Emerging Wireless Technologies for Local Loop Broadband

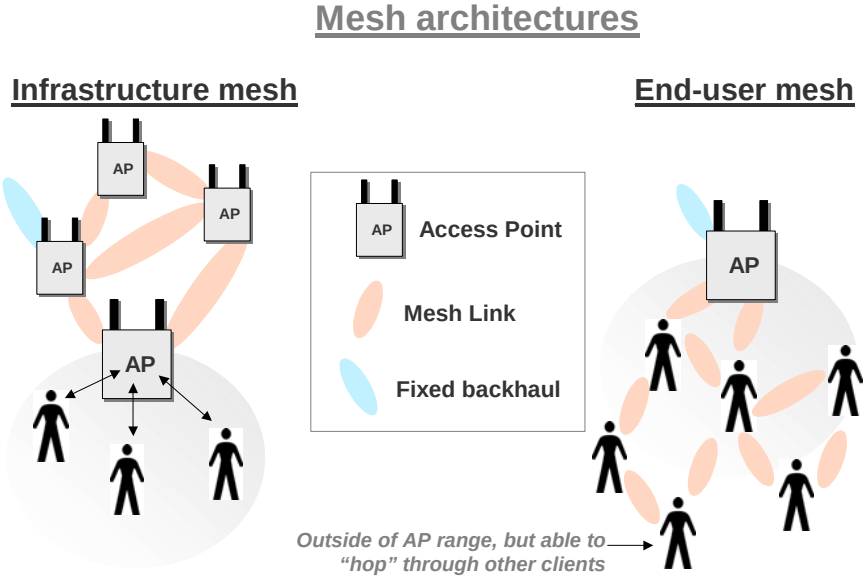
Part 2 – Wireless Mesh Architectures

Wireless mesh architectures constitute a different approach to wireless networks holding a variety of value propositions including new, potentially disruptive functionalities. But how valuable are these self-forming, self-organizing networks really for service providers?

The market segments

The market can be differentiated by the extent of the mesh architecture. The majority of solutions are currently **infrastructure mesh** systems: Clients connect normally (and independent of other clients) to a wireless access point. The access points themselves are interconnected with each other, forming a mesh.
These solutions are targeted at providing fixed, nomadic or even mobile broadband connectivity for areas larger than just one Hot Spot. The scenarios mostly applied are internet access in downtown areas - often coupled with network access for city servants – and broadband access in uncompetitive, Digital Divide cities.

A more sophisticated approach is to enable a **mesh of the end-users** themselves: In this case clients can form instant networks, with or without the presence of an access point. Clients can connect by "hopping through" other clients. These solutions are targeted at the security and rescue segment but also at public transportation and furthermore at industrial sensor networks (which we will not consider in this edition).



The majority of broadband access projects is driven by municipal initiatives. Activities have also increased in the framework of the US homeland security initiatives both on infrastructure and end-user level.

A different area of activities is related to the enterprise / industrial sector. Here mesh solutions enable connectivity, where fixed backhaul to each access point would be cost prohibitive or the installation would disturb ongoing operations (examples include Hotels, conference/trade show locations, airport estates).

Some relevant deployments to continue watching		
Project	**Technology**	**Scope**
Garland City (USA) 221,000 residents	Motorola (MeshNetworks)	Goal: over 57 square miles coverage (900 access points) for police, fire and medical emergency teams. One of the largest mobile mesh deployments.
Philadelphia (USA) 1,517,550 residents	Tropos (in the initial pilot)	Trial succeeded & will be extended to the city for businesses and residents connections. Goal: 135 square miles to be covered; about 1,500 nodes
Taipei's Mobile City (Taiwan) 2,mn residents	Nortel	Goal: 10,000 access points to be installed across 90% of Tapei's 272 square kilometers

Evaluation of Value Proposition

The question arises, how strong the value of wireless mesh systems is from the perspective of the service provider, who is considering wireless mesh as local loop platform. One argument in favor sees WiFi-mesh as link between cellular networks and isolated hotspots: Cellular networks offer ubiquitous coverage but lack bandwidth. Hotspots have significant bandwidth but lack the range. A WiFi-Mesh could therefore enable easier high-speed coverage within an extended area of a city today; something that could not be done with e.g. WiMAX or UMTS at the moment.

