

BreezeCOM and Floware unite



## Mobile Telephony Base Station Feeding Using Wireless Point-to-multipoint Technology



## Introduction

Mobile telephony networks require connectivity solutions to support the link between base stations and the Mobile Switching Center (MSC). In this paper, we discuss traditional base station feeding solutions, including leased lines and private wire-line links and point-to-point wireless, and explain the function, advantages and drawbacks of each. We then introduce a highly attractive alternative to these options - point-to-multipoint wireless, and detail the design and benefits of this solution.

## Traditional Base Station Feeding Solutions

In a GSM network, each base station (also known as Base Transceiver Station —BTS) must be connected to a Base Station Controller (BSC). The BSC controls and manages a number of base stations and aggregates the traffic to the MSC. Mobile operators typically use one of several approaches for carrying voice and data traffic from cellular base stations to the Base Station Controller:

- Leased lines
- Privately owned wire-line links
- Point-to-point microwave links

### Leased Lines

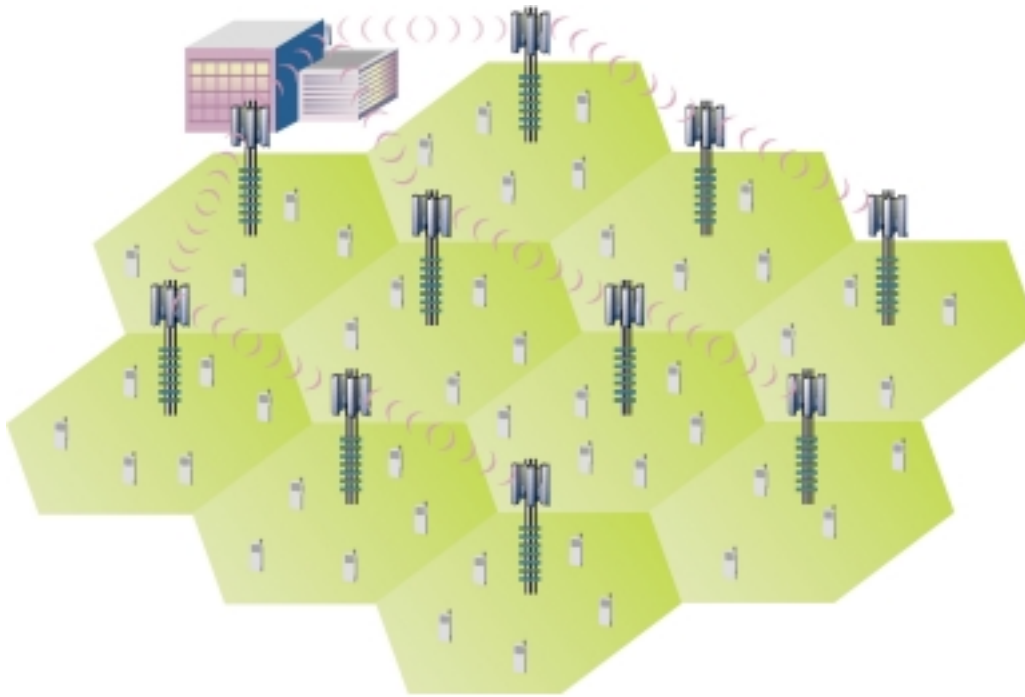
The use of leased lines, typically E1, T1 or their fractions, for base station feeding can be attractive during the rollout stage of installing a mobile telephony network. Where available, leased lines enable low entry cost letting a mobile operator get on with his core business - billing air time. Leased lines, however, involve expensive monthly charges and are thus typically not cost effective beyond the short term. Leased lines can create a dependency on the fixed telephony provider - often a direct competitor of the mobile operator. The leased line provider can often be slow moving, delaying the installation of new base stations, and thus impacting revenue. Additionally, leased lines are not available in many base station locations, meaning that most operators need to consider additional options from the start.

### Private Wire-Line Solutions

An obvious solution to the ongoing cost of leased lines is to own a wire-line solution, with fiber or copper runs to each site. This approach is, however, rare, due to the extremely high cost of digging and laying the required infrastructure, as well as regulatory issues. More commonly, operators lay copper or fiber to the Base Station Controller sites, but not to each mobile base station. Occasionally, large cellular operators, particularly those affiliated with the incumbent telephony provider, electricity supplier or water works, can deploy private wire-line backhaul to most base stations at a reasonable cost. But even these deployment are relatively slow to deploy, and are inflexible, delaying expansion and base station deployment changes.

