- Increased building value
- Central manageability
- High scalability
- Creating reliable, secure user access to Broadband beyond wireless hotspot ingress and intermediate RF outage
Building Upgrade without the Construction Effort

Opportunity: Market Numbers

MDU Broadband Market to Double
By 2009

Broadband injected onto the existing electrical wires of a multi-dwelling unit is a maturing, accepted and fast growing technology around the world. This provides consumers with desirable functionalities and services for a vast range of applications including security, entertainment, remote control, energy management, automation, comfort and home office.

The expectation of tenants are rising quickly and defining the requirements for broadband access in multi-dwelling units. In 2004 the US market was defined by five million broadband subscribers. This number will more than double to ten million by the year 2009, says In-Stat, a high-tech market research firm in Scottsdale, AZ. “The market potential for delivering broadband to MDU residents is growing in proportion to single-family home residents (figures only include apartments and condos and do not include college and military housing, and assisted living facilities).”

Solution

This subject matter is no longer a mere question of “If” and “How does it Work?”, but rather “When can I have it?” and “How do I deploy?” and “What are the financial benefits?” to the stakeholders - Tenants and Property Management companies - involved.

Facilitating high-speed Internet connectivity in existing multi-dwelling buildings, has become one of the major challenges and cost factors of property management companies or owner operators of large-scale multi-unit housing around the world. There may be no low cost opportunity to rewire the existing buildings with standard network cables, except for disruptive and expensive building reconstruction. Although expense is not the only consideration, a disruption to the residential or commercial tenants, occupants of term-leased facilities like hotels, health care facilities like hospitals or assisted living facilities, and office buildings can be significant and may result in reduced occupation rates during the refurbishing process. Technology expertise would grant the facilitation of wireless technologies, however the reality shows that wireless solutions are often, “point-solutions”, not providing coverage throughout the desired space in such buildings and also not providing enough security to protect the interests of the occupants.

An ideal solution is based upon the networking technology and products by Corinex Communications Corp. (Corinex), which uses the existing electrical wiring infrastructure (electrical or coaxial) throughout the building walls to provide high-speed Internet connectivity. This solution revolves around the 600 Mbps Corinex MDU Gateway, which provides a backbone to the entire building with little effort and no infrastructure changes by means of introducing laborious, dirty, and disruptive building refurbishing projects. It allows the seamless integration of wireless and hardwired solutions to effectively supply broadband Internet access to all rooms, with no need to rewire the building. The Corinex solution is not bound by the restrictions of pure wireless networking, which has limited range and security features. Therefore, it is the most cost-effective and non-disruptive measure to facilitate the tenant’s request for high-speed Internet access.

The Internet access point can be typically sourced from a fiber or wireless link. In addition, instead of a T1 line, any existing xDSL or cable end-point would be suitable.

How does it work?

200 Mbps Data Rates

The Corinex AV200 Powerline technology, based on the UPA Digital Home Standard standard achieves data rates of up to 200 Mbps and propagates signals throughout an entire MDU, all without the need for pulling new wiring. Linear sustainability of actual network traffic throughput is achieved by the equal bandwidth division amongst the users and types of service. Corinex has mastered the challenge to sustain throughput almost
directionally proportional to users and application load.

**Revolutionary Simplicity**

Deployment of the Gateway is simple and fast, allowing Installers, System Integrators, and End Customers to deploy Internet Access, VoIP, and Streaming Video in every room in an MDU without running cables.

**Market Leading Products and Technology**

Built on the Corinex AV200 Enterprise technology, the MDU Gateway can communicate with other Corinex AV200 Enterprise devices such as the successful Corinex AV200 Enterprise Powerline Ethernet Adapter, Corinex AV200 Enterprise Powerline Wall Mount, Corinex AV200 Enterprise Powerline Router, and the Corinex AV200 Enterprise CableLAN Adapter.

**Corinex AnyWire™ Connectivity**

Deploying an AV200 Powerline network in an MDU is simple and easy – simply connect a single head-end 600 Mbps Corinex MDU Gateway to inject the broadband Internet signal onto the existing building Powerlines and get the connection through every building power receptacle, by using the Corinex AV200 Enterprise Powerline Wall Mount or Corinex AV200 Enterprise Powerline Ethernet Adapter. The same can be achieved by using the coaxial wires of the cable-TV infrastructure and using the Corinex AV200 Enterprise CableLAN Adapter without disturbing the TV signal.

