VODAFONE FIJI SUCCESSFULLY DEPLOYS LOS MIMO LINK USING AVIAT WTM 4000 SOLUTION

THE REQUIREMENT

Vodafone Fiji needed a solution to provide over 2 Gbps of capacity over a distance of more than 6.5 kilometers, but there was only one problem. Lack of frequency spectrum. Vodafone only had a single 80 MHz channel allocation in the 11 GHz band. Using standard link designs, this channel could support just over 700 Mbps of guaranteed throughput per channel using 4096QAM modulation. By combining two radios together in co-channel dual-polarization configuration (CCDP), where each channel runs on vertical and horizontal polarization, the link capacity can be doubled to 1.4 Gbps with the aid of x-pole interference cancellation (XPIC). But, that did not reach Vodafone's capacity requirement. The link length ruled out using 80 GHz E-Band, which could support the larger channel bandwidth needed (eg: 500 MHz at 64QAM), but performance over such a distance would be extremely poor. So, what to do?

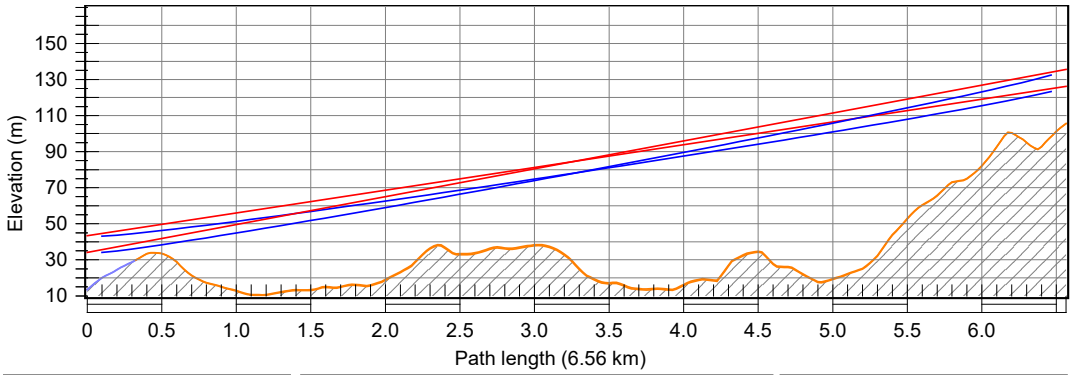

Figure 1: Path Profile of the 6.5 km link required in Fiji

THE SOLUTION

Vodafone turned to Aviat, their long-standing microwave backhaul provider. Aviat was able to design a link using their WTM 4000 all-outdoor radio platform, employing Line-of-Sight (LOS) MIMO to quadruple the efficiency of the single available frequency channel.

WHAT IS LOS MIMO?

MIMO, or Multiple-In-Multiple-Out, technology is a method for multiplying the capacity of a radio link using multiple transmission and receiving antennas to exploit multipath propagation. MIMO has been the mainstay in mobile RAN and Wi-Fi systems for many years, to increase throughput efficiency with limited available bandwidth. LOS MIMO uses the same techniques and applies it to point-to-point microwave.

As shown in the Figure 2 below, two antennas are used at each site. One WTM 4200 is attached to each antenna. Each WTM 4200 operates in 2+0/XPIC mode, as in a regular CCDP system. The second WTM 4200 and antenna is then added to double the link capacity again to approximately 2.8 Gbps, all within the single 80 MHz channel allocation.

For this reason, MIMO is a very useful tool where operators have limited access to additional channels, or in Regulatory environments where high spectrum fees make using wider or additional channels cost prohibitive.

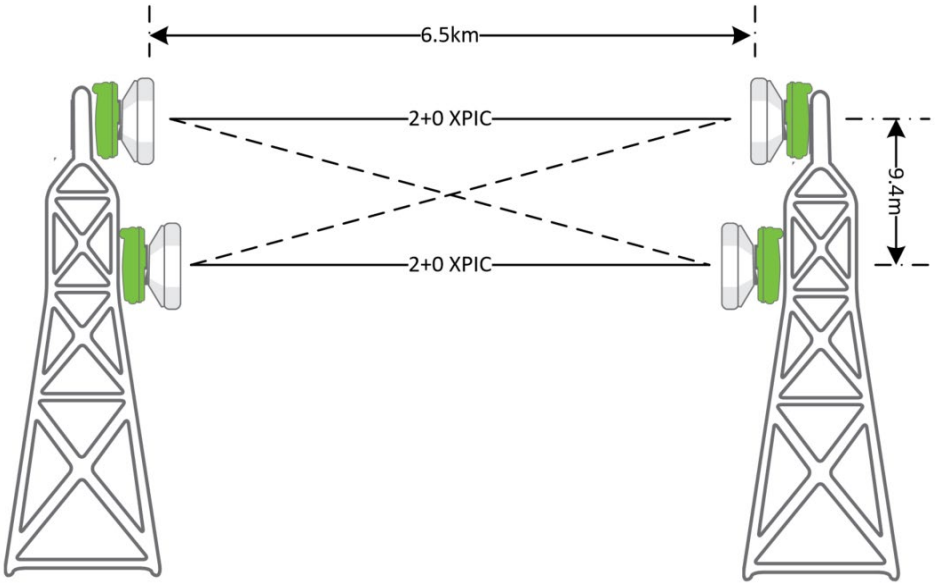

Figure 2: LOS MIMO link architecture

In addition to using XPIC between each polarization on each antenna, MIMO also uses spatial cancellation to eliminate interference between the two antennas. In this was 4x frequency re-use is achieved.

