Aviat Networks

WTM 4000 Adaptive Dual Carrier (A2C)

WHITE PAPER

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White Paper – WTM 4000 Adaptive Dual Channel

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Introduction

With the ongoing evolution of telecommunication networks for mobile, fixed and enterprise applications, Network Operators and Service Providers need to be able to deploy microwave transmission systems that can cost effectively deliver multi-Gigabit link capacities as an alternative to the exorbitant cost and right-of-way issues usually associated with fiber deployments.

Traditionally, delivering ultra-high capacity links using microwave in the licensed 6 to 42 GHz bands involves employing higher and higher modulation levels, leading to drastically decreased radio performance and shorter paths, or installing additional parallel microwave systems that doubles or trebles the link capacity, but at a similar multiple in terms of cost.

The new WTM 4000 platform from Aviat Networks introduces a ground-breaking and novel new feature called Adaptive Dual Carrier, or A2C, that enables the efficient doubling of capacity over a microwave radio link, but without a corresponding increase in cost.
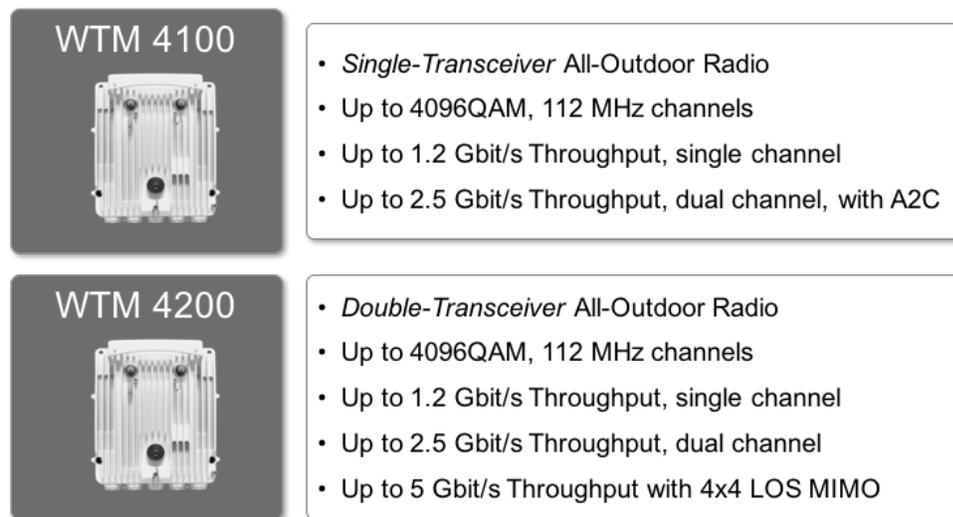
Unlike other radio solutions on the market that require a doubling of equipment, WTM 4000 with A2C supports twice the capacity without any additional hardware. This means that customers save time and money, due to simplified ordering, lower shipping costs, ease of maintenance and inventory management, lower energy costs and improved reliability/higher MTBF. Other features aimed at increasing capacity tend to be either unreliable or impractical. For example, header compression only works if frame sizes are universally small, and LOS MIMO involves doubling the amount of equipment used, including antennas.

This papers describes how Aviat A2C is implemented, and compares this to alternative approaches available in the market today.

Aviat WTM 4000 Outdoor Radio Unit

Aviat's new WTM 4000 microwave solution delivers ultra-high capacity capability in single or dual-header architecture options, optimized for all-outdoor applications. With up to 2.5 Gbit/s of throughput and cutting edge microwave networking features, such as unique A2C, the WTM 4000 sets a new benchmark for 4G and 5G backhaul requirements.

WTM 4000 builds in all the very latest capacity innovations, including 4096QAM, wide 80 MHz(ANSI) or 112 MHz (ETSI) channel support, enhanced Ethernet optimization using multi-Layer Header Compression (ML-HC), and line-of-sight MIMO. WTM 4000 is available in single header (WTM 4100, with one transceiver) and dual-header (WTM 4200, with two transceiver) configurations, enabling capacities up to 5 Gbit/s per link. WTM 4000 is also the only microwave platform to support adaptive dual-carrier (A2C) capability, enabling double capacity on a low cost single transceiver (WTM 4100) design.

