How we deal with a fading signal over Satellite

Summary

Rain fade can be a serious issue with high frequency satellite communication systems. The signal attenuation changes in rain fade events as the frequency increases or the rain rate increases. KA as an example has far higher rain fade impact than KU because the frequency in KA is higher than KU. The rain rate at 20mm per hour has the impact of no communications on the 30GHZ (KA) spectrum and a <50% throughput in the 14 GHZ (KU) spectrum. For KU communications to have a loss of communications the rain rate need to reach 60mm per hour.

Astrolab’s service has the additional service feature of **Multi-Level Advanced Adaptive Transmissions.** This increases service availability, service quality, and allow more users on a given space segment capacity with Bi-directional adaptive technologies. They include Adaptive Outbound (ACM) and Inbound (ICM), which mitigate impact of Ka-band rain fade.

Simply summarised this feature allows Astrolab to lower the channel rate every second, we gain 3dB when a rain event is detected by doing this. This impact lowers the change in rain fade signal attenuation but with a trade off in throughput performance during the rain event to maintain communications.

Astrolab has a SLA of 99.5% with its KU service.

Case Study- Panama

A case study in rain fade located within Panama City is a relevant example for Astrolab to explain the impact of rain fade. A study of the weather between 2007-2015 in Panama produced the average impact for time and event for KA and KU communications. These are relevant when assessing a KU versus a KA service and also the expected rain fade depending on your location’s average and highest rain rate in mm/per hour. Important notes to consider are:

- KU spectrum for the study was set at 14GHZ whereas Astrolab’s service is at the 12 GHZ band.
- Panama and Papua New Guinea are both in the same climate categorisation for rainfall “P” (*Figure 1 - Rec. ITU-R PN.837-1 1).* This makes the study’s data relevant although in a separate continent.

Panama has a similar rainfall category to Papua New Guinea. Over the study’s period the following dot graph was assembled for a rain rate of over 4 mins per event by the time in the day. For Panama they experience higher rain rate events in the afternoon.

Figure 1 is the dot graph and a good example of the thresholds where throughput is impacted by 50%, 85% and loss of communications. As shown KA has a complete loss of communications at 20mm per hour and a degradation of 50% at 5mm per hour. Whereas KU has a degradation of 50% at 20mm per hour and a loss of communications at 60mm per hour.

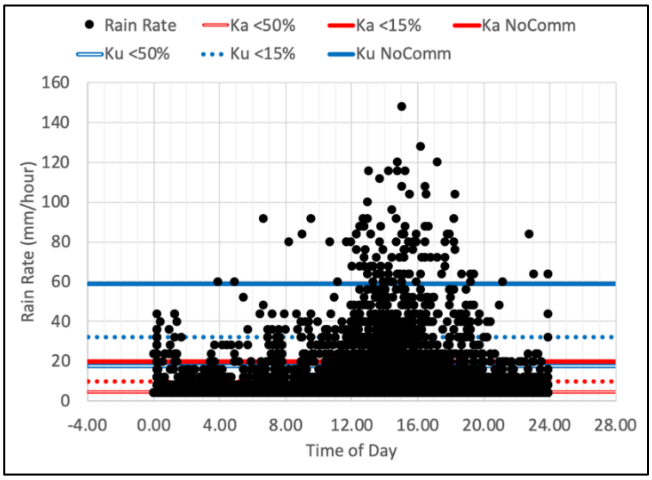

Figure 1

Figure 2 marks percentages of rain fade as a percent of the time the rain fade occurs by the hour. It is a good example that KU has a limited impact due to its higher resiliency to rain fade where in a 4 hour window you should expect rain fade in the loss of communications for over 4 minutes less than 1% of the time. This is compared to KA with a 8% impact.

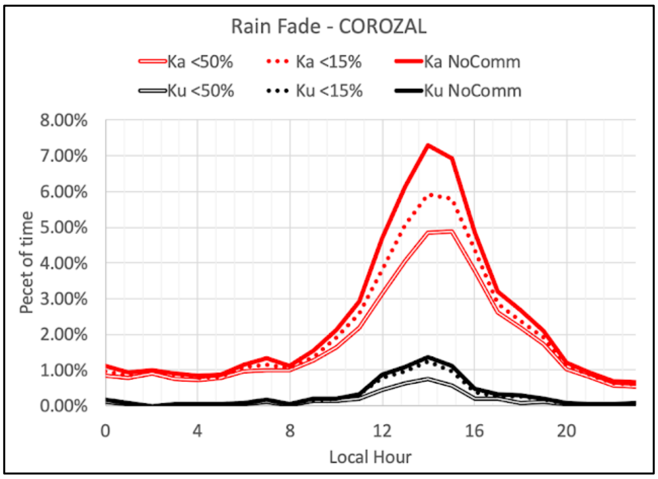

Figure 2

This case study should be used as a guide only to inform your decision making on service choice. Only detailed weather data could inform your exact location’s impact to rain fade.

Adaptive Channel Rate Selection

Astrolab's service features the ability to change channel rapidly to deal with the impacts of rain fade. There is a lot of propriety technology behind this service with our software partners. What it boils down to is it allows us to change the channel selection quickly every burst (second). The impact is we gain 3dB by lowering the channel which lowers the throughput as well. It is a trade off for speed but it maintains communications during a rain event.

This technology was developed for KA due to the constant rain fade signal attenuation that occurs at KA's higher frequency. As Astrolab also uses the technology at KU it allows us to give a normal 99.5% service availability SLA.

As shown in Figure 3, the timeslots used by a VSAT can be allocated to various channels with different symbol rates. ICM-1D exploits the gain differential between higher and lower symbol rates above. The change can be from fast channel to slower channel or vice versa on a burst by burst basis.

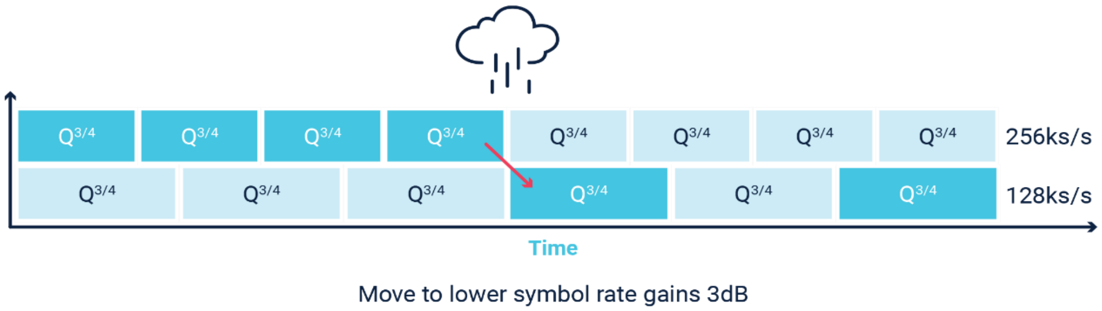

Figure 3: ICM-1D Change to Lower Symbol Rate