

# Packet Analysis Improves Throughput, Video and Voice Quality

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## White Paper

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### Challenges

Consumption of mobile data has boomed, as masses of new wireless customers use their handsets to spend ever-increasing amounts of time online. Telecom companies are responding by investing heavily in their wireless networks, even as subscriber growth has slowed. As a result, the average ratio of capital spending to revenues has remained stubbornly high, at around 15 percent, for the major players (see Fig. 1), as reported by McKinsey & Company in February 2017.

One of the major challenges of mobile operators is achieving the highest possible efficiency from capital expenditures required to meet increasing amounts of data consumption. Mobile operators are constantly challenged to run their wireless networks at the highest possible level of efficiency to increase bandwidth capacity. Network performance issues that cause packet loss events (see Fig.2) below, reduce real effective user throughput (data transferred per second)

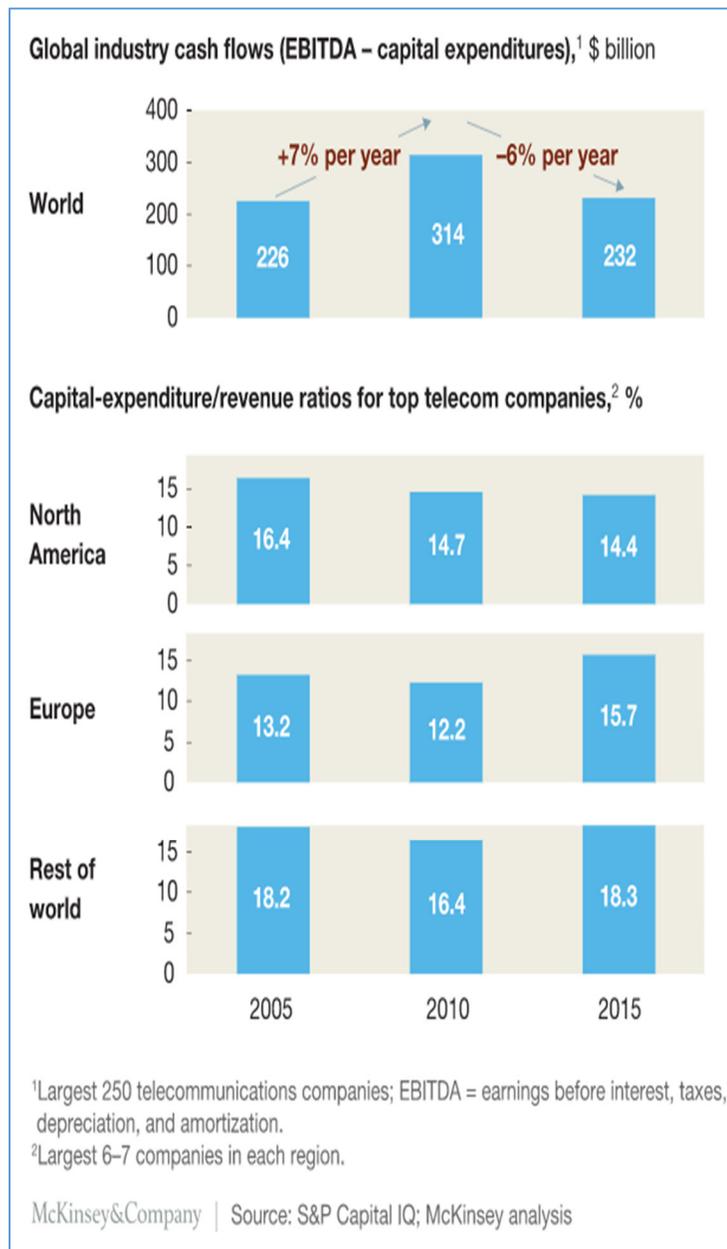
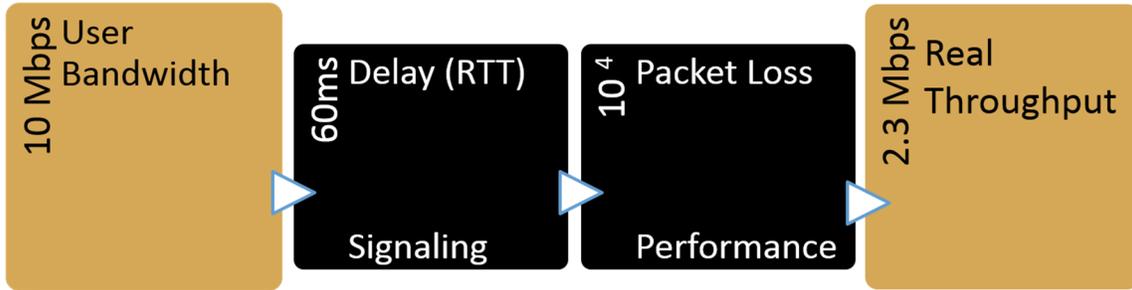


