Motorola Point-to-Point Bridges – 400 and 600 Series

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MOTOWI4™

Contents

1 Overview

A unique technology combination means Motorola's point-to-point, broadband wireless solutions work where other products often do not.

Within Motorola's line of point-to-point wireless Ethernet bridges, there are two families of products -- the 400 Series and the 600 Series. The Point-to-Point Bridges - 400 Series (formerly Orthogon Systems OS-Gemini) operate in the 5.8 and 5.4 GHz as well as 4.9 GHz (public safety) frequencies, while the Point-to-Point Bridges - 600 Series (formerly Orthogon Systems OS-Spectra) operate in the 5.8 and 5.4 GHz frequencies. All the point-to-point solutions can deliver up to 99.999% availability in even the most challenging situations – in non-line-of-sight environments, over long distances, and across water and open terrain. It is a unique claim in the point-to-point broadband wireless world where 95% availability or less is often the norm.

This carrier-class reliability comes from a powerful combination of technologies which enable the radios to overcome the key factors that degrade all radio signals – signal attenuation, fading, dispersion and polarisation. First, Motorola adds intelligence to proven technologies like OFDM, adaptive modulation and dynamic frequency selection. Then Motorola combines these technologies with its own breakthrough hardware and software innovations to deliver a high level of capacity, signal quality, spectral efficiency and performance.

The radios are cost-effective, quick to deploy and easy to manage. Operating at Ethernet data rates from 3 to 300 Mbps, the systems support a wide variety of demanding applications, including:

- Handling last-mile and heavy-duty backhaul traffic
- Migrating from an analog to a digital network
- Linking separate loops within individual buildings
- Communicating between buildings
- Linking networks in a campus setting
- Quickly deploying emergency services, special operations and events
- Transmitting across long distances, over water or around obstacles

With Motorola's acquisition of Orthogon Systems, Orthogon's products were renamed and integrated into the **MOTO**wi4™ product line:

Old Name	New Name
OS-Gemini	Point-to-Point Bridge – 400 Series
OS-Spectra	Point-to-Point Bridge – 600 Series

Motorola's **MOTO**wi4 portfolio of innovative wireless broadband solutions create, complement and complete IP networks. Delivering IP coverage to virtually all spaces, the **MOTO**wi4 portfolio includes Fixed Broadband, WiMAX, Mesh, and Broadband over Powerline solutions for private and public networks.

2 Multiple-Input Multiple-Output (MIMO)

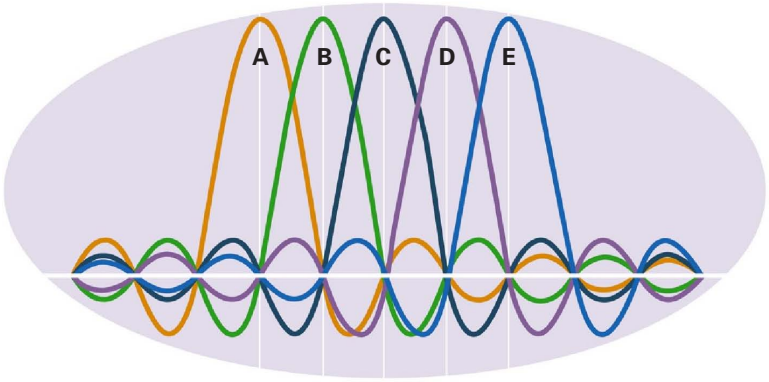
Minimises signal fading due to path obstructions or atmospheric disturbances

Non-line-of-sight (NLoS) environments create all kinds of signal issues. Connections are subject to massive periodic fading, often dropping to 1/10,000th of the already highly attenuated level. Signals are prone to be out-of-phase, because there is no main path, just many indirect paths of similar energy, dramatically raising the risk that signals will cancel each other.

With Motorola's technology, numerous data streams are transmitted between multiple transmitters and receivers. At the receiving end, all the data streams are compared and evaluated until the data image is accurately restored and sequenced. The result is significantly reduced NLoS fading, providing consistently reliable, high-quality links in even the toughest environments.

