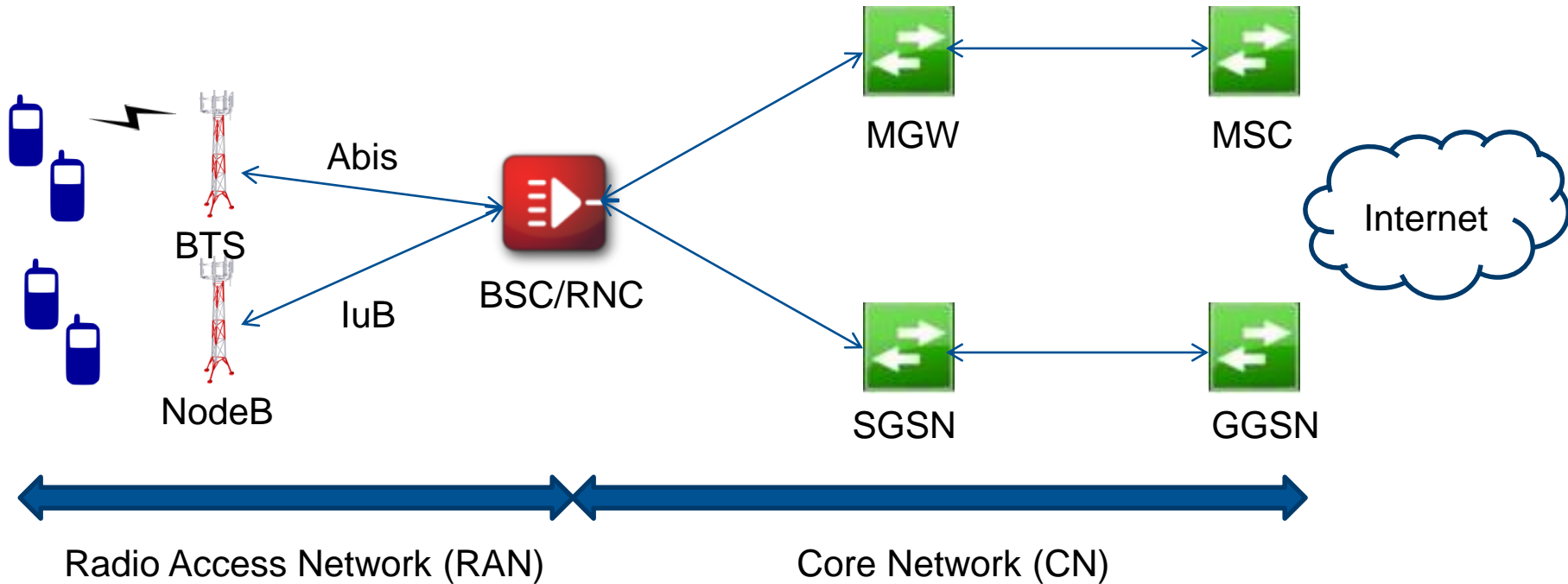


*What is Needed from your  
Satellite Ground Infrastructure to  
Support 2G, 3G and LTE  
Backhaul with Superior Quality of  
Experience for End Users?*

GVF London, June 2017



# 2G and 3G architecture



Abis (2G) voice was for the first 20 years only circuit switched. Most traffic carried today is still over E1.