### Point-to-Point Microwave

Point-to-point microwave radio links have long been the technology of choice for cellular base station backhaul. With point-to-point, a microwave radio and antenna is placed at the base station facing a similar radio and antenna at the Base Station Controller. These links carry one or more E1/T1 trunks, or their fractions. Point-to-point radios are available in a wide variety of radio frequencies, many of them dedicated worldwide to point-to-point applications. A large number of vendors supply a wide variety of microwave radio products at affordable, but somewhat high, prices.



**Figure 1 - Point-to-point Wireless Mobile Base Station Backhaul**

Installation of point-to-point microwave links can be tedious and time consuming. Radio planning must be performed on each and every link. One of the most difficult tasks in the installation of a point-to-point link is aligning the antennas. Point-to-point links use a very narrow width beam, and thus alignment has to be extremely accurate. Alignment must be performed simultaneously on both sides of the link, using specialized equipment and often requiring at least two skilled personnel per side - an expensive proposition.

Licensing of point-to-point backhaul is another difficulty. Each point-to-point link must be licensed independently with the local regulator, often a long and bureaucratic process.

After completing the licensing process, the mobile operator can select the most appropriate point-to-point radio equipment and begin the installation process. Any changes in the base station that include changes to the radio link frequency, bandwidth or orientation require re-licensing of the link. The ramifications of such restrictions on the ability of mobile operators to scale and optimize their networks are significant. With point-to-point, Adding capacity or moving base stations can take weeks or months, until regulatory approval is provided. With the dynamic nature of many markets, this can mean lost revenue and increased cost, with direct impact on the bottom line.

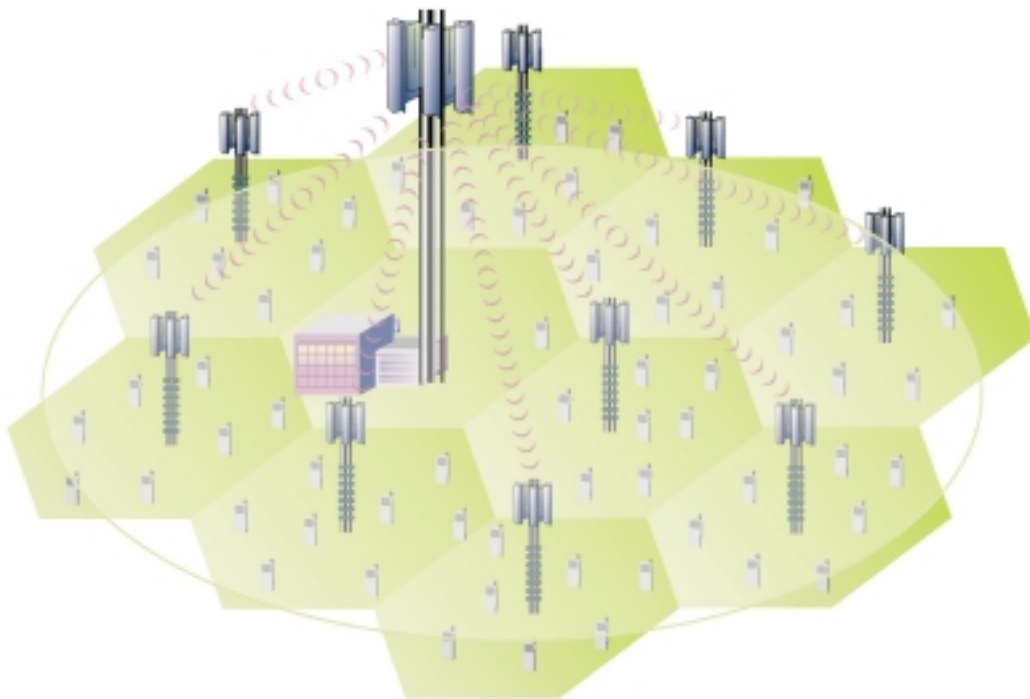
The number of antennas at the Base Station Controller is another issue. Point-to-point links require one microwave antenna at the Base Station Controller for each base station. With a dozen or more base stations per Base Station Controller, the large number of antennas occupy a lot of space and can generate significant wind-load on the antenna mast, increasing the cost of installing the mast, or renting mast space.



