White Paper

Deploying Heterogeneous Networks

Almost all networks are heterogeneous by definition, so why don't all wireless service providers integrate and manage between them…because it's hard to do.

Summary

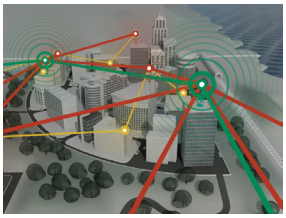
Most components of telecommunications networks are constructed of various types of wired and wireless architectures. The major components are: 1) the backhaul or the central transport between other networks or the internet; 2) core networks that handle high volume aggregated transmissions between the network and the **backhaul**; 3) distribution networks that extend the line of sight (LoS) **coverage** area of the core network and 4) local networks that interface directly with the **end users**.

Based on the network components described above, the wireless network architecture is chosen to maximize spectral and cost efficiency to serve the specific needs of the users of each network. To do this, most networks have three types of architectures: 1) Hierarchical – which are ideal for targeted coverage areas in challenging or rapidly changing environments; 2) Mesh – which is ideal for street level coverage of wide coverage areas including mobile users; and 3) Hybrid – which connect hierarchical IP based networks to wireless mesh networks. Each type of architecture is optimized to perform its function. Each node in the network makes forwarding decisions based on its knowledge of the architecture. Integrating the architectures to work seamlessly together and managing their efficient, reliable and robust operation is challenging. When selecting a network service provider, it is important to choose a provider that has a platform that is agnostic and rigorous enough to handle the diverse needs of each architecture.

Heterogeneous Network Challenges

Hierarchical architectures apply a top down approach to managing nodes in the network. Each node is static, or fixed, and has its own IP address. Nodes, or routers, in a hierarchical architected network are not aware of nodes that they are not connected to. In the wired environment, this is very similar to plugging your computer into an Ethernet connection. Your computer, the client, sends to the server its MAC address and vice versa. They now know where each resides and begin communicating.

Example 1
Xiocom Hierarchical Network

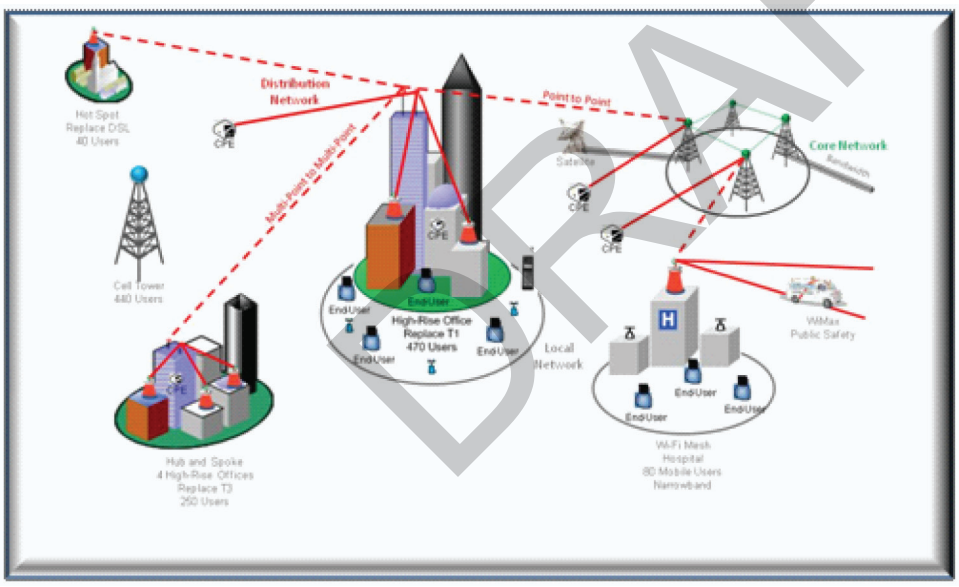


- Ideal for targeted coverage areas
- Applications include: replacement for dedicated DSL or T1 services
- Easy to resize/reconfigure
- Works well in rapidly challenging environments

Wireless networks use hybrid architectures to create specialized deployments focused on the needs of network users. Whether it is street level coverage, fixed mobile convergence or CPE connectivity that is required, many challenges exist in integrating these architectures into one seamless flow of voice, data and media.

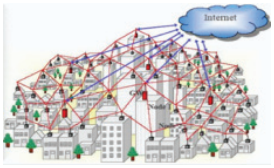
In wireless network architectures, the process is very similar for point-to-point networks. There is only one gateway and everything that needs to communicate on the network flows through that gateway. The server and the gateway trade MAC addresses and begin sending data. The network looks like a simple subnet of the hierarchical network.