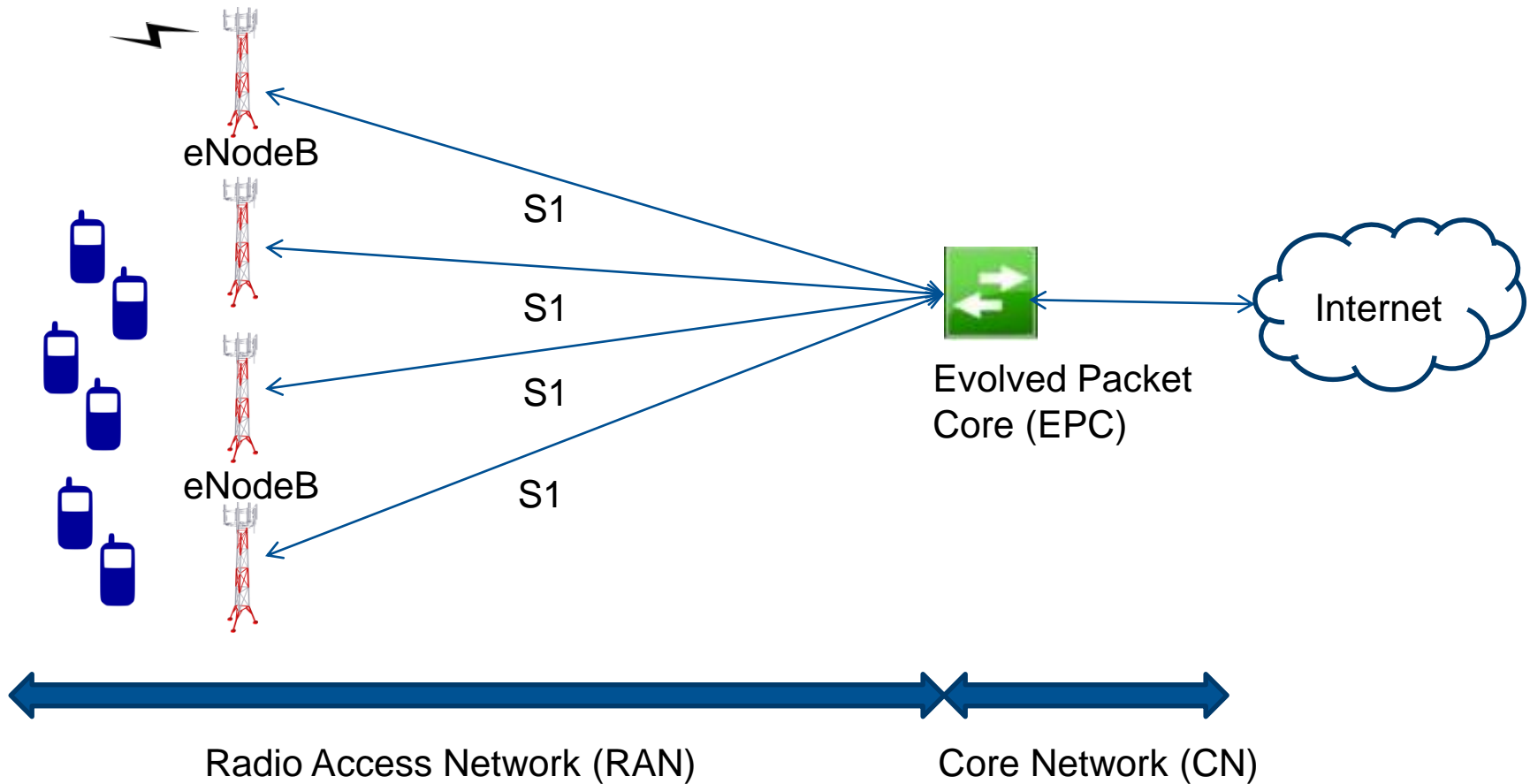
IuB (3G) voice and data was initially E1 based but quickly migrated to IP

Voice is circuit switched (dedicated resources) and data is packet based

Common for both is that signaling to manage end user traffic is handled by the

RNC/BSC on the “wrong” side of the satellite backhaul link. Very sensitive to jitter.

# LTE architecture



LTE is a flat architecture. Only IP services defined with no circuit based voice service. VoLTE is actually an afterthought and suffer from limited penetration and poor roaming support. Signaling to manage radio resources is local to the eNodeB -> faster feedback loop

# Characteristics of 2G, 3G and LTE

- Jitter causes packets to be lost or dropped
- Voice – humans can handle jitter as we understand context. Traffic is sent unacknowledged over IP/UDP.
- Example: “it is 33 degree outside and London suffers from a #%@\$ wave”
- Data – cannot handle jitter. Traffic is mostly TCP based and acknowledged. Reason is machines or “things” do not understand context.
- When jitter is present retransmissions occurs.

