ST Engineering

REAP THE BENEFITS OF 4G OVER SATELLITE

Introduction

4G LTE over satellite is arriving to the market at a faster pace than 2G and 3G did when they emerged. 4G carries the promise of a true mobile broadband experience with high volumes, higher speeds and enhanced efficiency, blurring the lines between cellular and wifi. Mobile operators will nevertheless wonder if 4G can be even more successful than its predecessors, and what value it really brings to the subscriber. They will also want to know if there are specific characteristics required to run the service over satellite, and if it is possible to optimize the traffic just like in 2G and 3G to gain bandwidth and decrease the OPEX. Lastly, can 4G deployments be future proof in light of the upcoming 5G standards?

DIALOG

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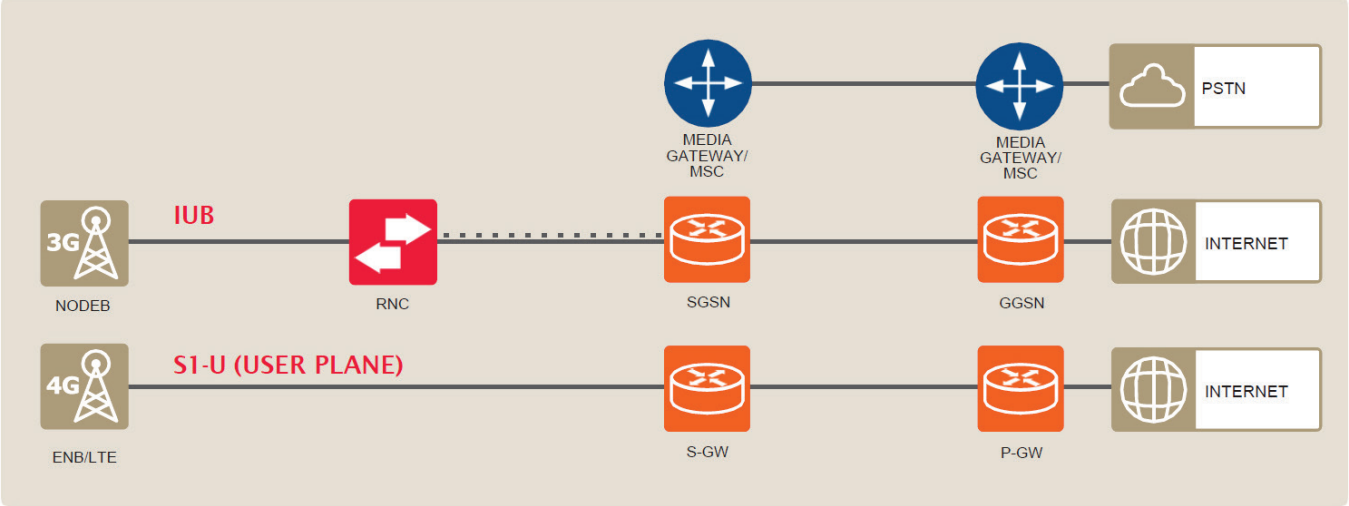
User Experience in the Satellite Environment

User experience in the 3G/UMTS architecture is dependent on the nature of the interface between the remote stations and the core mobile network, i.e. the Iub interface between the NodeB and the Radio Network controller (RNC), and on the architecture of this RNC.

The Iub interface is usually proprietary which makes it difficult to optimize consistently (through silence suppression or compression techniques for example). The RNC on the other hand is impacting the user experience via two mechanisms:

- The RNC has a lot of the radio channels management responsibility where the satellite delay and jitter have a swirling impact on the retransmission rate.
- The RNC scheduling mechanism hampers the throughput available to the end-user.

User experience and OPEX are therefore not necessarily optimal with 3G over satellite.
With 4G, the remote station Evolved NodeB (eNb) carries most of the radio channel management functionality which simplifies the mobile traffic flow. 4G is based on a flat IP architecture, with lower-overhead protocols providing access to user data and allowing accelerating TCP sessions if there is no encryption. This is a unique feature which has the greatest benefit on user experience. It can be addictive to consumers, which in turn will drive data usage and trigger increased revenue for mobile operators.