In large wireless hybrid networks, multi-gateway paths are provided to increase routing speeds. Nodes in the network can self-direct transmissions to get to the closest gateway. This, in turn, reduces the load on any one gateway. Each gateway has its own IP address, but the connection between the mesh network and the hierarchical network has only one IP address. The mobility of users within the network may also require node movements and access to more than one gateway. This makes IP address allocation required to re-connect with an end-user increasingly difficult. But it is required to maintain global connectivity.



- Ideal fo bridging indoor, outdoor and mobility networks
- Applications include: mobile/transient users, public safety, video surveillance, rural, suburban, etc
- Highly complex, robust and reliable
- Covers efficiently (only where needed)

Example 2
Xiocom Mesh Network



- Ideal for street-level coverage
- Applications include: mobile/transient users, public safety, video surveillance, etc.
- Simpler to plan and deploy
- Covers ALL areas evenly

Wireless hybrid networks present special challenges in design and implementation. The hand-offs between networks that allow servers to continuously find end-users and maintain connectivity is complex and challenging to execute. This makes deploying thecorrect architecture for the given topology, best of breed technologies and end-user needs necessary to produce the optimal network design. So, finding a provider that is up to the challenge is essential.

Even more complex are situations where end-users move across multiple networks. When an end-user moves from network to network and changes its IP address, the connection is broken and the session is lost.

In each of these scenarios, the goal of the network designer is to focus first on the support of global IP connectivity. However, to meet the needs of the end-users of the network, we must also find solutions for 1) the topological correctness of an IP address; 2) support of networks with multiple gateways; 3) support of mobility within and between networks; and 4) open transports for hand-offs between heterogeneous networks.

Hybrid Architecture Design and Deployment

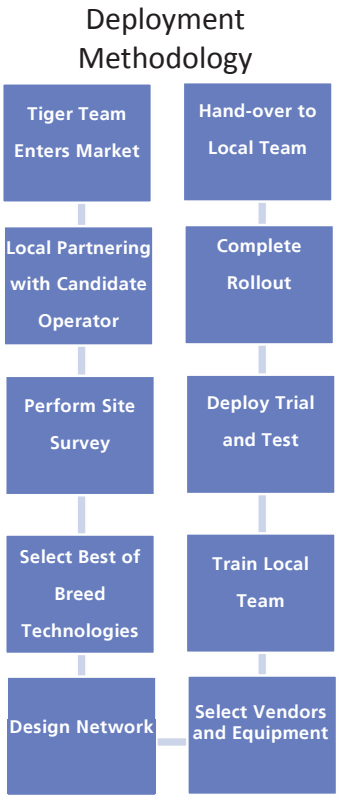
Designers of hybrid networks require expertise in creating "smart" address assignments for each node that is unique and fundamentally stateless. While this works within any given network, address assignments between networks require a centralized management scheme to avoid duplication. This can also be solved, in some situations, by creating a dual address protocol for mobile nodes. One address is the home IP address while the other is a roaming, or agent, address that is unique to the visited network.

This allows network designers to tackle the needs of end-users whose connectivity is mission-critical like public safety officials and business people. Moving from indoor to outdoor environments and travelling between wireless mesh to hierarchical to cellular networks is common. Each situation is unique and must be rigorously tested to ensure that connectivity can be maintained in the specific terrain and conditions of the deployment site.

Management of Hybrid Networks

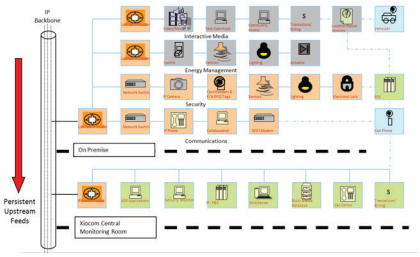
Wireless hybrid networks can be managed centrally or decentralized depending on the needs of the network.

Typically, high volume transactions, communication dependencies or high-levels of security require central monitoring and management. This capability can also be used to optimize the network on a real-time basis and identify expansion or refinement opportunities.



Rigorous design and deployment methodologies result in successful networks. The steps include extensive trials and testing plus the training of the local management team who will operate the deployed network.

Decentralization provides an inexpensive solution that is just as reliable. At a minimum, portals used to manage hybrid networks include: 1) Real-time Monitoring of nodes on a geographical map; 2) a Configuration Tool for the network routers; 3) Hot Zone provisioning, billing and monitoring; 4) User Account provisioning, tracking, billing and support; 5) Payment Processing using a standard CIM interface; and, 6) Reporting on revenue, activity and security breaches by network and end-user.