**Wireless Hotspots**

In addition, the Corinex AV200 Router G enables the creation of wireless hotspots where required.

Once the building’s power network is connected to broadband, it can be managed like any other IP network. The entire network can be managed from one central site by using standard SNMP enterprise management software (e.g. HP OpenView).

**Access Throughout the Building**

The MDU Gateway is able to process signals so that even the most distant electrical or coaxial outlets will be able to serve as broadband connection access points, in contrast to WiFi installations where connectivity is limited.

**Technology**

The Corinex MDU Gateway creates an IP network throughout any type of building and enables the outside Internet signal to be connected to the electrical wiring or coaxial building wiring to provide three 200 Mbps connections for up to 96 total end users (per Gateway) in a building structure. The broadband building access solution is highly scalable by simply adding more Corinex MDU Gateways to provide service to additional end-users.

**Description Details**

- 3 x 200 Mbps Connectivity
- Simultaneous Powerline and Coax Operation
- Range - up to 1200m (4,000’) Coax
- Range - up to 600m (2,000’) Powerline
- Supports Video, VoIP and Data
- 802.1q VLAN and Optimized VLANs
- Programmable Bandwidth Allocation
- Frequency Notching
- QoS, 8 Levels of Queuing (802.1p)
- 168-bit 3DES Encryption

In a Powerline-based network, a head-end unit, preferably located close to the main electrical distribution board, controls the entire network. Access to the backhaul network (through the head-end) is provided via DSL, cable or fiber installations, these connect directly to the head-end via Ethernet. Powerline modems such as the **Corinex AV200 Enterprise Powerline Ethernet Adapter** or **Corinex AV200 Enterprise Powerline Wall Mount**, available in all apartments that require networking, will connect automatically to the head-end as soon as they are plugged into a power outlet. Each device also known as a CPE (Customer Premises Equipment) has an Ethernet interface for easy connectivity to any type of IP-addressable user equipment. Alternatively, in a Coaxial-based network, the **Corinex AV200 Enterprise CableLAN** is connected to the coaxial terminals within each apartment, and the MDU is connected to the main coaxial feed to the building.

Each MDU Gateway has three head-end modules. This modular design makes it easier to deploy any type of MDU installation, from simple networks to more complex networks. Every apartment can be connected for Video, VoIP telephony services, data, Gaming, or other services.

The MDU Gateway has three coaxial interfaces and three Powerline interfaces. If coaxial cable is available in the building, the customer may connect to the coaxial interface on the back of the MDU Gateway and use it as the backbone in the building.

If coax is not available in the building, one can use Powerline as the backbone. Each Powerline interface can be dedicated to a single electric phase. All three modules may be used to feed a three-phase building, conversely only two modules may be used to distribute the signal, while the third module is used to repeat the signal to a second MDU Gateway for reasons of scalability and to address a larger number of devices or users. Alternatively the three modules on the MDU Gateway can be fed to individual electric power meters in a building (located in the meter room within the building) for buildings where each apartment/flat have their own power meters.
Selected Deployment Types

Because of the product versatility, the following description of deployment types are a per-case scenario and do not represent all possible installation instances.

**Single Power Meter – Signal Injection on 3 phase Power**

Each of the three modules of the Corinex MDU Gateway is serving one of the three building’s electrical power phases. In each of the apartments/flats served there is a Corinex AV200 CPE (Customer Premises Equipment) product which is plugged into a power outlet. The three frequency bands (modes) serve 32 users per phase for a total of 96 users per Corinex MDU Gateway. The main power meter of the building is bypassed. In this scenario the MDU Gateway signal cables plug directly into wall outlets and an electrician is not required if each phase has an electrical outlet available.