WTM 4100

- *Single-Transceiver* All-Outdoor Radio
- Up to 4096QAM, 112 MHz channels
- Up to 1.2 Gbit/s Throughput, single channel
- Up to 2.5 Gbit/s Throughput, dual channel, with A2C

WTM 4200

- *Double-Transceiver* All-Outdoor Radio
- Up to 4096QAM, 112 MHz channels
- Up to 1.2 Gbit/s Throughput, single channel
- Up to 2.5 Gbit/s Throughput, dual channel
- Up to 5 Gbit/s Throughput with 4x4 LOS MIMO

Figure 1. WTM 4000 Platform

Why Use Dual Channel Operation

Microwave link capacity over a single channel frequency can be increased by simply using a wider channel, or by increasing the modulation used. However, obtaining very wide single channels is often very difficult within existing congested public or common carrier bands, and increasing modulation only provides a relatively small and decreasing improvement in capacity, but at the expense of lower system performance.

For example, increasing modulation from 1024 to 4096QAM increases throughput by about 25%, but reduces system gain by 10dB, equivalent to between 3 and 4 antenna sizes (ie: the difference between the gain of a 4ft and a 10ft diameter antenna).

Figure 2. Size comparison between a 1.2m (4ft) and 2.5m (8ft) antenna

Dual channel, or 2+0 configuration, is a very simple and effective way of doubling a radio link's capacity, while also preserving high RF performance to enable use of smaller antennas, and achieve longer paths and higher availability.
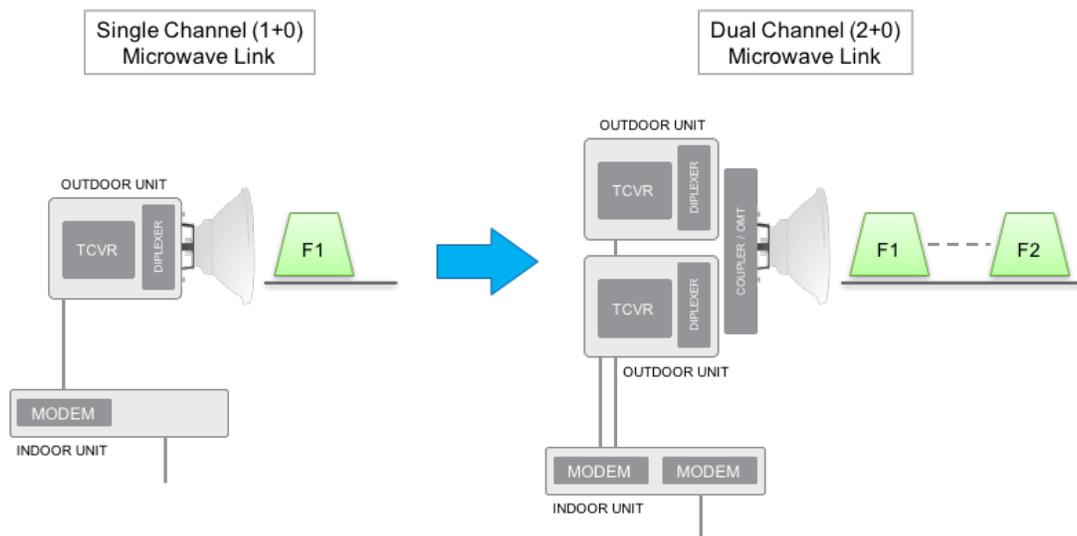

Figure 3. Doubling capacity of a 1+0 link with 2+0 Dual Channel

The downside of 2+0 dual channel links is that it effectively doubles the amount of radio equipment required, increasing Capex, as well as cost of shipping, deployment, sparing and maintenance.

