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Digital IF Interoperability for Satellite and SATCOM applications – IEEE (Topic – Interoperability, compatibility, and standards)

GSAW

February 23 – March 3, 2022

The Future is Digital!

“90% of CEOs believe the digital economy will impact their industry, but less than 15% are executing on a digital strategy.”
— MIT Sloan and Capgemini

“There is no alternative to digital transformation. Visionary companies will carve out new strategic options for themselves — those that don’t adapt, will fail.”
— Jeff Bezos, Amazon

"Some people don't like change, but you need to embrace change if the alternative is a disaster."
- Elon Musk, Tesla Founder

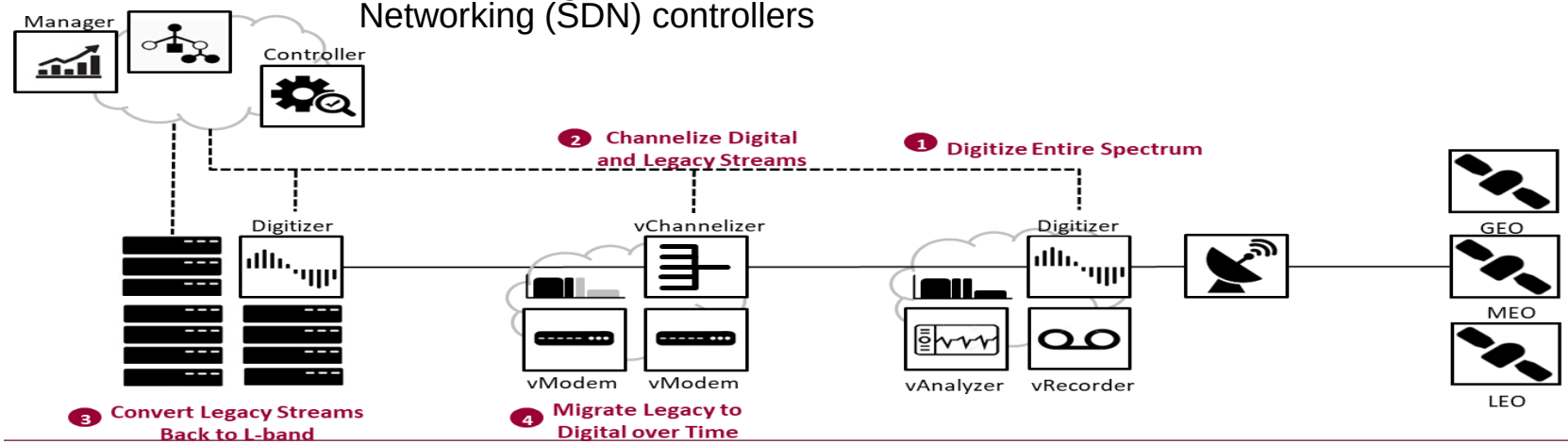
"It's no longer the big beating the small, but the fast beating the slow." - **Eric Pearson, International Hotel Group CIO**

“We went from being the Flintstones to the Jetsons in 9 months.”
— Dan Schulman, PayPal

“When digital transformation is done right, it’s like a caterpillar turning into a butterfly, but when done wrong, all you have is a really fast caterpillar.”
— George Westerman, MIT Sloan Initiative on the Digital Economy

For Space, Digital Starts with Digital IF

1. RF Spectrum is captured, digitized and converted into IP packets (Digital IF/RF)
2. Routing of the digital IF/RF spectrum using IP network
3. Virtualized distribution and processing of Digital IF/RF IP stream
    1. Convert back IF/RF to use legacy modems
    2. Process using orchestrated Virtualized Network Functions VNFs and Software Defined Networking (SDN) controllers