**Multiple Power Meters – Signal Injection on multiple individual Powerlines**

In this deployment the complete frequency spectrum 2-34 MHz (2-30MHz in Europe) of the Corinex MDU Gateway is being used by each of the three module interfaces. Each module provides a 200 Mbps connection which is input into the Corinex 11+1 Phase Coupler. The coupler has a coaxial input, and provides 11 Powerline outputs which bypass the individual meters of an apartment building to inject the PLC signal. In this scenario the output of the phase coupler connects directly to individual electric lines and will require the use of a qualified electrician.
Corinex 11+1 Phase Coupler (CXZ-CXP-PH12)

**Single Power Meter, Coaxial backbone, Multiple Electrical Subpanels – Signal Injection via Coax and Powerline (32 users per floor)**

This scenario distributes the broadband signal along the coaxial line from floor to floor. Each MDU Gateway injects the signal onto each floor via the floors Powerlines at the electrical subpanel. The complete frequency band on the gateway’s backbone is provided to a maximum of 32 users. No electrician is required for the installation as typically an electrical outlet is free and the Gateway can simply be plugged into the outlet, thus saving deployment costs. The advantage of this installation is that each logical group of users (one floor) can be served, while the broadband signal is being extended from floor to floor thus providing increased throughput and expansion capability. In this scenario one MDU Gateway is used as a head-end (not shown in diagram) and injects the signal on the Coaxial backbone. The signal is compatible with Cable-TV signals as Cable-TV signals operate above 50MHz and the MDU Gateway operates below 34MHz.

**Single Power Meter, Coaxial backbone, Multiple Electrical Subpanels – Signal Injection via Coax and Powerline (64 users per floor)**

This scenario is similar to the previous, however, a second output module of the Corinex MDU Gateway is used and the available frequency band of the 600 Mbps backbone is segmented to address an additional 32 users to a maximum of 64 users per floor/gateway. In this scenario different frequency modes are alternated between floors to maximize the physical separation of repeating frequencies.

**Pure Coaxial Networking (32 users per floor)**

The following two scenarios describe the coaxial cable networking capabilities of the Corinex MDU Gateway, without the use of Powerlines at all, thus proving its versatility for any type of Multi-Dwelling broadband requirement.
The MDU Gateway acts as a head-end in this scenario. The three output modules of the Corinex MDU Gateway are combined with a 3-way RF splitter and then injected onto the coaxial cabling. In this scenario each module is operating on one of three frequency bands and each floor will receive one of the frequency bands and block the others (via the Corinex Mode Filters). There is a maximum of 32 users per floor to a maximum of 96 users per Gateway over 3 floors. For buildings with more than 3 floors, additional MDU Gateways can be added and the topology above repeated, the only additional requirement being adding an Ethernet cable to the additional MDU Gateway. The Corinex AV200 Enterprise CableLAN Adapter is installed in each room.

Such a deployment coexists with the current TV cable signal. This is a perfect scenario for hotels or long-term care facilities or hospitals.

**Pure Coaxial Networking (64 users per floor)**

The following scenario is almost identical to the Pure Coaxial Networking example above. In this case we can deliver service to 64 users per floor.

**Powerline Phase Coupling**

Corinex has developed various equipment and techniques to achieve Powerline phase coupling which is a common requirement in real-world MDU deployments.

Phase coupling is required to transfer the Powerline signal generated from the MDU Gateway modules on one phase of power to the remaining one or two phases of multiple phase electric power in buildings. Corinex Powerline Coupling only couples signals between phases within the 2-34MHz frequency band, this maintains the isolation of electrical power on each phase, thereby avoiding trickle-through of line voltages.

Phase Couplers are necessary in environments where there are more than one single-phase for residential wiring. The use of phase couplers is to ensure complete network connectivity throughout the electrical distribution system, thus ensuring every outlet in the MDU is available for Powerline communications.

Phase-couplers are easy to use and inexpensive. They should be mounted close to the electrical main breaker panel with as short as possible wiring runs to avoid RF interference. In all cases the electrician can either wire free-standing power cables into empty slots on each phase of the main breaker panel or proceed further and provide standard power receptacles connected to the different phases of the main breaker.
In either case the Corinex equipment is conveniently installed for signal coupling. There are three main methods of coupling the PLC signal: coaxial-to-Powerline coupling, capacitive coupling and inductive coupling.

For more information on Signal Coupling and detailed instructions please refer to the Corinex OC600 Quick Start Guide – Advanced Installation Procedure or the Professional MDU Networking Installation and Users Guide, both available from Corinex.

