



Virtualized Ground Station

Wideband Signal Processing

DIFI WORKSHOP



Introductions

Who is KSAT?

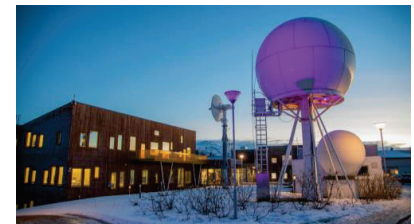


Kongsberg Satellite Services (KSAT)

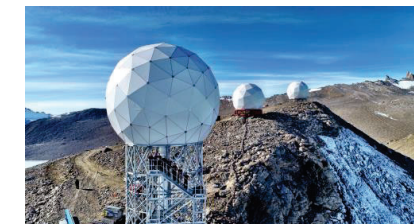
World's largest LEO Satellite Ground Station Network
350+ Groundstations over 25+ locations



Svalbard (78° North)



Tromsø Norway - KSAT-HQ (69° North)



Troll Antarctica (72° South)

WORLD CLASS – Through people, technology and dedication

KONGSBERG PROPRIETARY - See Statement of Proprietary information

A few facts about KSAT

- 1.7M+ satellite contacts per year across the network
 - 99.5% Proficiency
 - 99.9% Availability
- Svaldsat (150+ Apertures)
- Multiple Bands & Sizes
 - UHF / S / X / Ku / Ka
 - 3m – 13m LEO Apertures
 - 20+m Lunar Apertures
 - 50cm Optical-1550nm
- Approx 35% of Groundstations have been virtualized
- API service (Ground Station aaS model)
- All services are automated & M2M

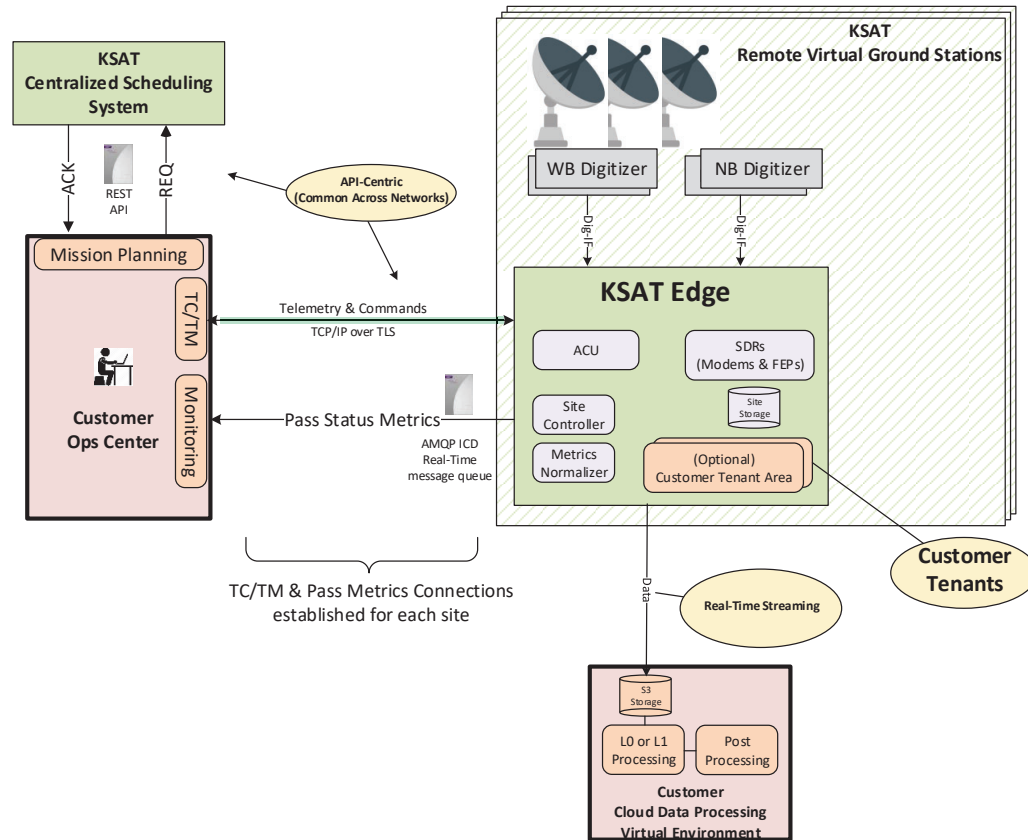


Virtualized Ground Station

KSAT's Virtual Ground Station

- Foundational Components
 - Digital-IF (DIFI standard)
 - Cloud Compute Solution (Edge or Public)
 - SDRs

- Performance
 - S & X-band (up to 400MHz bandwidth)
 - Direct S-Band Digitization (sampling)
 - 2Gbps throughput (dual-pole)
 - Limitations of Bandwidth & SDRs
 - 1min setup time (limited by mechanical)



Wideband Signal Processing

What is Wideband?