Double Header Radios

Recently, a new class of microwave radios have become available, based on an all-outdoor design that incorporates two radios inside one mechanical enclosure – often referred to as 'multi-core' or 'multi-carrier'.
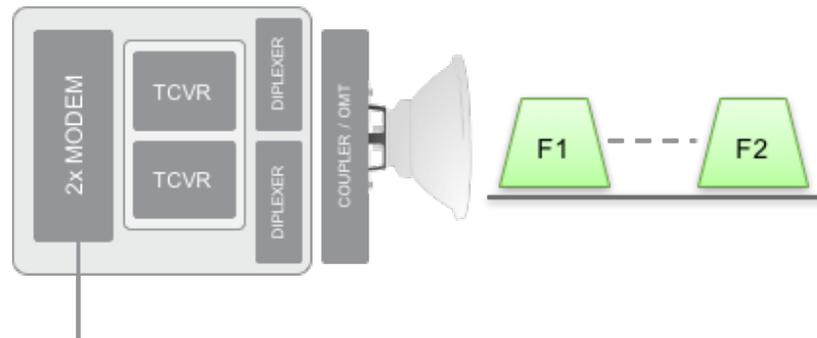

Figure 4. Double-Header (2x Tx/Rx) radio architecture

These new double-header radios are still based on two separate and independent RF and diplexer chains (one each per channel), and require a separate coupler or OMT to interface to the antenna, but deliver costs savings compared to split-mount, in that there is only one unit to purchase, install and maintain. On the other hand, due to the highly integrated design any failure (say internal power supply) is likely to take out of service the entire two-channel link, and even if it didn't the link would have to be taken down to allow the unit to be swapped.

Aviat WTM 4000 with A2C

Aviat's new WTM 4000 radio platform can support a 2+0 Dual Carrier link with less equipment than an equivalent double-header radio. A new and novel feature called Adaptive Dual Carrier (A2C), enables high capacity, dual channel links to be implemented with a single integrated dual-core modem, Tcvr and Diplexer, with no Antenna coupler/OMT.
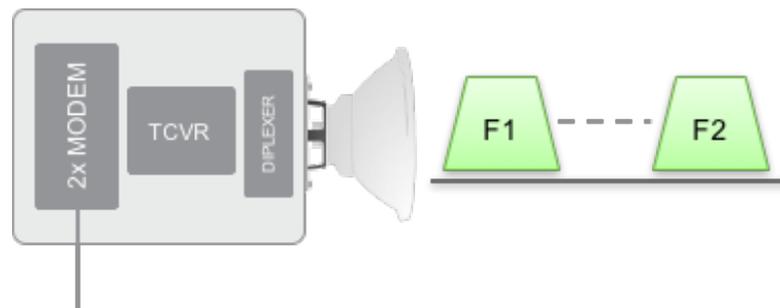
Figure 5. Aviat WTM 4100 single header (1x Tx/Rx) with A2C architecture

This reduction in hardware needed results in several benefits over the alternative double-header design:

- Lower power consumption – reduced by almost 50%

- Simpler to order/ship/install – no additional external coupler needed

- More reliable – one transceiver means fewer components that can fail resulting in higher overall MTBF

- Lowest price/Mbit - most cost effective high capacity solution

What is A2C?

Introduction

A2C, or Adaptive Dual Carrier, is a new feature supported by Aviat's WTM 4000. Utilizing the dual-core modem and single transceiver, A2C supports two bi-directional carriers, with each carrier operating independently with modulations from QPSK to 4096QAM, and channel bandwidths from 7 to 112 MHz.

Enabling a single ODU transceiver (RFM) to transmit (and receive) two separate radio carriers is facilitated by multiple technologies, including GaN power amplification, and adaptive pre-distortion. Before A2C, a doubling of capacity required two separate radios, joined to the antenna using a bulky and high-loss RF coupler to gain.

For each channel, Adaptive Coding & Modulation (ACM) and TX power control (ATPC) operate independently as normal, including independent mute/un-mute on each carrier.

