DIGITAL TELEPORT

HOW THE 5G JOURNEY RUNS THROUGH CLOUD AND VIRTUALIZATION

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ST Engineering
iDirect

TRANSFORMATION
CLOUD - 5G - NEW SPACE

5G STIMULATING NEW USE CASES AND GROWTH:

- 3GPP standards with NTN
- Direct access
- 5G NR Waveform
- Virtualization, NFV/SDN, Orchestration

- New LEO/MEO/HEO constellations
- Dynamic Space Segment
- Multi-orbit

- Generic hardware platforms
- Strong Security Requirements
- New business models

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CUSTOMER CHALLENGES

Deploying satellite networks

Operational complexity and cost

Lengthy and manual process

Reduced Scalability

Increase security and system accessibility

Flexibility in Satellite Operations

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DRIVING INNOVATION
- Expansion of services
- Optimizing customer experiences

NEW OPPORTUNITIES
- Digital transformation
- Flexible services & agile implementation

INTEROPERABILITY OF SATELLITE TECHNOLOGY WITH CLOUD IS KEY

ENABLE COMPETITIVE SERVICES
- Access to performance information and analytical data
- Interact with the network across multiple layers of abstraction

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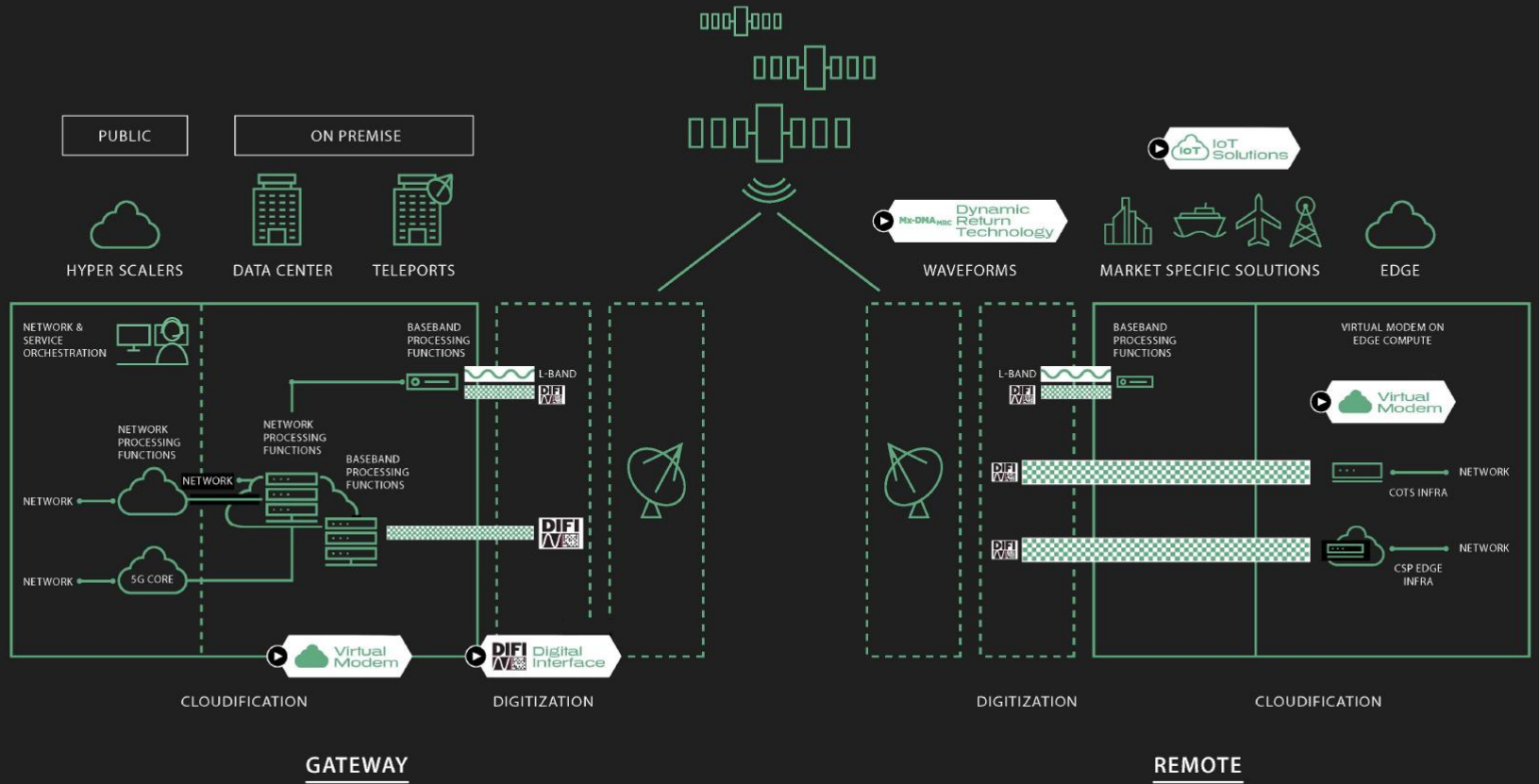
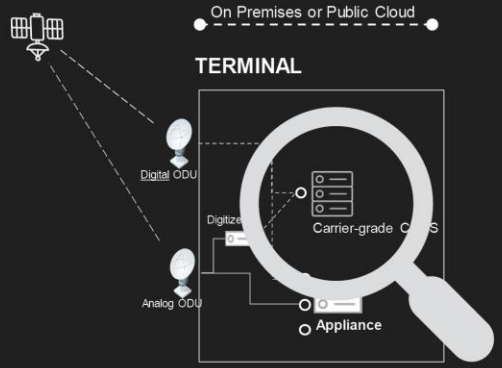
Supporting Your Cloudification and Digitization Journey