**Coaxial-to-Powerline Coupling**

In this method of coupling the Corinex Powerline-to-Coax Coupler is used.

*Corinex Powerline-to-Coax Coupler (CXZ-CPX-CXC)*

This coupler is able to change the transmission medium from Powerline to coaxial cable and vice-versa. It passes the high frequency Powerline signal while isolating the line voltage of the Powerline from the coaxial interface, thereby offering a safe method of signal coupling. This is of great benefit to MDU installations where a hybrid network using existing coaxial and Powerline cables can be used.

The coaxial output of one of the MDU modules can be coupled to each of the 3 phases of the Powerline as shown in the following diagram.

The coaxial output of the MDU module is connected to a 3-way coaxial splitter which will feed the 3 Corinex couplers. These couplers will then be connected via standard power cables to the 3 outlets from the distribution panel.

**Capacitive Coupling**

In this method of coupling the Corinex 11+1 Phase Coupler, that was introduced earlier for bypassing meters, is used to couple phases. The modularity of its design enables it to be used for Phase coupling as shown below.

The coaxial output of the MDU module is connected to the input of the 11+1 coupler. Three Powerline outputs on the coupler are connected via standard power cables to the 3 phase electrical outlets installed by the electrician, or directly to the distribution panel.

**Inductive Coupling**

In this innovative method of coupling, special Corinex ferrites and cables are used, as shown in the following diagram.
The Powerline output of the MDU module is connected to the Corinex Powerline Signal Coupling Cable. This cable is then connected to three Corinex Powerline Signal Loop cables by using Corinex ferrites to attach the wires together. This method of coupling can be used as an alternative to the previous two methods.

**Powerline Noise and Treatment**

The power supplies of some home appliances (especially those with a built-in coil or transformer) such as hair dryers and vacuum cleaners, can generate excessive high frequency noise. These unwanted electrical signals can pass through their input power connections into the electrical lines. Computers, modems and especially Powerline communications connected to these same electrical lines, may pick up this noise, which can disrupt the Powerline communications or make them completely unintelligible.

![Corinex Powerline Noise Filter](CXF-CXP-200)

Corinex' new **Powerline Noise Filter** is carefully designed to eliminate and block all noisy signals from entering the electrical line grid. The Powerline Noise Filter from Corinex blocks high frequency noise without affecting the frequency or level of the Powerline signal on the electrical lines. The Powerline Noise Filter helps increase the performance of any Powerline network experiencing noise issues.

**Security Considerations**

OVLAN technology is a revolutionary approach for the delivery of Ethernet based services. Optimized Virtual LAN technology allows the simple creation of secure, isolated network segments. All Corinex Access products including the Corinex MDU Gateway support the capability to include both 802.1q VLAN tagging and separate OVLAN tagging in the same packet.

This mechanism allows the end user networks to be isolated, while also separating the traffic flows. In many big deployments such as hotel deployments, VLAN tagging is used to differentiate Data, Voice, or Video traffic. Multiple CPEs should be placed on the same VLAN to receive the traffic from one router. If multiple users are placed on the same VLAN, then they would be able to see each other. User isolation is one of the major requirements in Hotel and apartment building deployments.

The Corinex MDU Gateway can isolate the users on the same VLAN by using OVLAN tagging. Therefore the user on the network can’t get access to the other users’ computers. This is a critical requirement of any MDU deployment.

**Operational Frequencies**

The Corinex suite of products allows communication by means of selecting the frequency bandwidth and location. In this way, 3 predefined frequency operational modes (Mode 1, Mode 2, and Mode 3) are possible and are dependent on the desired bandwidth of the signal injected onto the Powerline, whose spectral location is fully programmable between 2 and 34MHz (or 30 MHz in Europe).

At the network designer’s discretion the use of frequency notching can be programmed to avoid signal interference between the Corinex MDU Gateway and other devices that may work within
the same frequency band such as amateur radio operators (HAMs).

The ability of using various communication modes and frequency notching makes the **Corinex AV200 MDU Gateway** a perfect solution for even the most challenging Powerline circuits. The **Corinex AV200 MDU Gateway** can be integrated and used in large-scale, complex applications to support the challenges that network designers face in the field.