3 *Intelligent* Orthogonal Frequency Division Multiplexing (*i*-OFDM)

Transmits data on multiple frequencies, resulting in higher channel bandwidth and greater resistance to interference and signal fading



In NLoS environments, signals arrive by many different (dispersed) paths. The path lengths vary, so the signals also arrive at different times. In addition, the paths have different delay characteristics, causing previously transmitted data bits to interfere with current data bits. This interference is known as multipath inter-symbol-interference or ISI.

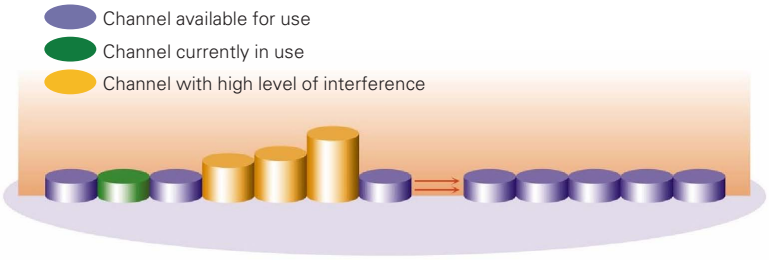
Conventional radios resolve the problem using an ISI equalizer. Many NLoS vendors employ some form of OFDM (Orthogonal Frequency Division Multiplexing) to overcome this problem, but none of them add the intelligence that is embedded in Motorola's *intelligent* OFDM.

Motorola's *i*-OFDM separates data into channels, which overlap in frequency. Orthogonal to each other, the channels do not interfere with each other, resulting in better spectrum efficiency and higher data throughput. In addition, *i*-OFDM allows the radios to compensate for environmental conditions by applying a uniform phase correction to all channels simultaneously – a correction value that can be modified on the fly in response to external events. Thus, Motorola's *i*-OFDM not only resolves channel dispersion, achieves high spectral efficiency and offers high resistance to frequency-selective fading, but it also offers the following enhancements not available in other products:

- Significantly more pilot tones and sub-carriers
- Instant fade recovery

4 Advanced Spectrum Management with *i*-DFS (*Intelligent* Dynamic Frequency Selection)

Self-selects the frequency over which it can sustain the highest data rate at the highest availability



Channel frequencies can be set either manually or dynamically. The Motorola 400 and 600 families of point-to-point wireless bridges monitor all available radio channels – 500 times a second – and dynamically select the frequency over which they can sustain the highest data rate at the best quality. This means that the bridges are very likely to find a clear channel (without operator intervention) even in a crowded space. From the user's point of view, this experience is equivalent to having exclusive rights to use a licensed channel.

In addition to *i*-DFS, Motorola's unique spectrum management capabilities include two other techniques:

- Fixed frequency – the operator presets (locks in) link frequency so that it stays within the best channel known to be available
- Channel tuning – the operator can adjust the centre of the channel up or down to optimally fit it into the available spectrum

5 Adaptive Modulation

Continually optimises modulation to transmit the maximum amount of data across the path while maintaining the highest levels of link quality

Motorola PTP 58400 and PTP 54400 Bridges Sample Modulation and Data Rates

Modulation Scheme	Data Rate (Mbps)	System Gain (dBm)
64 QAM 7/8	42.51	138.1
64 QAM 3/4	36.44	142.3
64 QAM 2/3	32.99	144.4
16 QAM 3/4	24.29	150.4
16 QAM 1/2	16.20	156.2
QPSK 2/3	10.80	160.7
QPSK 1/2	8.10	163.0
BPSK	3.60	168.5

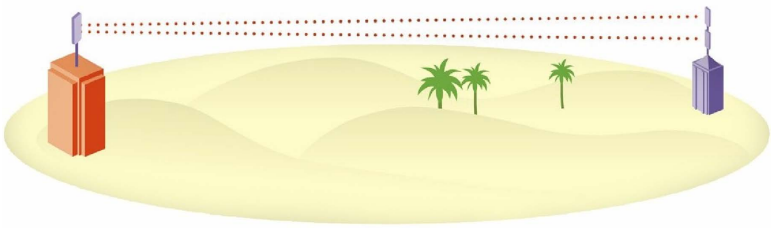
Adaptive Modulation optimises signals according to the conditions of the RF path, allowing transmissions to travel from one receiver to the next without signal loss. The radio power output is dynamically modified according to the received signal level, upshifting or downshifting to overcome fading. Since the channel may vary in intensity on a sub-second basis, adapting the modulation dynamically allows the maximum amount of data possible to be sent across the path while keeping the link quality at the highest level.