Channel Arrangement

The spot frequency for each channel can be freely selected with a separation of up to 450 MHz, or within the range of the equipped diplexer (whichever is narrower), or can be as close as one channel spacing (adjacent channel). Each channel must operate on the same antenna polarization (vertical or horizontal). Cross pole operation/XPIC are not supported when using A2C.
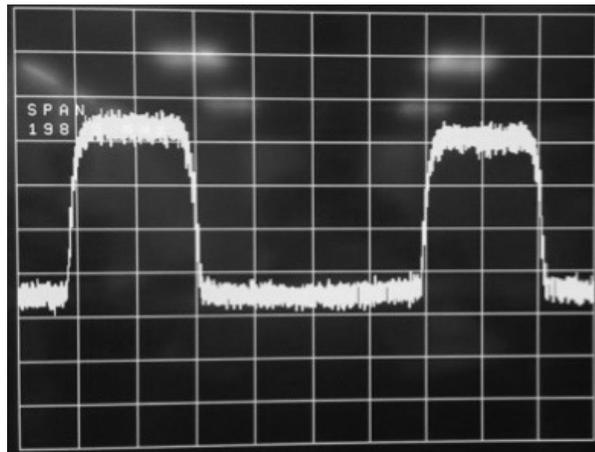

Figure 6. A2C Spectrum for 18 GHz A2C link, 4096QAM, 2x80 MHz channels, supporting total throughput of 1.5 Gbit/s

Transmit Power Performance

Since A2C extends the power output from a single transceiver across two channels, Transmit power output is halved, or reduced by 3dB. Some additional back-off is required to comply with ETSI and FCC mask requirements, so the total system gain reduction when operating with A2C will be up to 5dB. This compares favorably to the same configuration when using a double header radio with an antenna coupler, which would reduce the link system gain by at least 7dB.

Adaptive Operation

In addition to doubling the capacity of a microwave link, A2C is also 'adaptive', in that during adverse propagation conditions, in addition to varying modulation and increasing power using ACM/ATPC, the link can hitlessly transition from two active carriers to just one active carrier. This enables the 5dB power back-off in the remaining channel to be removed, enabling high priority traffic to be maintained.
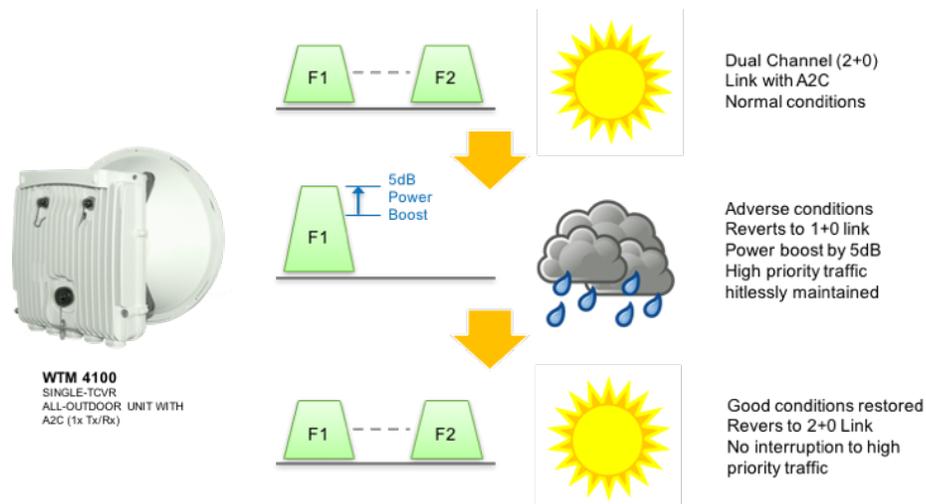
Figure 7. A2C 'adaptive' link operation

Once normal propagation conditions are restored, full dual channel operation resumes. During the event, high priority traffic is maintained over the remaining channel without errors or interruption.

Summary and Conclusions

Adaptive Dual Carrier is a ground-breaking new feature only available on the WTM 4000 from Aviat Networks, and enables a doubling the capacity of a microwave link, without an equivalent increase in the amount of equipment required. Compared to the main alternative of a double header radio, Aviat's WTM 4000 with A2C can support up to 2.5Gbit/s of throughput, without compression, using less power, less equipment, higher reliability and lower price/Mbps.

If you would like to discuss what WTM 4000 can do for your network needs, please contact us at marketing@aviatnet.com.