The **Corinex AV200 MDU Gateway** can be configured to tolerate 40 individual frequency notches per device and specified by Start/Stop frequencies and Attenuation levels. The software configuration can be handled via a telnet console or Corinex’ very own Customized Frequency Notching Application software.

**Application and Deployment**

To ensure rapid deployment, a DHCP server on a router or PC can be attached to the Corinex MDU Gateway to be able to assign IP addresses to end user CPEs automatically. Therefore, building a network with the Corinex MDU Gateway will be more convenient and less error prone.

Another advantage of the Corinex MDU Gateway is its ability to be set as a master (server), slave (client), or repeater. Thus, it can be integrated in many complex applications as part of the backbone or the head-end unit.

The QoS options for the Corinex MDU Gateway solution supports quality of service in three different forms

- 802.1p
- ToS (type of service)
- custom QoS

allowing an integrator to define various priorities of network traffic.

**Site Considerations**

As part of the planning for an MDU deployment or reconfiguration to access Internet broadband capability, a number of considerations need to be assessed. The following is a concise list of questions to be addressed:

- Single or individual power meters
- Subpanel locations and availability
- Availability of electrical diagrams to increase speed of planning and deployment phase
- Availability and termination of ISP feed
- Addition of network segments required to cover wireless dead zones
- Number of VLANS or User groups that are to be configured
- QoS requirements
- What are the logical/physical security considerations

**Conclusion**

Corinex’ complete line of MDU networking equipment provides the tools for deploying a simple, fast and reliable solution to meeting the increasing demands for complete broadband connectivity within buildings. The ability to provide broadband over existing Powerlines and coaxial cables presents an efficient and complete solution in networking a building without the costly and laborious task of modifying the existing wiring infrastructure.

**About Corinex**

Corinex AnyWire™ Connectivity solutions distribute 200Mbps IP signals on electrical wiring and coaxial cables, in buildings, homes, and over electrical power grids. Corinex customers include Amperion, Belgacom, Best Buy, Damovo, Designed Telecommunications, IBM, Sojitz, Telefónica, Teleste, as well as several other national tier one service providers and numerous OEM customers who use Corinex’s broad product portfolio to compliment their solutions. Distributors of Corinex products include multi billion dollar companies Sonepar, Rexel, Graybar, Wynit, and Ingram Micro.
Office Connect 600

Pre-configured 200 Mbps Solution for office networking

Corinex Communications, the largest Powerline and Coaxial networking company in the world, brings you the all in one office networking kit, the Corinex Office Connect 600. The Office Connect 600 Kit eliminates the need to wire your office with expensive category-5/6 Ethernet cabling, and let’s you get your office up and running in about an hour. The Corinex Office connect 600 is the only “Plug and Work” solution available in the industry.

Creating the network is as simple as plugging the master unit into an internet router (or other Internet modem) and powering it up. Users are added to the network by plugging an adapter into a standard electrical outlet at a workstation and then connecting to a computer or VoIP box. This is repeated for up to 10 or 20 workstations. There is no software to load or configure! Advanced configurations allow for up to 96 workstations on the network.

This kit contains all the parts necessary to create a 10 or 20 user high speed, secure network. Security is never a concern as 168-bit 3DES encryption and password protection is used to safeguard your companies’ valuable information.

Moving the office? No problem, simply unplug the adapters and master unit and move them to the new location, in about an hour the new location will be connected and your company is ready to work!

The Corinex Office Connect 600 can also be easily configured using SNMP for advanced management options like setting VLAN’S. From monitoring and configuring to remotely accessing and controlling devices, Corinex’s powerful software gives network managers control of the network from any web enabled PC.

Product Package Contents:

Product Code: CXP-OC600-10
10 user networking package:

(1) MDU Gateway
(10) AV200 Powerline Ethernet Adapters
(3) USB cables
(1) MDU Gateway power cord
(11) RJ45 Ethernet cables
(3) Powerline signal coupling cables
(3) Powerline to Coax couplers
(1) 11+1 coupler
(1) Powerline signal coupling cable B
(3) Powerline signal loop cable
(4) 1m coax cables
(6) Inductive couplers
(1) RF splitter

Product Code: CXP-OC600-20
20 user networking package:
Package contents the same as CXP-OC600-10 but with (20) AV200 Powerline Ethernet adapters instead of (10)