«Wideband» varies by application, band & decade:

- Deep Space vs. LEO vs. HTS vs. Relay
- Optical vs. RF
- 1990s vs 2000s vs 2010s

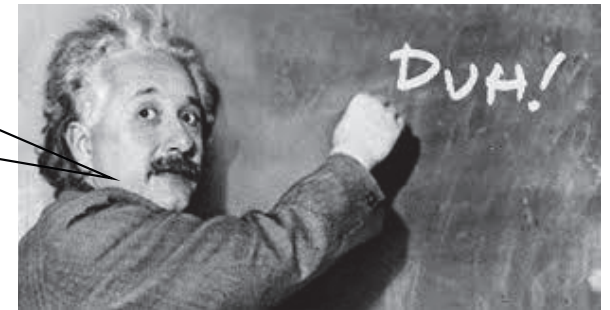
KSAT's Definition:

- Payload (or X-band) services
- Typically greater than 20MHz Bandwidth
- Large range of BW's: 20MHz – 1500MHz

For Virtualized Ground Stations: The Digital-IF network BW is now a defining factor for Wideband

- Digital-IF BW > 1Gbps (approx 40MHz)

Wideband is defined
as being wider than
Narrowband



Digital-IF Bandwidth is the number one challenge for our
virtualized architecture

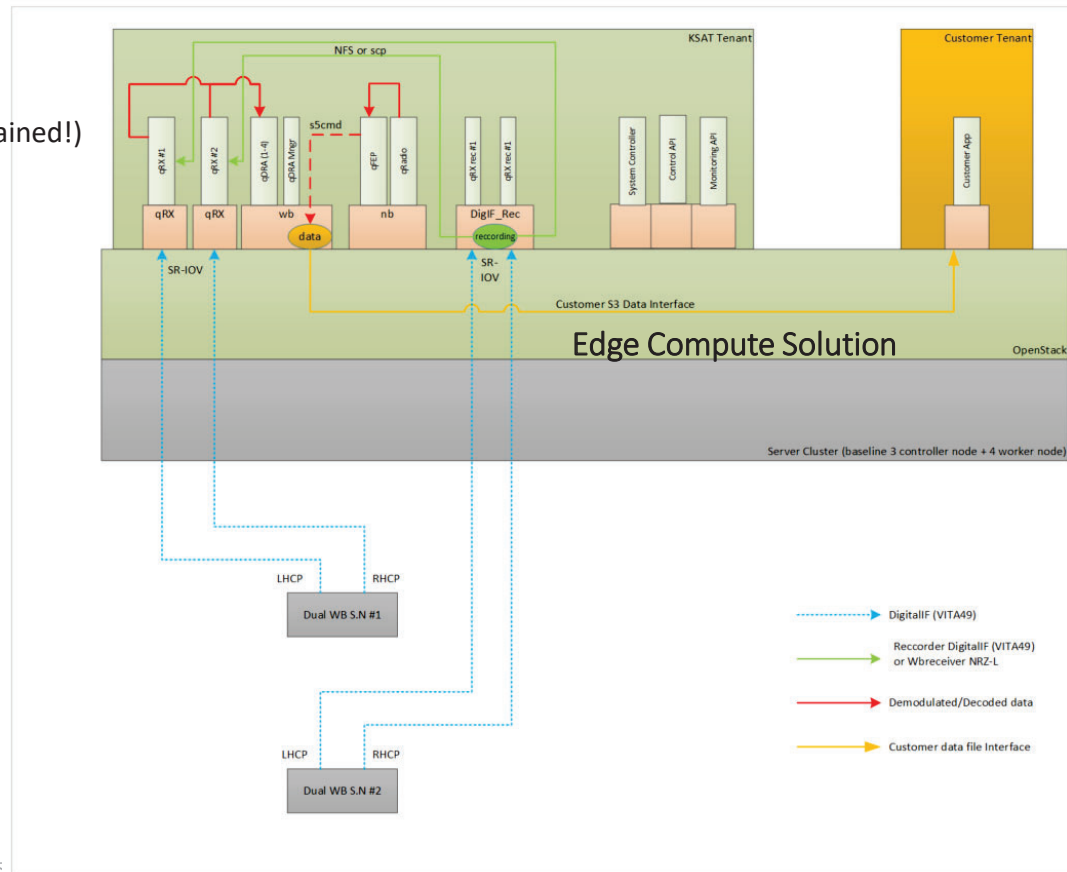
Processing Solution

Stressing Wideband Use Case:

- 400MHz Bandwidth
- Digitizer: 475Msps (Digital-IF BW: 7.6Gbps sustained!)
- 516Mbps Datarate
- 8PSK + R/S

Challenges

- Digital-IF Packet Loss
- CPU Interrupt Servicing
- Memory Access
- CPU type & quantity



Next Frontier

Where do we go next?

Use Cases which remain untapped or just beyond the horizon

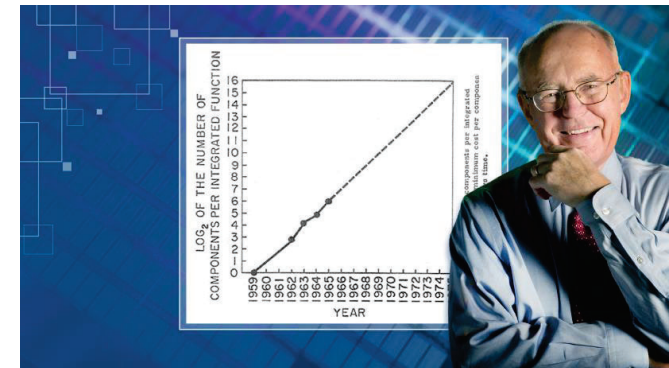
Ka-Band (1500MHz spectrum)

- 4x what we can do today

Chasing Moore's Law

Digital-IF long haul transfer

- Public Cloud processing
- Sensitive / Restricted Processing solutions



Takeaways

Virtualized Ground Station Architecture has brought significant efficiencies

- Reduced bespoke «boxes» and simplified/standardized supply chains
- Simplified and expedited remote site setup
- Quicker / More Flexible waveform adaptation

Overcoming Challenges / Lessons Learned

- (Cloud and Network Engineers) vs. (Traditional RF & Infrastructure Engineers)
- **Packet Loss** is an architectural killer for Digital-IF (Virtualized) architectures