

# The Transition from Unsynchronized to GPS Synchronized Networks – Finally Explained

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**TABLE OF CONTENTS**

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Abstract . . . . . 3

Single Sector Solution . . . . . 3

Multi-Sector Solution . . . . . 3

Non-TDD Unsynchronized Transmission Mode . . . . . 4

Typical Services – Perfectly suited for VoIP, Data and Video related services within a single sector.. . . . 4

    Main Considerations. . . . . 4

    Main factors that enable the services . . . . . 4

Figure 1: Flexible UL/DL Transmission Pattern . . . . . 4

Figure 2: Flexible UL/DL: 45 MHz of available contiguous spectrum. . . . 4

Fixed TDD (GPS Synchronized) Mode . . . . . 5

Typical Services – Perfectly suited for VoIP, Data and Video related services within a large scale network of access points and subscribers. . . . . 5

    Main Considerations. . . . . 5

    Main factors that enable the services . . . . . 6

Figure 3: Fixed TDD Transmission Pattern . . . . . 6

Figure 4: Fixed TDD: 45 MHz of available contiguous coverage . . . . . 6

Summary . . . . . 6

Transition Plan . . . . . 7

**ABSTRACT**

A critical challenge for service providers that use outdoor, Wide Area Broadband Wireless Access (BWA) equipment is how to offer a reliable, affordable and predictable wireless service to end customers that is also easy to deploy and scale within spectrum restrictions. The choice of equipment and, consequently, the transmission modes selected depend upon requirements for coverage, capacity, the nature of service, projected revenue and environment.

The ePMP™ 1000 from Cambium Networks has developed solutions that will resolve these major challenges for service providers and will allow their networks to grow from a single sector to a multi-sector complex deployment.

The systems support two TDMA-based transmission modes of operation targeting various coverage and capacity network requirements.

**SINGLE SECTOR SOLUTION**

The non-TDD Unsynchronized with flexible DL to UL ratios mode is based on data demands and ideal for subscribers within an individual sector.

**MULTI-SECTOR SOLUTION**

The GPS Synchronized TDD with fixed DL to UL ratios is required for growing multi-sector subscriber base with a need for frequency reuse and scalability. The GPS Sync solution reduces the number of towers needed to provide coverage and capacity and minimizes self-interference across the network. Using Cambium Networks’ ePMP™ 1000, service providers will be able to select the mode that is suitable for them at an early stage of their network development and easily transition from one mode to the next based on network demands.



*A GPS Synchronized solution supports up to three times more subscribers than an unsynchronized solution.*

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*Using Cambium Networks’ ePMP™ 1000, service providers will be able to select the mode that is suitable for them at an early stage of their network development and easily transition from one mode to the next based on network demands.*

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## NON-TDD UNSYNCHRONIZED TRANSMISSION MODE

Non-TDD Unsyncronized mode (Non GPS Sync solution) – is a transmission mode when flexible time for uplink and downlink data based on network needs is allocated. This mode does not organize the TDMA data frames into TDD sub-frames of fixed ratios, and therefore the DL to UL ratios are flexible, not fixed, and cannot be synchronized across the entire network. The scheduler at the AP (Access Point) dynamically switches between DL and UL allocations based on traffic demand. Allocation of frames is flexible and moves dynamically from transmitting in one direction to another. The common name used for this mode of operation on the ePMP™ 1000 is the “flexible DL to UL ratio” mode.

**TYPICAL SERVICES – PERFECTLY SUITED FOR VOIP, DATA AND VIDEO RELATED SERVICES WITHIN A SINGLE SECTOR.**

### MAIN CONSIDERATIONS

Operating in 5GHz frequency bands, this transmission mode is similar to Wi-Fi in nature but offers more efficient dynamic scheduling and scalability with no contention due to Cambium Networks’ a proprietary MAC layer. Compared to other technologies, the Flexible UL/DL mode from Cambium Networks permits better scalability at a single sector level. This mode easily meets fluctuating demands where traffic is balanced or unbalanced between downlink and uplink.

### MAIN FACTORS THAT ENABLE THE SERVICES

- 1) **Low latency** is produced by flexible allocation of frames based on traffic patterns and by filling transmission frames to capacity without any time missed. Services such as VoIP, Data and Video targeting individual subscribers in the sector can take full advantage of this mode.
- 2) **High capacity** for an individual sector is produced by dynamic frame allocation – provides more than 150 Mbps of real user throughput.

