Congestion

Technical Case study

How the Aprisa XE achieves high performance despite congested spectrum

A major telecommunications operator in the Middle East needed to make the best possible use of its small number of frequency channels to deploy a large network providing telephone and Ethernet connectivity to rural subscribers throughout the country. The company chose the Aprisa XE from 4RF, because of its superior adjacent and co-channel performance. The network is now fully operational, providing uninterrupted service.

Project background

A common design target for spectrum planners is to have a minimum of two channels of separation between frequencies used in the same region or site. However, today's demands on spectrum usage and frequency allocations mean this cannot always be accommodated. Often there is a need to consider a high level of adjacent channel or even co-channel reuse in the same region or site. The radio equipment's performance, along with the system and network engineering, is a limiting factor for how efficiently the valuable spectrum resource can be used.

Challenges

The key limitation for this deployment was the limited RF spectrum availability. Only five 250 kHz channels were available in the 400 MHz band for the entire country, with approximately 100 links to be installed and commissioned initially. The deployment also needed to include provision for future network expansion.

Frequency reuse was very high inside each of the country's regions, making the frequency planning extremely complex. Some regions required that the five channels be split into smaller channels while still providing the capacity required by subscribers. In the largest region, the initial requirement was for 30 links, with 15 of these to be sourced from one exchange site. All of the frequencies in the region were reused, with each of them split into three sub-channels to provide 15 channels for the large exchange site, with high adjacent channel use.

Although some isolation is provided by the antenna direction or polarization, this is relatively low at 400 MHz with Yagi antennas, and so there was a high reliance on providing adjacent and co-channel rejection.

The project in brief

- Congested spectrum requiring careful network planning, use of adjacent channels and spectrum reuse
- Aprisa XE's SAW filters, highly tuned band-pass duplexers and multi-tap equalization and FEC made this possible
- Over 100 links deployed, with provision for future network expansion
- Network is operational and providing uninterrupted service

Aprisa XE benefits when faced with congested spectrum

The Aprisa XE has a number of design features that contribute to its extremely good adjacent and co-channel performance:

- SAW filters in the receiver, providing excellent rejection of near frequencies.
- Highly tuned pass-band duplexers providing high isolation between transmitter and receiver as well as excellent out of band rejection, in excess of 100 dB, both preventing desensitisation of the receiver.
- Multi-tap adaptive equalization and forward error correction (FEC) in the modem, providing cancellation of signal interference or distortion and correction of errors, particularly important in co-channel or multi-path situations.

Project results

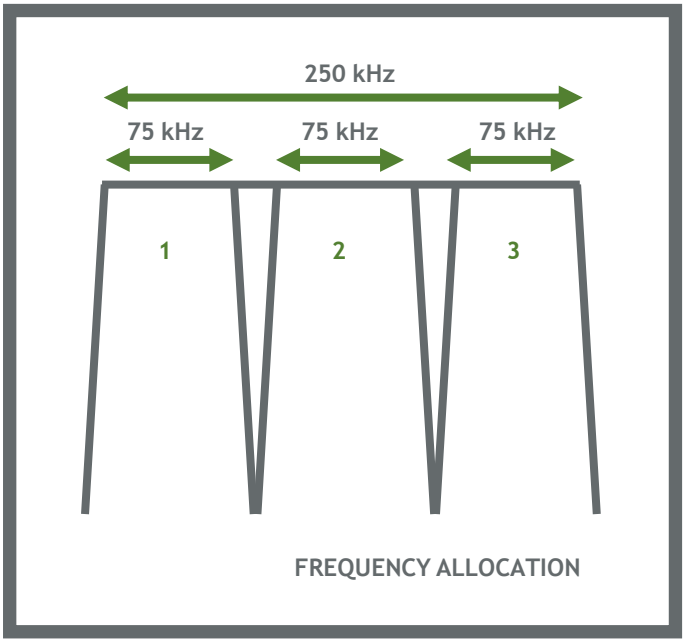
The network has now been commissioned, providing uninterrupted service with the telecommunications operator continuing to add further subscribers to the network.

Network deployment details

The sections below detail the frequency allocation and two major deployments in the network.