The speed of current solutions is not tremendously high though. Depending on the number of users accessing the same access point and the overall traffic load of the network data rates might be around 1Mbps. The commercial operations largely offer broadband speeds of this (low) level. Due to technical issues, which are debated quite heatedly, the number of "hops" in a mesh reduces the available bandwidth. Accordingly only a few hops, e.g. three to four appear feasible. This means that compared to ADSL (2+) WiFi-Mesh is not a solution to compete on speed and will not replace or endanger existing DSL operators. But it can be a complement in environments without solid broadband access.

Standardization efforts are currently focused on the IEEE802.11s group but ratification is not expected before 2006. Service providers will

have to wait at least another 2 years for the arrival of standards-based solutions, since all mesh players are offering a proprietary system. Furthermore the cost of mesh hardware is still expensive, depending on the configuration and system (~500-10.000 per access point).

Selection of Vendors to keep track of	
BelAir: www.belairnetworks.com	Motorola: www.motorola.com
Firetide: www.firetide.com	Nortel: www.nortelnetworks.com
Hopling: www.hopling.com	RoamAD: www.roamad.com
LocustWorld: www.locustworld.com	Strix Systems: www.strixsystems.com
Mesh Hopper: www.meshhopper.com	Tropos: www.tropos.com

Conclusion

Mesh architectures excel in temporary installations where it would not be suitable to deploy wiring, including networks for disaster areas. Furthermore enterprise / industrial IT-applications exhibit a variety of scenarios where a mesh solution can be cost-effective. In any case a certain amount of scale is required to justify the investment into the intelligent mesh routers in favor of deploying wires.

Wide-area mesh deployments can be an enabler for nomadic broadband access. Yet they have only emerged in the context of municipality-driven initiatives to combine connectivity for civil servants including law enforcement with public broadband access.

This indicates that large WiFi-networks continue to run into the same problems of business model definition as the individual WiFi Hot Spots. Those had encountered an underutilization and reluctance to embrace paid nomadic usage.

As demonstrated by the existing deployments there are two basic environments for broadband access through a wide area WiFi-mesh:

The first one is a complement of a public broadband strategy (primarily to modernize security & rescue services and provide nomadic/mobile access for city workers). It appears that in these cases the core value of the mesh is municipal applications. Broadband services to residential and business users are more of an add-on exploitation (exceptions exist).

The second environment is a Digital Divide area without existing broadband access. Mesh can be an alternative local loop access platform without competition (as demonstrated in numerous deployments).
Here it can also fit into existing national / regional development schemes as demonstrated e.g. by Smart Telecom's deployment in Cork, Ireland, utilizing the new MAN structures set up by the government.

Outlook

Market trends indicate a switch to multiple radios per access point, which leads to higher available bandwidth and performance, but also to higher price. On the other hand BelAir, one of the key promoters of multi-radio solutions, has introduced a single-radio solution to round up its portfolio for low bandwidth requirements. In the future it is expected to see increased use of 802.11a/g, making use of higher data rates in both the infrastructure and end-user connection.

Mesh networks have a strong appeal to municipal broadband development strategies, where partnerships between operator and city lead to mutual benefits.

The mesh topology has an inherent disruptive character that has largely not been unleashed yet. It lies in the meshing of end-users which has not found its way to main-stream applications. It could in fact revolutionize the way we interact with networks.♦

Part 1 of *Emerging Wireless Technologies for Local Loop Broadband* is available for download from www.bmp-tc.com

About bmp Telecommunications Consultants:

bmp TC is a strategic consultancy in the field of telecommunications with a focus on central issues related to business models based on broadband platforms such as DSL, Wireless, Fiber or Powerline Communications and related areas. The longstanding experience & a wide-ranging industry view enables to create and launch new services for the market and support the implementation and introduction of unique and sound business models.

bmp TC provides support for market entry, strategy development, business model definition, positioning, forming of strategic partnerships, technology assessment and trial and other related strategic issues. Its clients are international telecom players including

- **Network operators / Service Providers / Utilities**
- **Equipment suppliers / System Integrators / Enablers**
- **Institutions / Governmental Authorities and others**

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