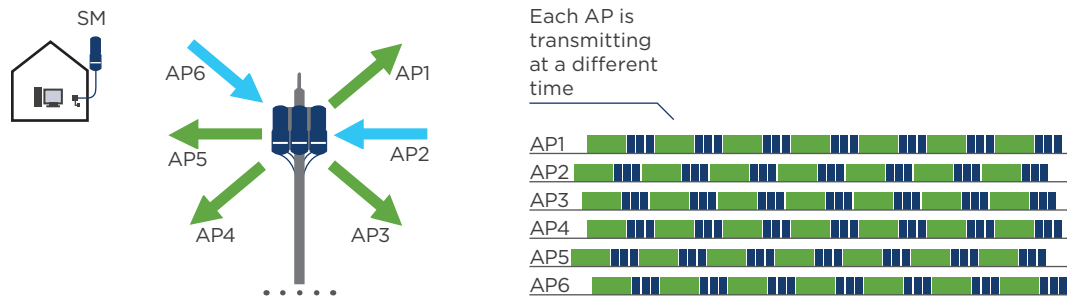


Figure 1: Flexible UL/DL Transmission Pattern

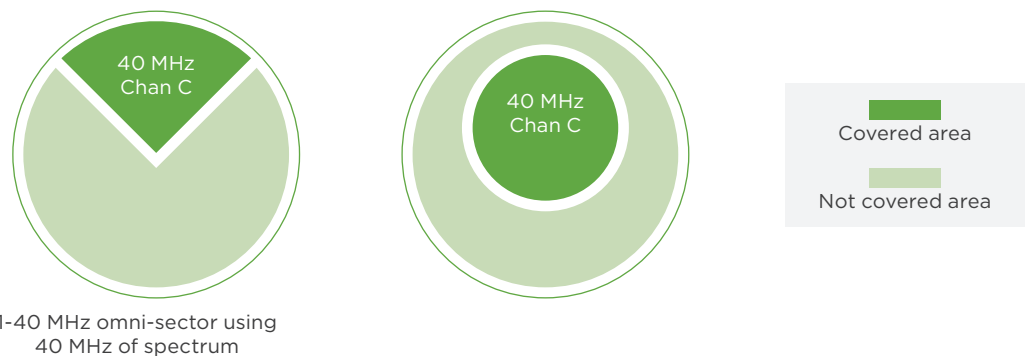


Figure 2: Flexible UL/DL: 45 MHz of available contiguous spectrum

### **FIXED TDD (GPS SYNCHRONIZED) MODE**

Fixed TDD (GPS Synchronized) mode organizes the TDMA data frames into TDD sub-frames based on fixed DL to UL ratios, thereby enabling synchronization across the network. The UL/DL cycles are configured in the AP and are controlled by the GPS timer mechanism, which sends a pulse to the Access Point radios for synchronization amongst them. Based on settings, an AP stops broadcasting, pauses briefly and then starts listening to its Subscriber Modules (SM). This periodic DL/UL cycle creates a predictable communication model that reduces self-interference and improves both performance and reliability. In addition to synchronized transmit and receive times, high quality antennas with good front-to-back isolation are required. These elements maximize the main lobe signal that communicates with assigned SMs and minimize the side and back lobe leakage to adjacent APs. Taken together with transmit power control, these features enable collocated and noncollocated frequency reuse, maximize spectral efficiency in congested areas and offer an increase in subscriber density with improved quality of service.

### **TYPICAL SERVICES – PERFECTLY SUITED FOR VOIP, DATA AND VIDEO RELATED SERVICES WITHIN A LARGE SCALE NETWORK OF ACCESS POINTS AND SUBSCRIBERS.**

#### **MAIN CONSIDERATIONS**

This operation mode accommodates a large number of users requiring high capacity where spectral efficiency and scalability are of the essence. Cambium Networks' GPS Sync Solution enables service providers to pick the best UL/DL ratio suitable for their network and services. As a result, virtually no spectrum is lost and the network operates in the most efficient way.

#### **MAIN FACTORS THAT ENABLE THE SERVICES**

- 1) **Spectral Efficiency** ensures that fewer channels are needed to service customers (8.8 bps/Hz - for 20 MHz channel width and 9.4 bps/Hz for a 40 MHz channel using 90 degree sectors) and connectivity is delivered to more subscribers utilizing fewer access points and towers, ultimately reducing the amount and cost of needed equipment.
- 2) **Scalability** allows the network to grow from a few subscribers to region-wide coverage (up to 120 subscribers per access point )
- 3) **Reduced self-interference** allows devices and subscribers to be added to the network seamlessly. All subscribers experience predictable throughput with guaranteed stability - perfect for high number of users in multiple sectors.
- 4) **Frequency Reuse** provides increased capacity in a noisy environment, servicing up to 3 times more subscribers than flexible UL/DL mode using the same channel bandwidth (see the picture- don't want to give the wrong image that one access point supports less users with flexible DL/UL than with fixed).
- 5) **Downlink/Uplink Ratio** can be adjusted according to the anticipated user traffic profile. It offers the flexibility to create the most effective use of bandwidth for customers.
- 6) **An Optimized scheduler** is enabled by a powerful processor in addition to effective scheduling algorithms allowing for high data throughput to accommodate modern needs for data rates.
- 7) **Gigabit Ethernet** port enables a user to transfer data at rates greater than 200+ Mbps.