Fig. 1 McKinsey: a-future-for-mobile-operators Feb 2017



**Throughput Definition : E2E Effective Transmitted Bandwidth**

Fig. 2 Packet loss significantly reduces throughput

As described in Fig. 2 user bandwidth or theoretical throughput is impacted by delay and packet loss resulting in significantly reduced real effective throughput. Delays caused by TCP (Transmission Control Protocol) signaling inefficiencies have been mediated using adaptive techniques, but packet loss continues to impact TCP throughput. Since TCP is very susceptible to packet loss events and most of the data traffic on mobile networks uses TCP, the focus for this white paper is packet loss events that lowers TCP throughput, video and voice quality.

Packet analysis is used to determine packet loss effect on TCP throughput. A congestion avoidance algorithm, activated by packet loss events reduces throughput.

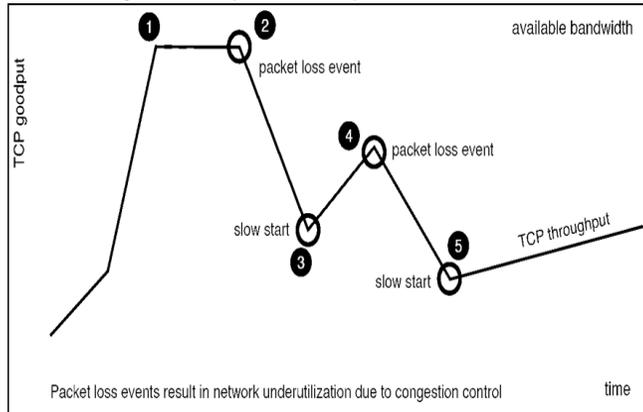


Fig. 3 Packet loss events effect throughput

As shown above in Fig. 3, available bandwidth is discovered at 1 then at 2 a packet loss event occurs and TCP begins its slow start process (3) in order to determine the link bandwidth then repeated at 4 and 5. Therefore, periodic packet loss events that occur in sub-second time intervals have a greater effect on end to end effective throughput than continuous packet loss events that occur over longer periods of time as shown in Fig. 4 below.

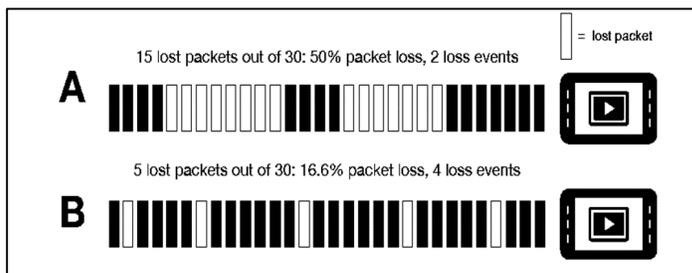


Fig. 4 Packet loss events vs. packet loss effect on throughput

Network A in Fig. 4 above has fewer packet loss events, but a very high packet loss rate. Network B has many more loss events, but a much lower packet loss rate resulting in lower throughput.

The problem is sub-second packet loss events trigger a TCP slow start process that reduces session throughput by 50%. These sub-second packet loss events and the frequency of their occurrence has a significant effect on throughput, video and voice quality. In addition, since existing performance counters from equipment vendors is hourly or fifteen minute average reporting, they cannot detect and analyze sub-second packet loss events. Even five minute performance counters, currently the most detailed available flat-line the events (See Fig. 5) providing little or no value. Therefore new packet loss event analysis is required to detect and analyze loss events that cause throughput and voice quality issues.