Connected leading edge users on wireless networks are constantly developing new applications to meet their needs. Many of these applications support more efficient uses of resources and people. Ultimately these solutions provide a foundation for "green" initiatives in better power management and conservation. The combination of low powered narrowband sensors and controls with broadband networks can provide new insights into urban patterns.

Applications

Once a wireless network is deployed, the number of –opportunities for broadband and narrowband applications is limitless. Today, applications that are in use include:

- **Government, Metro and Municipal Services:**

Wireless networks offer flexible, fast access for police, surveillance, ambulance, rescue, medical and other essential and community services. Narrowband applications include power, water and lighting management, security, location based services, traffic management, video surveillance and metering.

- **Business Services:**

Numerous mobile applications to enable telecommuting, instant messaging, email, VoIP, thin client office systems, security, , business continuity, crisis management and more.

- **Residential Services:**

Along with voice, data and media applications, solutions include remote operation of environment, lighting, security, access control, mobility, home to auto synchronizing, pet minding and more.

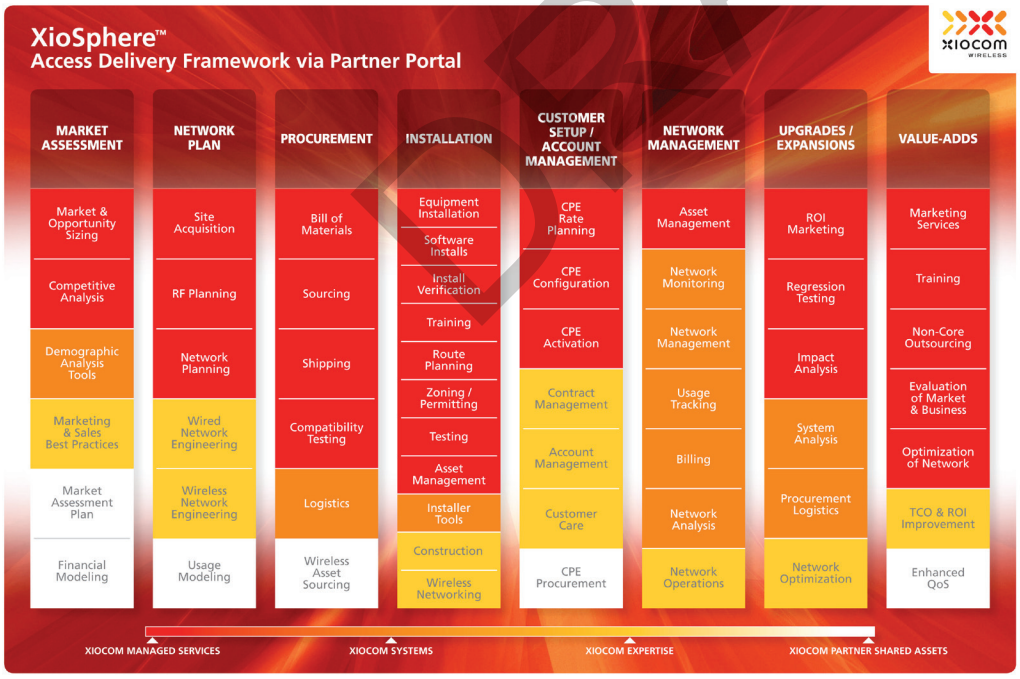
When searching for the provider that can meet these needs consider Xiocom Wireless. Xiocom's successful, market-tested experience in deploying the right architecture to produce large, hybrid networks for specialized deployments focused on the needs of network users provides the certainty operators require in choosing a partner.

Along with expertise in creating "smart" address assignments for each node, Xiocom's design and deployment methodologies meet the most demanding needs of network operators today. Xiocom-built wireless broadband networks are not only effective but, with spectrum independence and open standards, cost efficient as well.

Having met the challenges of integrating multiple architectures into one seamless flow of voice, data and media utilizing Xiocom's rigorous and agnostic platform, the XioSphere™ Xiocom stands ready to provide the same services and the revenue opportunities that they bring to network operators in developing markets throughout the world.

Xiocom's best of breed technologies and best practices provide the standard of service required by all types of users including Governments, Municipalities, Businesses and Residential subscribers.

Our fully tailored wireless access solution allows operators to optimize existing skills, infrastructure, and resources. Through our Rapid Launch Program, we're able to deliver fully operational and managed networks at a pace unheard of in the industry. What's more, it's all integrated into a single, simplified business solution. We handle everything from design through deployment and offer a complete web-based management solution for maintenance and automated end-user provisioning, billing, and monitoring ensure success.



Why Build a Partnership with Xiocom Wireless?

- We have a partner first mentality
- We enable our partner's business model
- We provide turnkey wireless network services
- We simplify the wireless experience
- We are cost effective
- We are global