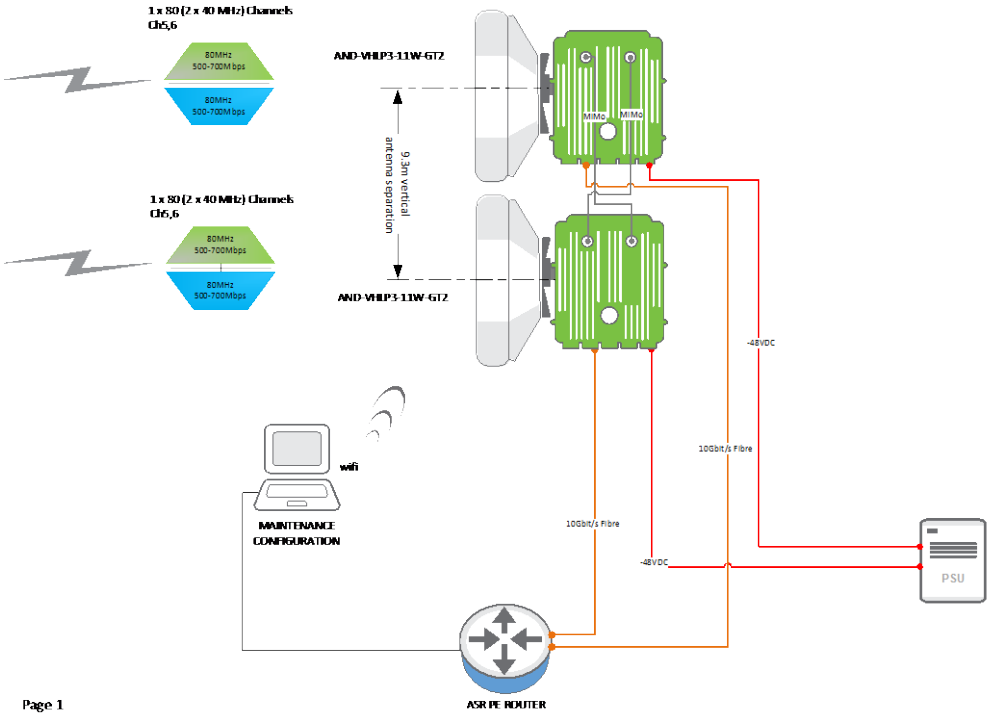

Figure 3: WTM 4000 LOS MIMO radio and antenna arrangement

The key consideration for LOS MIMO is the antenna spacing at each end of the link, which is dictated by the frequency band used and the link length. Essentially the longer the path and the lower the band the larger the spacing between antennas required to get the full MIMO capacity improvement. In ideal conditions with optimal spacing, in addition to the 4x capacity gain, MIMO will also deliver additional system gain of 3dB. For antenna spacings that are 70% of the optimal distance, the full capacity gain is achieved but without the system gain improvement.

Figure 4: Shows the two MIMO antennas installed, and detail of the upper antenna and WTM 4200

The requirement for the additional antenna at both ends of the link, along with the spacing considerations, is the biggest factor to be considered when deploying MIMO. The additional site costs should be weighed versus the benefit of the additional capacity and saving in frequency resources.

THE RESULT

Aviat had designed the MIMO link to support 2.2 Gbps operating at 512QAM to meet Vodafone Fiji's objective with a link reliability of better than 99.999%. This objective was achieved over the monitoring period on the implemented link.

> *"The WTM portfolio has allowed Vodafone Fiji to significantly enable more capacity on the transmission network by using new innovative features such as adaptive dual carrier and MIMO,…..Vodafone Fiji has been early adopters of new technology and I am very pleased to have Aviat Networks as a key partner in helping Vodafone Fiji deliver innovative products and services to its customers."*
>
> **Vikash Prasad**
> **Chief Technology Officer**
> **Vodafone Fiji**

In fact, the MIMO link performance was so good that the modulation was increased up to 4096QAM to achieve a total link capacity of 2.85 Gbps – a 43% increase over the original objective.

The link has since operated flawlessly, with any rain-induced fading countered with ACM (adaptive coding/modulation), where the radios dropped modulation to increase system gain to maintain operation.