## Base Station Feeding Using Point-to-Multipoint

Point-to-multipoint technology is a highly attractive alternative for implementing mobile base station feeding solutions. Point-to-multipoint presents significant advantages over traditional backhaul methods such as leased lines and point-to-point wireless.

In a point-to-multipoint architecture, a central site connects to multiple remote locations, sharing frequency spectrum and equipment. When used in a base station feeding application, several cellular Base Transceiver Stations are connected to a single radio and antenna at the Base Station Controller. This concept allows for smooth network growth and expansion, and facilitates optimization as user patterns change - by allowing dynamic allocation of backhaul channels to any base station. When a base station requires more channels, additional bandwidth is simply allocated on the backhaul link by a network management command, limited only by the total capacity of the central site.



**Figure 2 - Point-to-multipoint Mobile Base Station Backhaul**

With point-to-multipoint there is no need to license individual links. Point-to-multipoint systems are licensed on a one-time basis. All additions and changes are covered by the original approval, and do not require regulator intervention.

Using a point-to-multipoint system requires a specific license from the regulator. The allocated frequency band is licensed for the exclusive use of the licensee. With the current telecom downturn, obtaining a point-to-multipoint license has become easier than ever. Once the operator owns this spectrum, the licensing issue is over. In cases where spectrum is not available to the mobile operator, it may be leased from the license holders, or, alternatively, backhaul services may be purchased from a broadband wireless access operator.

With point-to-multipoint, radio planning is performed only once for an entire area, using methods and tools similar to those used for cellular telephony. Adding base stations does not require additional radio planning, so long as backhaul capacity has been reserved for growth.

Installing base station backhaul in point-to-multipoint system is much simpler than in a point-to-point system. Once the point-to-multipoint central site is installed and radio planning is completed, connecting a new link becomes relatively an easy task. As the central site of the point-to-multipoint system covers a wide area, radio alignment at the mobile base station is easy and can be performed quickly, often by a single technician.

With point-to-multipoint, the number of antennas at the Base Station Controller is greatly reduced. Unlike the point-to-point solution, a single central site antenna serves multiple BTS sites. Typically, a maximum of four antennas will cover an entire area. This improvement not only decreases space requirements and wind-load on antenna masts, but also reduces the environmental and esthetic impact of backhaul deployment.

Point-to-multipoint systems offer significant cost savings over point-to-point. Since with point-to-multipoint, the central site radios and antennas are shared by multiple base station sites, the total cost of the system is reduced. In addition, due to mass production for Broadband Wireless Access applications, the cost of individual point-to-multipoint radios is lower than those of their point-to-point equivalents. All-in-all, point-to-multipoint systems can offer equipment cost savings of 50% or more, when compared to point-to-point systems. Moreover, point-to-multipoint systems also feature lower operating costs: There are fewer units to manage, and the remote terminals are managed as one system with the central site.

Unlike leased lines, a point-to-multipoint solution does not involve payment of an expensive monthly charge. It gives the mobile operator independence from its competitor, the fixed telephony service provider, and allows the cellular system to be deployed at its own pace - with no dependence on slow moving, bureaucratic phone companies. Point-to-multipoint systems are orders of magnitude less expensive than installing private lines, which require digging and laying of copper or fiber infrastructure.

Cellular operators deploying point-to-multipoint systems for base station backhaul can, relatively easily, utilize the same infrastructure to provide Broadband Wireless Access services to business and residential users. Cellular Operators can thus capitalize on additional revenue sources by providing new services and applications using the same infrastructure and with minimal additional cost.

## **Alvarion WALKair Mobile Base Station Feeding Solutions**

The WALKair Broadband Wireless Access System is a state of the art point-to-multipoint radio system for broadband applications, which can provide an optimal solution for the mobile backhauling requirements. WALKair offers significant operational cost savings over leased lines and is much less expensive than point-to-point alternatives. Its modular architecture requires a small initial investment and features simple, fast and non service-interrupting upgrades upon capacity growth or site addition. The WALKair system allows very high voice and data backhaul capacity, enabled by the high spectral efficiency of the radio interface. Spare capacity can also be used for Broadband Wireless Access applications, providing services to business customers.



