# Topology Possibility

## *An Exploration of Advanced WiMAX Backhaul and Access Topologies*

## Abstract

*This whitepaper examines different topologies that can be achieved using the Libra-MAX RBS (Repeater Base Station). These topologies allow operators to extend the range of typical WiMAX deployments, handle impossible NLOS situations and realize new revenue streams from exploded end-customer deployment possibilities. Many of these deployment options required many fewer IDU than in a typical deployment.*

## Equipment Overview

The Libra-MAX contains dual radio cards housed in an all-in-one outdoor enclosure. The RBS has three interfaces, a northbound wireless, southbound wireless and an Ethernet port. The two wireless interfaces use an N-type antenna connector so that the operator can choose the antennas best suited for the applications. This allows the RBS to be used in a PtP repeater mode, or a PtMP sector extension mode. The Ethernet serves a dual purpose, it provides power to the enclosure via PoE, and it also allows the RBS to connect to a local network, Internet Point of Presence, co-located subscriber unit, or WiFi access point. The MAX-RBS is designed to be used as a building block to make complicated deployments simple.

## Line Speed Repeater

The dual radio cards in the MAX-RBS allow the unit to transmit data through the link at line speed. Because the repeater operates at layer 2, the data does not need to be decoded and re-coded at the radio site. This type of store and forward transmission is typically used in WiFi repeaters and unnecessarily uses the resources of the radio CPU.

## Two Modes

There two basic modes of operation for the MAX-RBS. These two modes enable all of the different topologies.

**Repeater Mode:** In Repeater mode, the RBS uses two directional antennas for point to point communication. This type of configuration is used for backhaul scenarios. Typical topologies in repeater include straight line, ring and mesh. An example of the RBS in repeater mode is shown in the figure below.
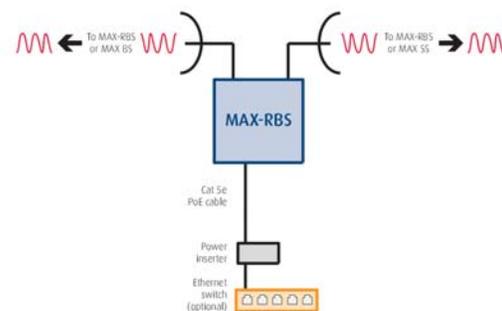


**Figure 1 MAX-RBS in Repeater Mode**

**Sector Extension Mode:** The other basic operating mode of the MAX-RBS is the sector extension. In the sector extension mode, the RBS uses a directional antenna on the southbound interface and a sector antenna on the northbound interface. This configuration is typically used to extend the range of a base station to reach out of range or out of sight subscriber stations. An example of this topology building block is shown in the following figure.
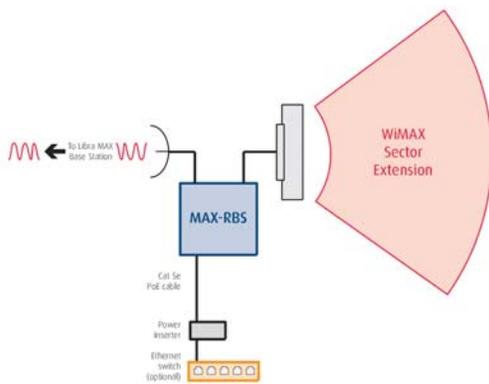


**Figure 2 MAX-RBS in Sector Extension Mode**

## Range Extension

In a very simple deployment, the MAX-RBS can be used as a point-to-point backhaul repeater. This can be useful for establishing a connection to an internet point of presence, or to a remote base station. A range extension is also useful for creating alternate links to navigate around problem paths.

As an added bonus, a MAX-RBS in a range extension can be co-located with subscriber station to provide service as well as link extension.

## Coverage Extension

This topology enables the extension of coverage from a main Base Station to distant subscriber stations outside the range of the main base station.

Multiple Subscribers (point to multipoint) can be served from the remote RBS creating a sub-sector.
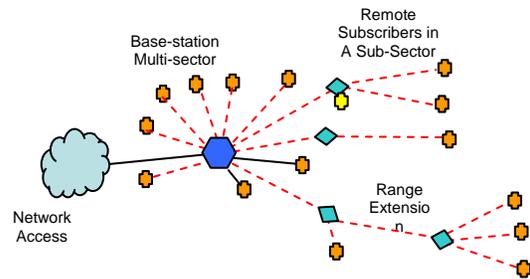


**Figure 3 Range and Coverage Extension**

## Ring Topology

A ring topology forms a very robust and efficient backhaul path for traffic. If there is a link failure in the ring, data is still able to pass to the correct node.