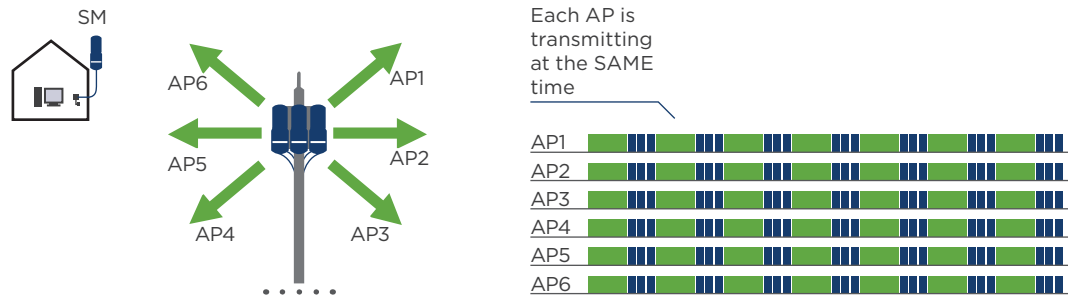


Figure 3: Fixed TDD Transmission Pattern

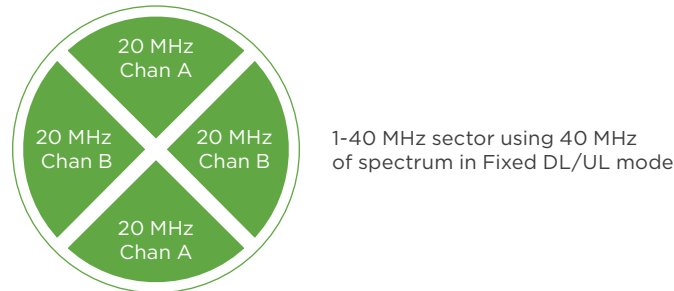


Figure 4: Fixed TDD: 45 MHz of available contiguous coverage

## SUMMARY

Cambium Networks has designed solutions to satisfy various network demands in terms of reliability, capacity and service package. Flexible UL/DL and Fixed TDD GPS Sync modes will meet the requirements of business models for service providers and allow them to scale up from one model to the next as demand changes.

- The first step is to identify your subscriber base and project your growth.
- The next step is to pick the right solution to satisfy your network needs and your business plans.
- The Flexible UL/DL solution will perfectly suit the single sector with fluctuation on demand of the UL/DL traffic.
- The GPS Synchronized solution will boost service providers to the next level and provide unparalleled spectrum efficiency of more than 3X for a large subscriber base.

GPS Sync solution in large networks leads directly to expenditure reductions, results in lower installation costs and maintenance and allows your business to concentrate on growth and profitability.

Transition Plan: From a low cost unsynchronized sector to GPS Synchronized coverage with multiple sectors

Unsynchronized low-cost start  
with one 90 120° sector coverage with 100 Mbps

ePMP™ Connectorized Radio  
Non-GPS Synchronized

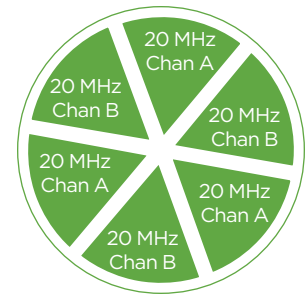
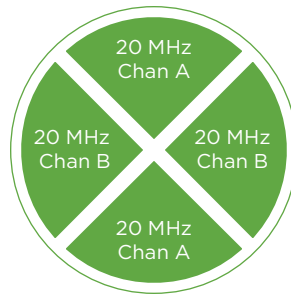


Add CAPACITY and RANGE  
as network grows with  
channel reuse

4 sectors coverage with 400 Mbps  
ABAB Channels

6 sectors coverage with 600 Mbps  
ABABAB Channels

ePMP™ GPS-Synchronized Radio



Covered area   
Not covered area

*\*NOTE: with antenna that has side lobes lower than -30dB at +/- 90o azimuth*