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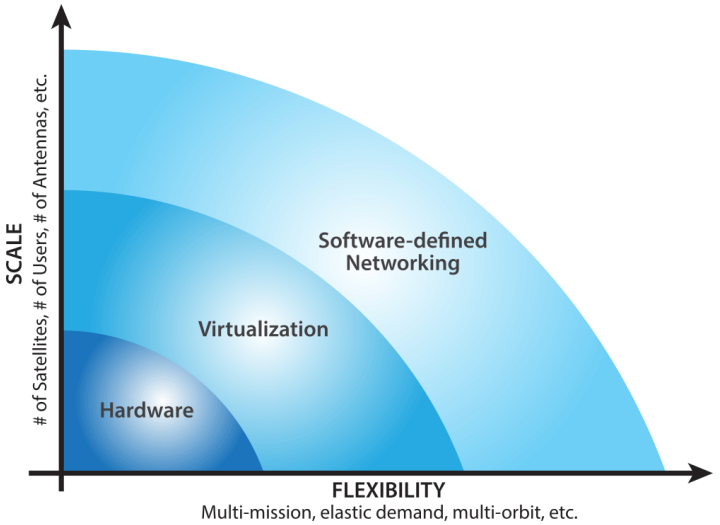
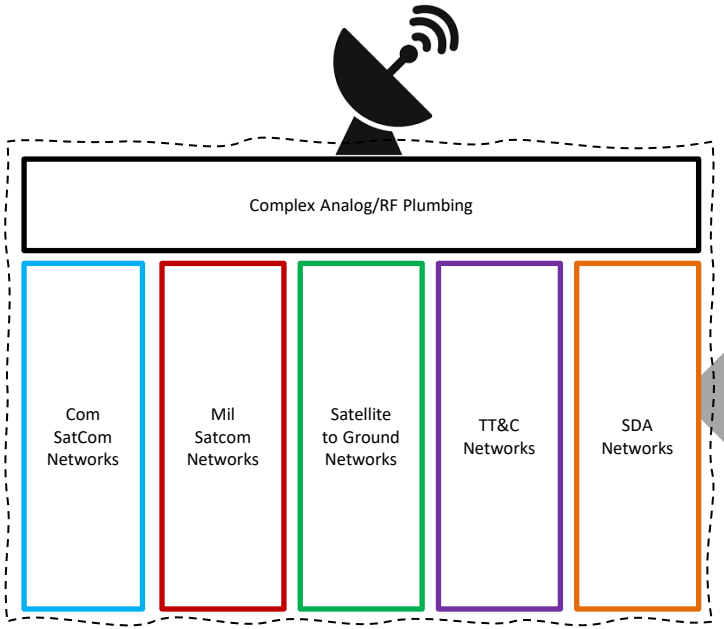
Why Go Digital?

- Better and easier ways to manage signals
  - Group delay, slope, power levels, pre-equalisation and other common signal distribution issues
- New architectures
  - Extended distances between the baseband and earth station locations are achievable
    - RFoFibre is good, but it has its limits
  - Greater diversity and resiliency options
- Enables use of virtualization, Software Defined Networking (SDN), and Cloud technologies
  - Dynamically reconfigurable
  - Enables automation at scale
  - Take Space from 2G to a 5G world
- Moore's and associated laws all work in your favor



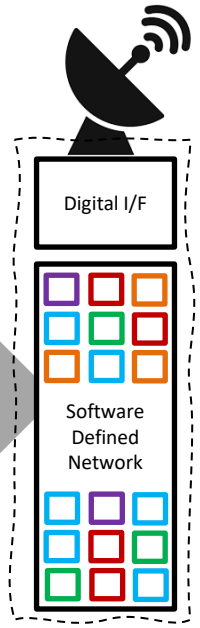
Collapse Infrastructure with a Software Define Ground Platform



Static, stove-piped network infrastructure

(Heavy CapEx, Low Resilience, Under Utilized, High TCO)

Digital Transformation



- Digitize once
- General Compute, Cloud
- Software-Defined
- Dynamically configurable
- Open Interfaces
- Secure

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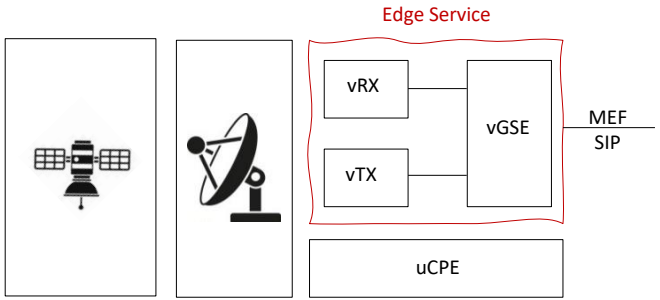
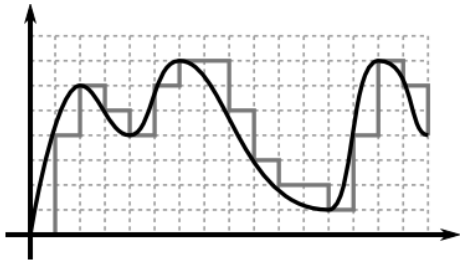
Remote Terminals Can Become Agnostic Devices

- Antenna/RF chain with generic compute
  - Applications only limited by antenna/RF capabilities
  - Leverage remote platforms' compute
- Generic compute enables:
  - Virtual modem defines application/network
    - Same terminal can seamlessly be used across different networks, satellites, or even applications
  - Other applications (firewall, WIFI, etc.)
- Compatible with SWAP/cost sensitive ASIC based remote terminals

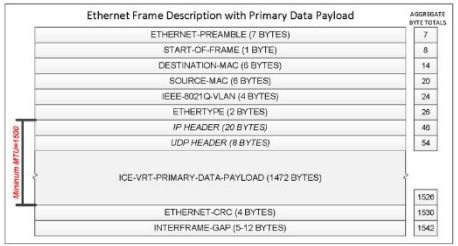


What is the Problem?