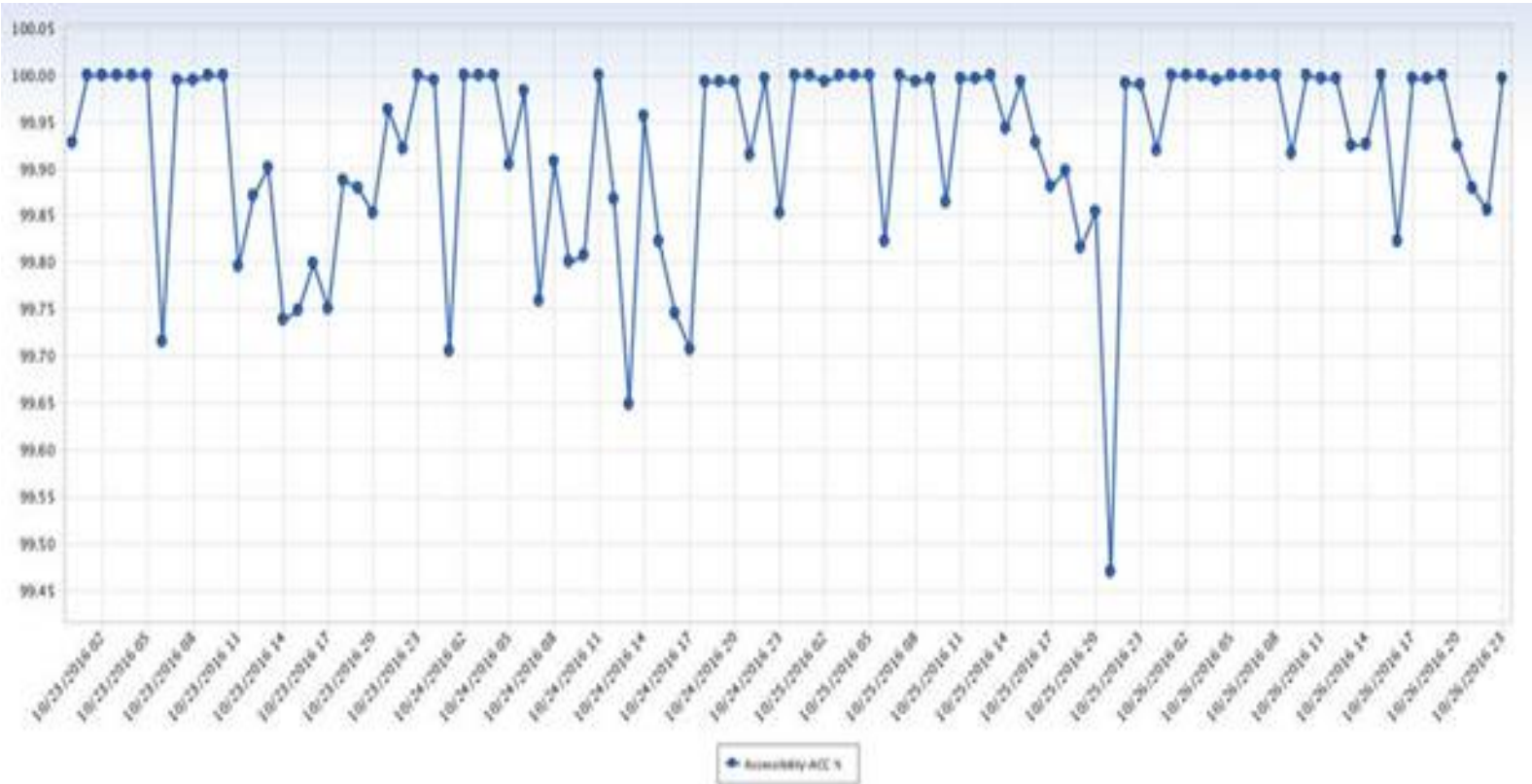
# Importance of mobile network KPIs

- End users perceived performance highly reflects how they view their mobile operator. Direct correlation to customer satisfaction, retention and revenue.
- All mobile operators use KPI's to drive performance in their network. Many of these KPI's are also closely watched by Telecom Regulators as they are sometimes part of the spectrum license agreement.
- There are literally thousands of KPI's but a few stand out like RRC Accessibility Rate. It measures if a phone can get access to and start to use the mobile network. Goal is to drive this parameter to 100%