Available modulation modes include 256 QAM, 64 QAM, 16 QAM, QPSK, BPSK, multiple FEC rates, single and dual payload.

6 Spatial Diversity

Combats ducting and multipath fading via space-diverse antennas at one or both ends of a link

The 400 and 600 families of point-to-point radios incorporate spatial diversity to combat ducting and multipath fading, allowing communications to travel over water, across vast expanses of open terrain and in deep non-line-of-sight environments without signal loss.



As radio waves travel across distances, especially over water and flat terrain, they run an increased risk of multipath interference caused by signals reflecting off the water, desert or flat plain. This interference can cause the signals to cancel each other as they travel to the receiver from various directions over multiple paths. In addition, signals can experience ducting as they move through air masses of different densities, which deflect the signals away from the receiving antenna, often cutting communication between radios.

In these situations, vertically separated antennas can be deployed at one or both ends of the link, sending two radio paths to the receiver that do not experience reflection and ducting at the same time. By optimally combining the separate transmissions, Motorola eliminates signal cancellation and maximises the signal received in each direction.

7 Best-in-Class Radios*

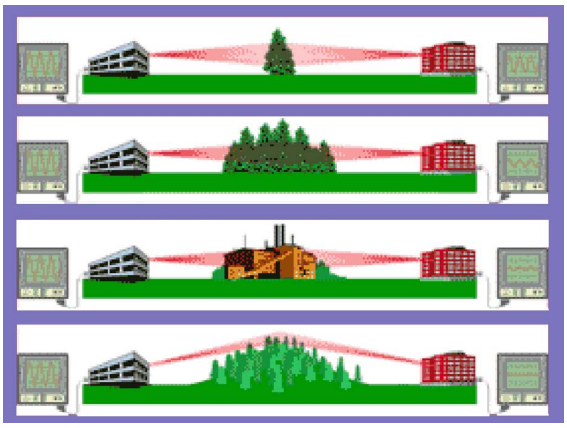
Maximise system gain

20dB
1/100th

30dB
1/1,000th

30 – 40dB
1/1,000th to 1/10,000th

40dB
1/10,000th



Signal attenuation occurs when natural or man-made obstacles in the path reduce the signal. Typical NLoS environments reduce the signal to 1/1000th of a normal LoS signal, because the signals are forced to arrive by diffraction around an object, reflection off objects that surround the obstruction, or by penetrating the obstruction – all of which substantially weaken the signal.

Motorola's best-in-class radios effectively overcome attenuation by maximising the system gain. By pairing a high-output transmitter with an ultra-sensitive receiver, the radios can achieve a system gain of up to 168dB using 23dBi integrated antennas.

* The Motorola PTP 58600 (formerly Orthogon Systems OS-Spectra) is the winner of the Network Computing 2006 "Well-Connected" Award and the Network Computing 2005 Editor's Choice Award.

8 Applications

The Motorola 400 and 600 families of point-to-point broadband wireless bridges* are enabling wireless service providers to extend broadband to remote areas and backhaul traffic efficiently and are connecting disparate networks in a wide variety of markets including corporate enterprises, government, education, healthcare, utilities and transportation. Enterprises and service providers alike find that Motorola's point-to-point broadband wireless solutions handle a wide variety of communication challenges when they need to:

- Deliver fast, reliable and highly-available data streams for networked applications
- Transmit data reliably over obstructed paths, across expanses of open terrain or water, or in areas with significant interference
- Backhaul more local loops using a single link
- Support bandwidth-intensive IP voice, video and data applications
- Combine E1/T1 and Ethernet ports in a single radio
- Implement a WiMAX-compatible backhaul solution
- Add capacity and redundancy to 6 GHz networks

Wherever point-to-point wireless is a candidate for Ethernet connectivity, the 400 and 600 Series solutions are a good fit, delivering faster data streams, more reliable connections and higher availability than comparable systems.

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For more information about the Motorola Point-to-Point Solutions:

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*formerly
Orthogon Systems
OS-Gemini and OS-Spectra