- Analog IF/RF has one big advantage over digital IF/RF:
  - Natural interoperability
  - Which ensured broad and deep supply chain



- First step of going digital is Creating a Digital IF/RF IP data stream
  - Problem is there are lots of ways to stuff bits in a packet
  - Digital IF suppliers have tended to follow framework standards like VITA-49
    - Vita-49 does not ensure interoperability



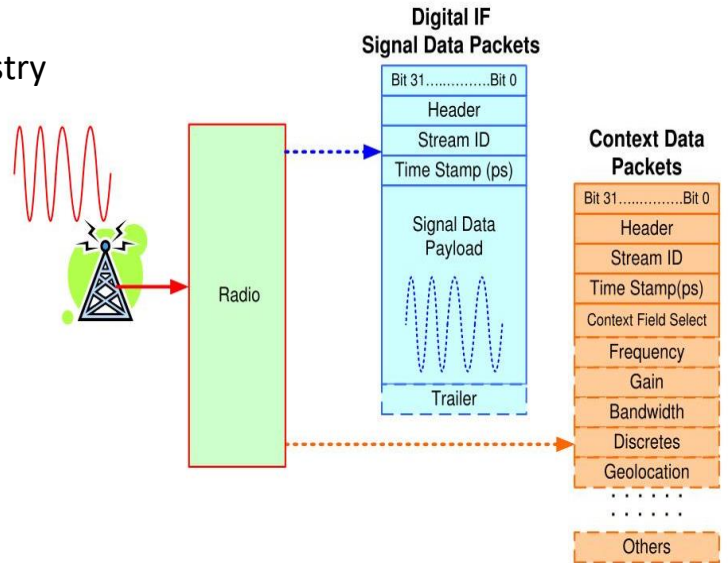
- Industry needs to a widely adopted interoperable digital IF standard to ensure a strong supply chain
  - Prevent vendor lock-in
  - Allow wide scale adoption

Goal: Digital IF Interoperability (DIFI) Consortium

- Goal: Wide adoption of an interoperable Digital IF standard
  - Match the interoperability that is native to analog IFs (e.g. L-band)
  - Create an open, simple, interoperable digital IF standard
  - Encourage adoption of the standard throughout the industry

- Purpose:
  - Define an interoperable standard based on VITA-49
  - Design standard for easy adoption
  - Publish as an open, referenceable standard
  - Provide a way to certify compliance
  - Market the standard through the satellite industry

- Structure: simple as possible
  - Leverage IEEE-ISTO to manage the Consortium and specification
  - Free spec, straightforward certification, membership a good value



DIFI Consortium Formation

- Formed under IEEE-ISTO on 18 August 2021, Publicaly announced on 31 August 2021:
  - Diverse set of founding board members:
    - Kratos Defense
    - HawkEye 360
    - Intelsat
    - Kongsberg Satellite Services AS (KSAT)
    - Kymeta Corporation
    - Microsoft Corporation
  - Obtained VITA Group release to use their IP and create derivative works
  - Ratified 1.0 specification: IEEE-ISTO-4900-2021 Digital IF Interoperability Standard (DIFI Standard)
    - Simple, data plane only, minimum viable specification to ensure interoperability
    - Available as a free download for organization web site (www.DIFIconsortium.org)

Consortium Structure

Board of Directors

- Govern organization
- Final approval over specification and certification

Membership Dues

- Gov't/non-profits $0
- Member companies $5K/yr,
- Board member $15k/yr

Standards Working Group

- Suggest, evaluate, and provide recommendations to the board on changes to the standard
  - All member companies can each have 1 vote within the working group.

Certification Working Group

- Owns certification software and process. (self certification or 3rd party certification)
  - All member companies can each have 1 vote within the working group.

Space Industry Specification Users (non-Members)

- Specification and certification available to both member and non-member companies for free
- Once implementation is certified, Companies are encouraged to publicly announce that and put it on their product

Organization Status

- Healthy membership growth and industry support
  - Strong US military and industry support
  - Members of Digital Interface Standard (DIS) to join DIFI
  - Over 250 downloads of the specification
  - Specification included in US Army EDIM modem RFI
- Specification Working Group (WG)
  - Minor technical adjustments to existing 1.0 Specification
  - Extensions and new specifications (e.g. symbols, control plane)
- Certification Working Group
  - Certification software package
  - Self and 3rd party certification programs
- Members web portal:
  - https://members.dificonsortium.org/wg/DIFI/workgroup/home
  - Includes all formal documents, membership roster, etc.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