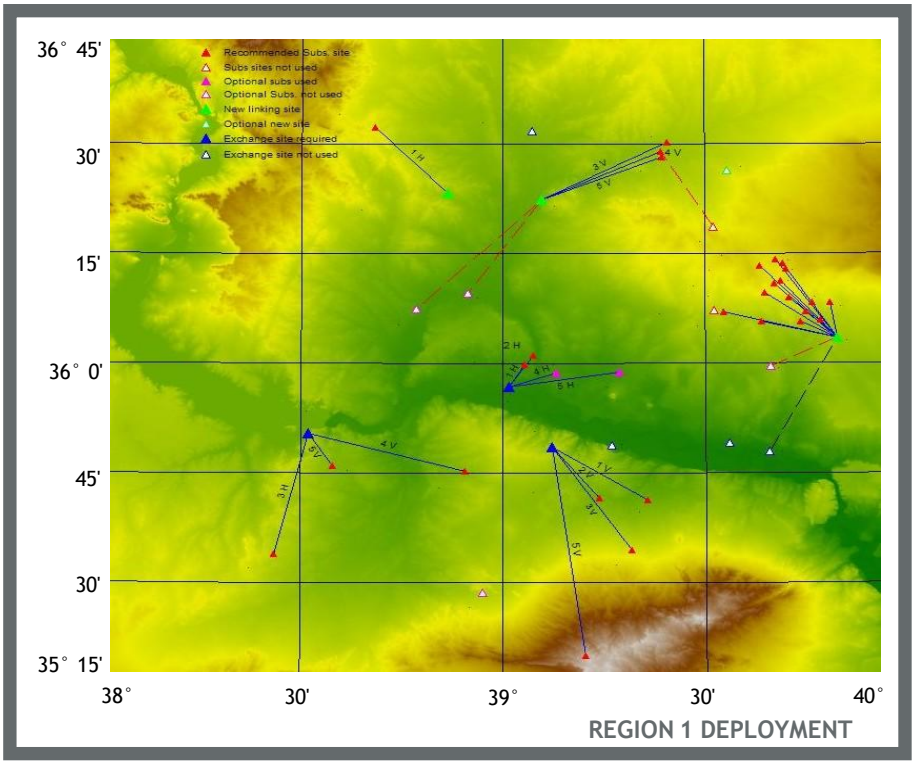
Frequency allocation

Three 75 kHz channels were accommodated in a 250 kHz channel, resulting in three adjacent channels. The channel plan also had three of the five 250 kHz channels as adjacent channels, highlighting the requirement for excessive adjacent channel and co-channel usage in the network design.



Network in Region 1

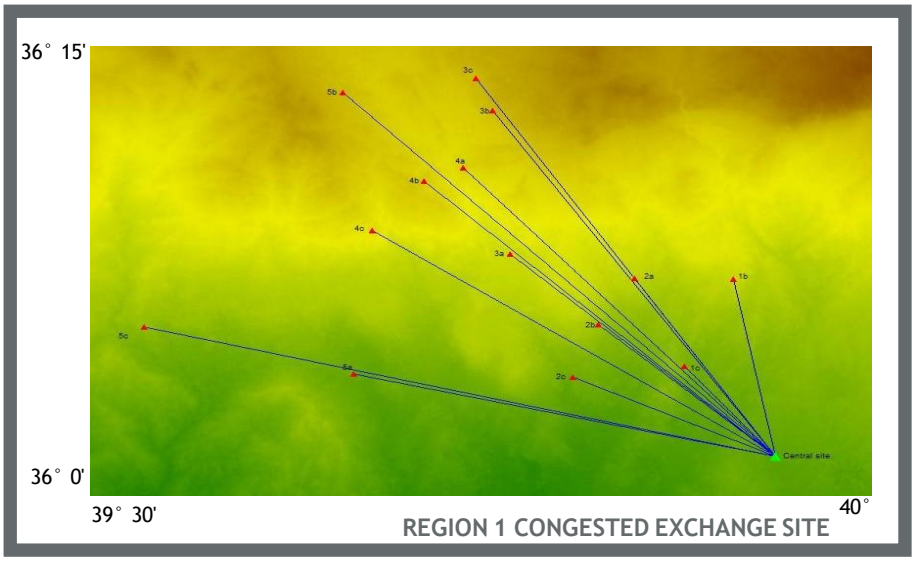
Region 1, one of eight similar regions, has the greatest number of links. The diagram below shows the use of channels 1 to 5, with the use of adjacent channels often in the same relative direction considering the wide beamwidth Yagi antennas used.



REGION 1 DEPLOYMENT

Congested exchange site

The congested exchange site has 15 links of varying distances spurred from it. As well as requiring co-channel interference planning and performance to ensure rejection of interference from the other exchange sites, this site also required a high level of adjacent and second channel performance, given the varying distances of the subscribers serviced from the single exchange site.



REGION 1 CONGESTED EXCHANGE SITE

ABOUT 4RF

Operating in more than 130 countries, 4RF provides radio communications equipment for critical infrastructure applications. Customers include utilities, oil and gas companies, transport companies, telecommunications operators, international aid organisations, public safety, military and security organisations. 4RF point-to-point and point-to-multipoint products are optimized for performance in harsh climates and difficult terrain, supporting IP, legacy analogue, serial data and PDH applications.

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