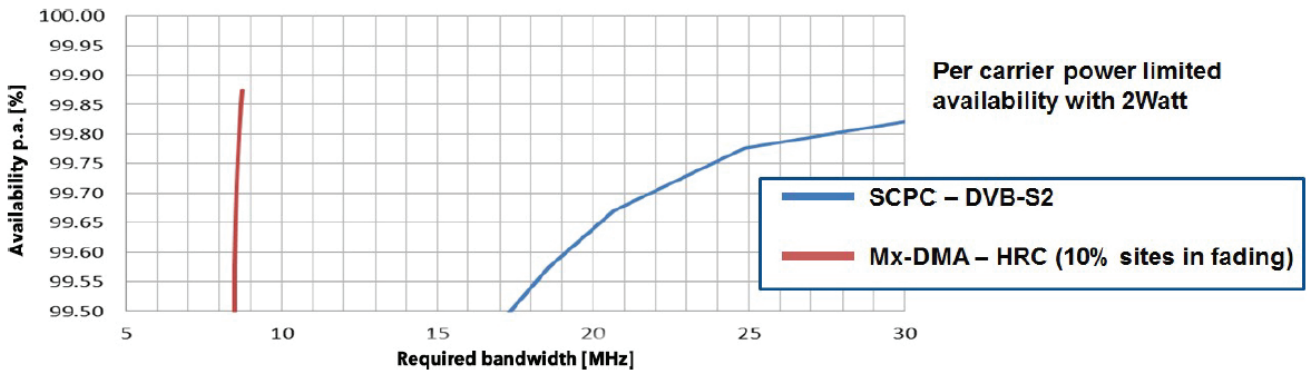


4G Solution with Dialog

Providing the highest Quality of Service (QoS) and controlling the expenditures are two of the key challenges for mobile operators. A 4G satellite solution must ensure the preservation of the voice traffic with guaranteed bit rate under any circumstances and optimized Quality of Experience (QoE). At the same time, the solution must also be able to provide top efficiency in order to guarantee low OPEX and leverage cost-effective solutions such as High Throughput Satellite, Ku/Ka bands and small cells.

These requirements lead to the need of a comprehensive solution where the highest efficiency is provided at any moment. This requirement, in turn, mandates the seamless adaptation of the satellite return channel according to the ongoing traffic and service levels throughout the satellite network, and sharing the bandwidth capacity.

Efficiency can be ensured with the encoding protocol HighResCoding (HRCTM), with high granularity in the modcods and high modulation (32APSK/256 APSK). Seamless adaptation and bandwidth sharing can be ensured with Mx-DMA® which updates the carrier plan every second according to the weather and traffic conditions, optimizing user experience. The same technology uniquely gives top availability over Ku or Ka bands: with Mx-DMA, the additional bandwidth to cope with the momentary deteriorating link conditions and to guarantee CIR at all times is only assigned when fading conditions occurs compared to SCPC where each and every carrier needs to have a permanent excess fade margin. On top of that, whenever an Mx-DMA carrier is resized, there is no risk of bandwidth fragmentation as the band planning is recalculated every second.



MX-DMA® Impact on Service Availability in Ka-band

The table below further compares the characteristics of the satellite return solution for 4G mobile backhaul.

	TDMA	Dynamic SCPC	Mx-DMA
Spectral Efficiency	Low (30% overhead)	High (3% overhead)	High (3% overhead)
Low Jitter	High Jitter	Yes, except for low rate traffic or when dynamic changes come into action	Yes, under any circumstances
High Throughput	Low (1-5Mbps typical)	Very High (over 500Mbps)	High (over 75Mbps)
Seamless Real-Time Efficiency Adjustments	Dynamic adjustments limited to capacity sharing	Yes, but often with increased jitter/latency or packet loss	Yes, totally seamless
Guaranteed Bit-rate	No	Yes (but not in Ku/Ka), and subject to delay for low rate and packet loss when dynamic adjustments take place	Yes (including for Ku/Ka)
Scalability (think Small Cells)	High	Low	Medium
Bandwidth Sharing in Return Channel	Yes	Yes, but slow adjustment rate	Yes

The Case for Mobile Optimization

In addition to the efficiency obtained with the satellite solution, it is often possible to achieve further gains with optimization features. However, while optimization of traffic for 2G E1 had straight-forward benefits, the solutions for 4G have to be chosen on a case-by-case basis. Their benefits are very variable and they often depend on the manufacturer of the mobile infrastructure - even if these entirely follow the 3GPP standards - the type of traffic involved and the encryption level. Several technologies are available which can help reduce satellite bandwidth needs and enhance user experience. The table below summarizes the benefits of optimization:

Optimization Technology for 4G	Benefits	Application
TCP Acceleration	Enhanced user experience	TCP Data traffic
Robust Header Compression	Bandwidth savings	VoLTE traffic
Payload Compression	Bandwidth savings	User data traffic (note that approx. 50% of data traffic can already be encrypted)
Byte caching	Enhanced user experience, bandwidth savings	User data traffic (note that approx. 50% of data traffic can already be encrypted), diminishes retransmission rate (all traffic)

Conclusion

4G democratizes satellite backhaul with the promise of optimal user experience, cost-effectiveness and high throughput capability over satellite. 2G and 3G backhaul over satellite essentially served remote and rural areas, but 4G satellite backhaul is reaching out to urban zones. 4G is frequently used as a wireless broadband solution in replacement of WiMAX for the last mile and it provides an excellent value proposition for critical missions such as emergency rescue services and police and military applications.

LTE broadcast represents another opportunity in the years ahead. 4G over satellite is an essential piece in the seamless connectivity that Internet of Things requires but the complete benefits of 4G over satellite can only be reaped if it is paired with the right solution such as ST Engineering iDirect: mobile operators have very stringent requirements which must be fulfilled!

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