In a ring topology, the MAX-RBS is in repeater mode with directional point-to-point antennas. The Ethernet interface drops down to a local area network, or combined with EION's Ultima3 5.8 GHz radio. Using the ring in tandem with the Ultima3 is a simple way for an operator to roll out a high speed access network in the unlicensed band, with highly reliable WiMAX backhaul.

Another option with the ring, if subscriber capacity is required in stead of blanket coverage is to co-locate a subscriber station at each of the node locations. This configuration, which is shown in the example below, is useful for bandwidth intensive applications such as video surveillance.
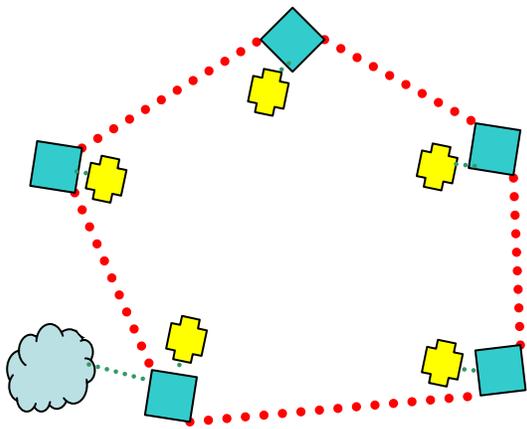
**Figure 4 MAX-RBS Ring**

By applying the spanning tree algorithm, the efficiency of the ring is increased because the data is instructed to travel the shorted path around the ring which reduces congestion.

## Mesh

A mesh is similar to the ring, except that each node can have three or more connections. The mesh unlocks many interesting backhaul scenarios for the operator and allows for very robust network planning with the ability to support multiple safety paths.
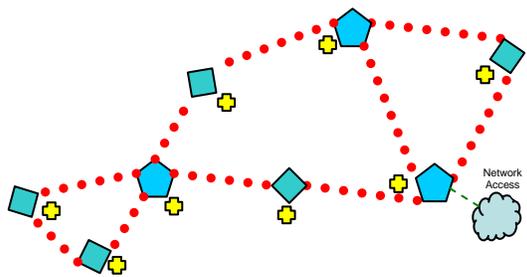


**Figure 5 MAX-RBS Mesh Topology**

## Jumbo Sector

When the MAX-RBS is in sector mode, it does not need to be connected straight to a subscriber station. It can be used in a multipoint configuration to connect to other MAX-RBS units. This unlocks some very exciting deployment options. Using this set-up a massive "Jumbo Sector" can be created. One of the advantages of creating the Jumbo Sector is that only on Indoor unit is required at the central location. The other advantage is that the flexibility of the MAX-RBS system allows the jumbo sector to grow seamlessly as the subscriber base grows and expands. This type of network reduces the risk for service providers as it lowers the initial CAPEX costs. In a properly planned deployment, a single jumbo sector can cover hundreds of kilometers.
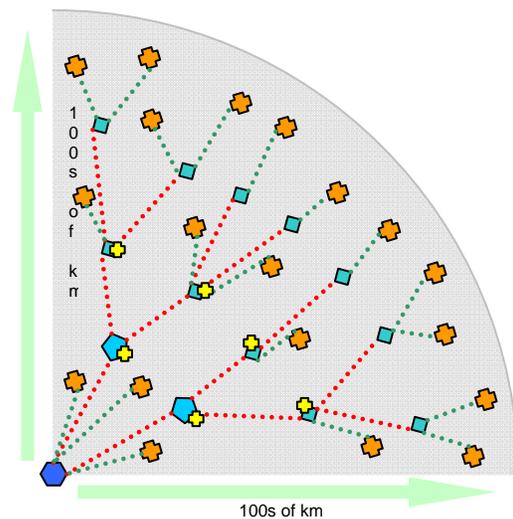


**Figure 6 MAX-RBS Jumbo Sector**