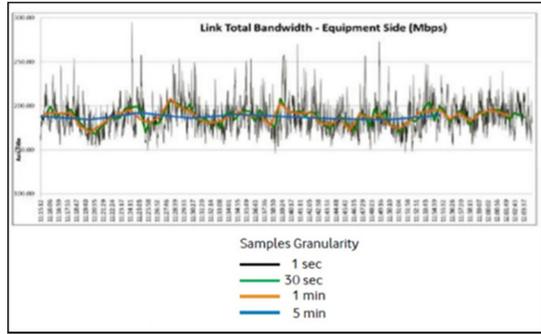
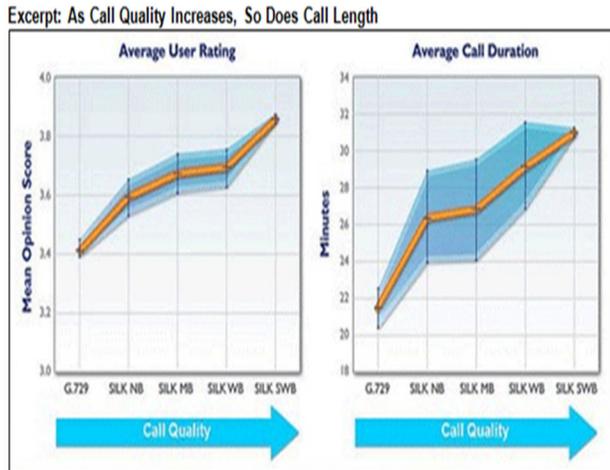


Fig. 5 Micro-second granularity required

## Opportunity

Unlimited data plans are putting significant pressure on LTE networks, requiring capacity upgrades to retain throughput speeds. Also, the faster the throughput speed the higher the network capacity. As highlighted earlier in this white paper, packet loss events reduce throughput. Therefore, mobile operators are able to increase data tonnage by reducing packet loss events. By increasing throughput on affected cells that increases data tonnage, mobile network efficiency is increased which reduces the CAPEX spend required to increase capacity.



Source: Skype

Fig. 6 Skype analysis of voice quality vs. customer satisfaction

In addition to increasing internet speed, reducing packet loss events is also a very effective way to increase voice quality and thus decrease customer churn. Skype has determined that call duration increases by as much as 25% when call quality increases by just 0.2 points on the Mean Opinion Score (MOS) scale (i.e. 3.4 to 3.6) as highlighted in the above (Fig. 7) graphs. In addition, Nokia research highlights that in addition to internet speed, call quality is also a major loyalty factor, especially in the U.S.

Increasing the capacity of existing infrastructure by increasing throughput on affected cells reduces CAPEX spend associated with network capacity. In addition, packet loss events that lower throughput, video and voice quality have the highest impact on churn caused by network quality issues. By reducing these network quality issues which account for 26% of churn (Nokia research), mobile operators are able to increase revenues and profitability.

## **Solution**

It can be appreciated that methods for throughput, video and voice optimization for mobile networks have been in use for years. Typically, mobile operator network teams drive test the mobile network to identify areas that need improvement. Drive testing has become less effective since packet analysis is required to determine packet loss event effect on throughput, video and voice quality. In addition, problem resolution recommendations include; cell parameter optimization, load balancing, interference management and cell coverage. As a result, intra cell automated cell planning (ACP) recommendations significantly reduce OPEX as compared to existing manual time consuming methods.

The main problem with conventional throughput, video and voice quality optimization is existing mobile network element based KPIs are not granular enough to detect and analyze packet loss events. Solve these problems by providing packet analysis that non-intrusively detects and analyzes packet loss events. Unique algorithms provide packet loss event indicators for encrypted and non-encrypted data flows that reduce throughput, video and voice quality without utilizing personal subscriber data.

## **Conclusion**

This white paper discusses why packet loss events are a serious problem for all IP, packet based, mobile networks, causing serious throughput, video and voice quality issues not currently detected and analyzed. These loss events reduce network capacity, video and voice quality which impact network CAPEX spend, churn, mobile operator revenue and profitability. Solve these problems by providing packet analysis that non-intrusively detects and analyzes packet loss events. Unique algorithms provide indicators for data flow (including encrypted data) packet loss events that impact throughput, video and voice quality without utilizing personal subscriber data.

Increase network throughput, video and voice quality with packet analysis to reduce CAPEX spend as a percentage of revenue.