WALKair is designed to meet the requirements of mobile base station backhaul applications. The WALKair system exhibits extremely high reliability, allow for link protection and diversity and provide the interfaces required by cellular telephony network. Walkair allows a simple backhaul structure, with a large coverage area and flexible bandwidth support - symmetric and asymmetric - from N x 64K fractional E1 through multiple E1 and even E3. WALKair features simple installation and easy network planning, and provides transparent access for all traffic and signaling types.

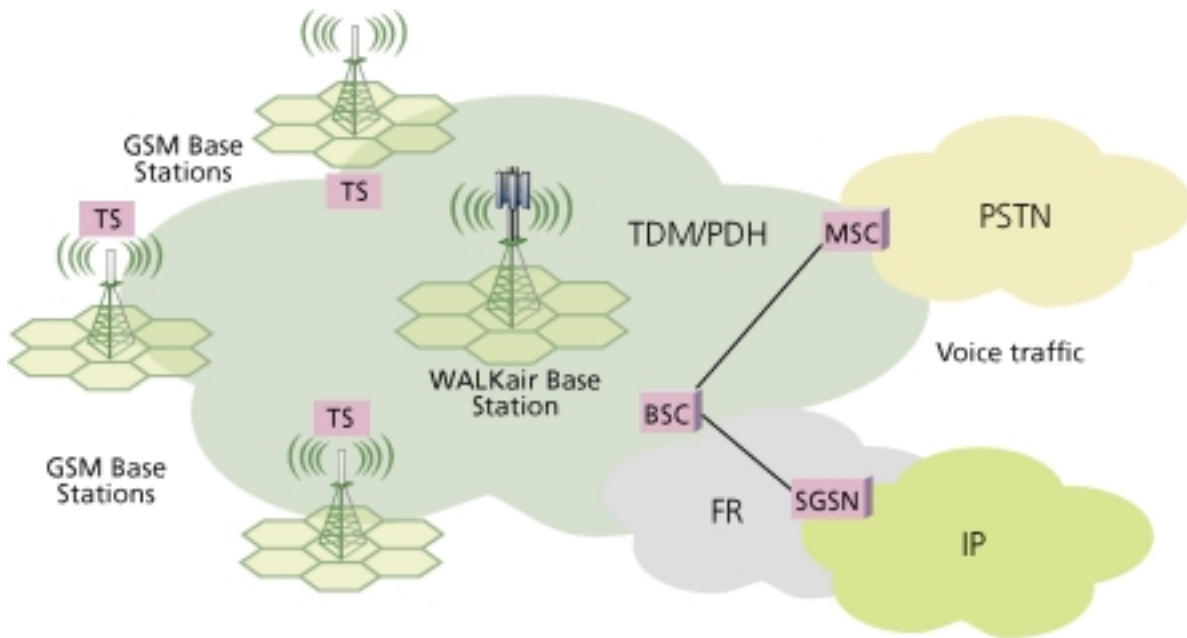


Figure 3 - WALKair Mobile Base Station Backhaul

A WALKair Terminal Station (TS) installed at each cellular base station site. The traffic will be concentrated at one point of presence near the BSC. Figure 3 shows WALKair units positioned in such a base station access network.

WALKair mobile base station backhaul solutions are, today, implemented in many mobile networks, around the world, feeding hundreds of base stations in some networks. With WALKair, mobile operators leverage on the advantages of an efficient and secure point-to-multipoint access system.

## Summary

When compared to traditional base station feeding options, point-to-multipoint solutions present significant advantages over other backhaul technologies in terms of cost, deployment speed, scalability and flexibility. With point-to-multipoint, operators can replace leased lines with high monthly charges. Point-to-multipoint wireless base station feeding solutions provide functions equivalent to wire-line and point-to-point microwave links. They have lower equipment cost, are quicker to deploy and require less space for equipment and antennas. Point-to-multipoint solutions scale easily to support subscriber growth, and enable the high bandwidth required to support data services, as their popularity grows.

Table 1, below, summarizes the key qualities of the technologies available for the backhaul of mobile telephony base station traffic.

	P2MP	Leased Lines	Private Wireline	P2P
Equipment cost	Low	N/A	High	Moderate
Installation cost	Low	Minimal	High	Low
Operational cost	Minimal	High	Minimal	Minimal
Install speed	Fast	Fast (depends on availability)	Slow	Moderate
Flexibility	High	None	None	Low
RF License	National/regional	N/A	N/A	Per link

**Table 1. Backhaul Technology Comparison**



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