# Examples from real deployments

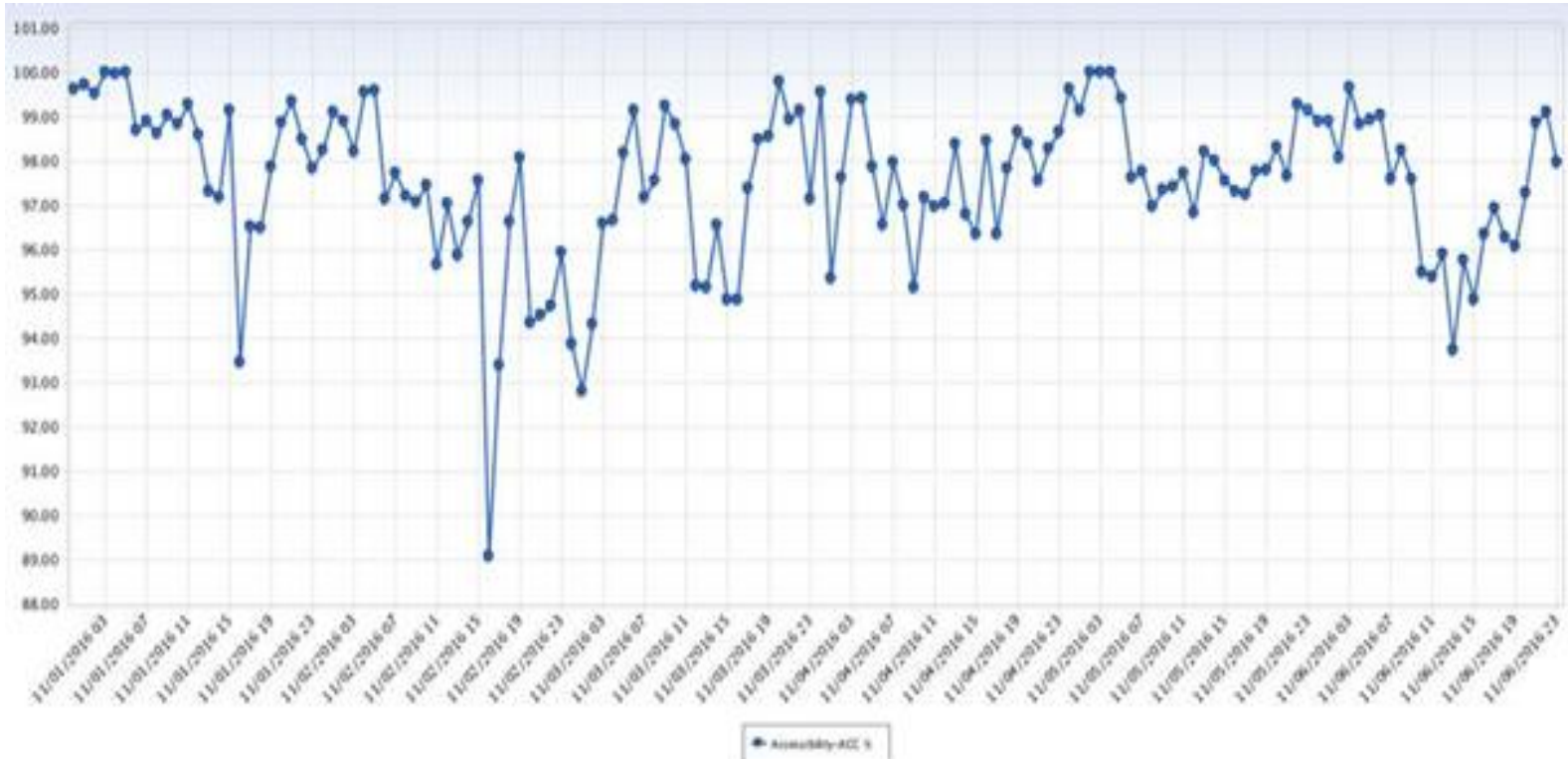
- Comtech has collected statistics from hundreds of 2G, 3G and LTE sites running over satellite from operators all over the world.
- Database include satellite backhaul technologies from all major satellite equipment manufacturers and mobile network infrastructure suppliers.
- Following slides are examples on how different backhaul technologies effect the Quality of Experience for end users and ultimately the bottom line of the mobile operator.

# KPI when using SCPC



- RRC Accessibility Rate KPI is around 99.95%
- 5 out of 10000 voice or data calls has to re-try
- Network is performing well and meet MNO's target

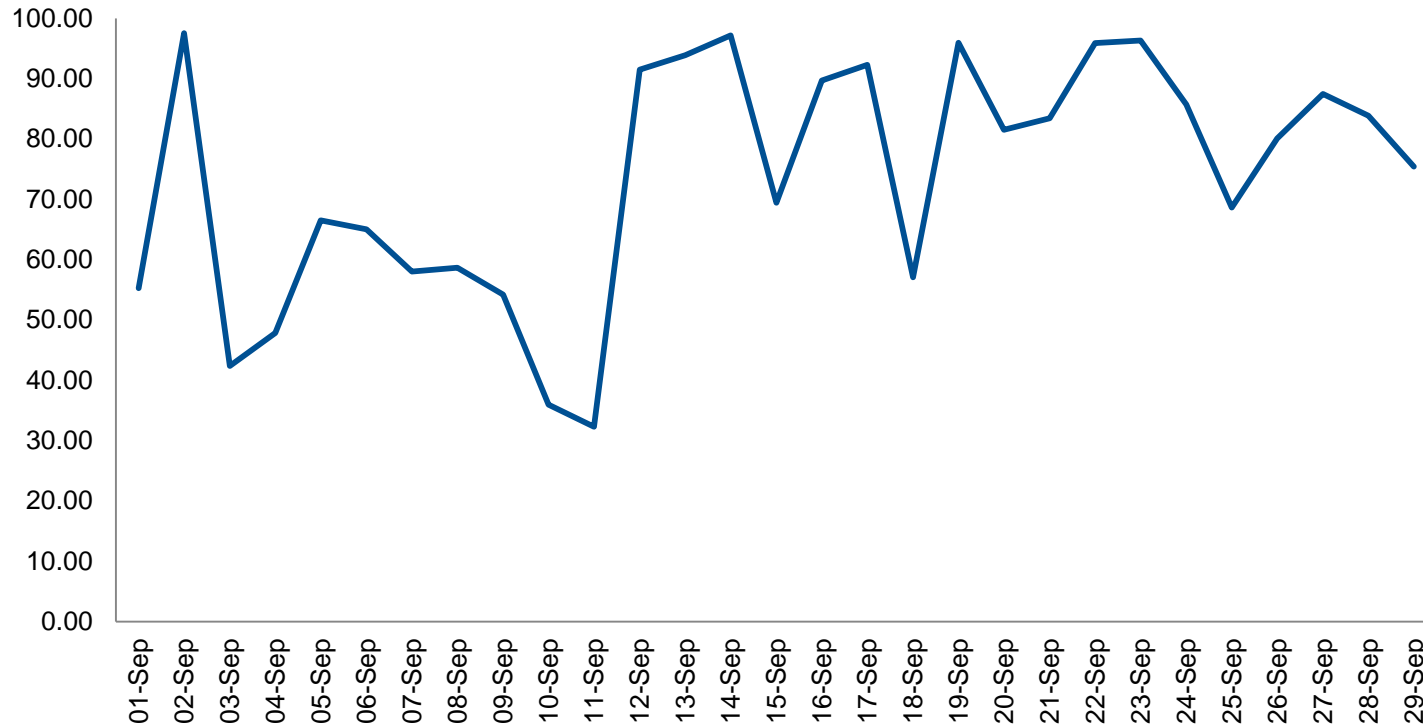
# KPI when using TDMA solution 1



- RRC Accessibility Rate KPI of 96.5%
- >3 out of 100 voice or data calls has to re-try.
- Poor QoE and significant re-transmissions on luB
- Loss of revenue



# KPI when using TDMA solution 2



- RRC Accessibility Rate KPI of 70%
- Far outside any acceptable level of performance
- Network eventually changed to SCPC

# Conclusion

- Not all satellite backhaul is created equal and negative effects of jitter and latency are real.
- Real life statistics show that that TDMA has difficulty achieving the same network performance as SCPC.
- Remember that in mobile backhaul there is one transmission link that carries all traffic (voice, data and signaling).
- A poor quality link to a base station effects hundreds or thousands of users and not only a handful end users like in many consumer and enterprise services.



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