VIRTUALIZED MODEM

POC with Microsoft –Virtualized modem on Azure Cloud Infrastructure

Demo



Modulator / Demodulator @work

Azure Operator Far Edge on-premises Infrastructure

VIRTUALIZED SCPC MODEM

- Deployed on Azure Operator Far Edge on-premises Infrastructure
- SCPC modem successful demonstration
- Wideband Modulator / Demodulator functionally on COTS

VIRTUALIZED SCPC MODEM POC IS A FUNDAMENTAL BUILDING BLOCK FOR OUR CLOUD ENABLEMENT JOURNEY

- COTS based Hub Baseband Devices with distributed processing
- Building Block towards TDMA variant use cases

Global Reach Enabled

Save Time

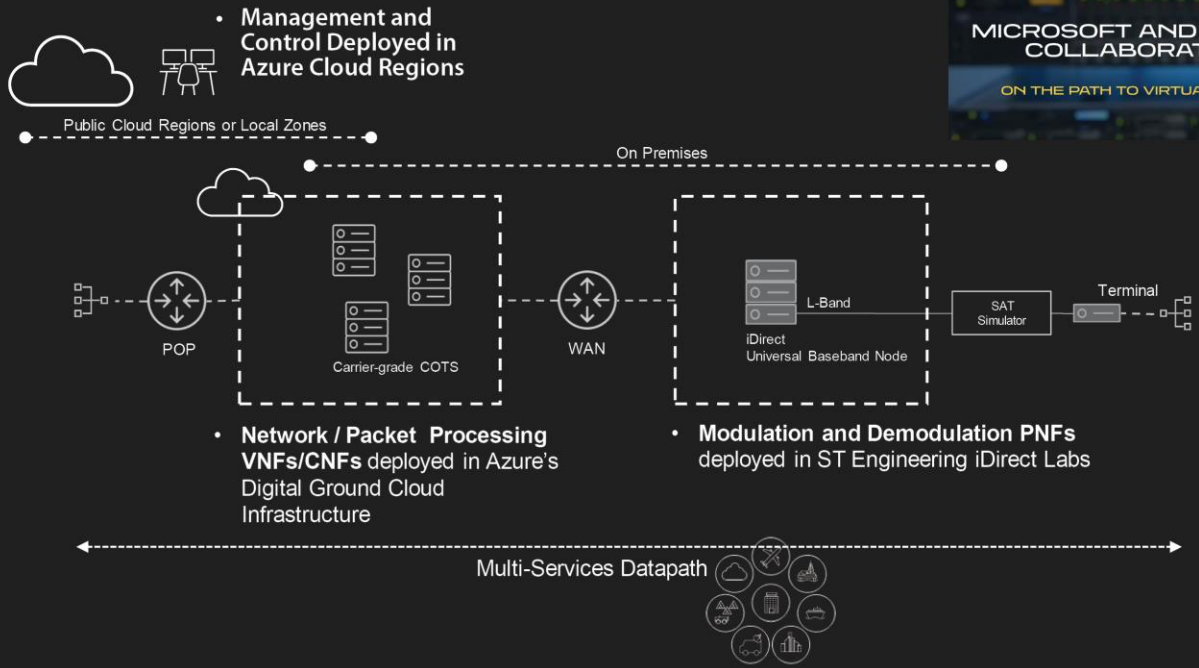
Improve Scale and Flexibility by decoupling Hardware and Software

Connect on Demand

PROCESSING IN CLOUD

E2E Communication Services in Hybrid Cloud

Modulator / Demodulator @work



Scale Dynamically

Reduce complexity

Automated, Software Defined and Open APIs

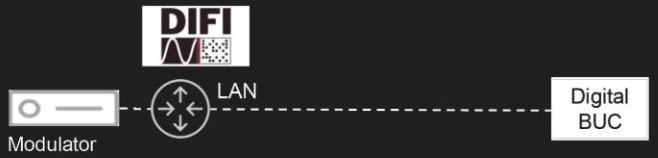
Provide 'value-added' solutions/ services

Managed Services

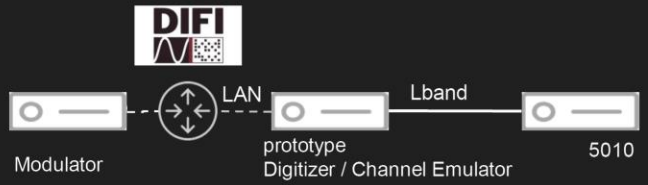
DIGITAL TELEPORT

Radio over IP – Standards based DIFI

March 2023 – Successfull DIFI Interop



August 2023 – Proving our Radio over IP expertise by adding Digitizer / Channel Emulator in DIFI pipeline



ALL DIGITAL TELEPORT

- Path of Virtualization requires full Digitized Radio over IP handoff
- Loss-less local transmission
- Simplified local signal level management
- Flexible routing/switching
- Standardized GW design (less error-prone)
- Network engineers vs RF engineers
- Flexible band-selection
- Allows for cloud 'COTS HW' baseband processing
- Improved monitoring options

Learn more about our collaboration with Microsoft, DiFi and 5G consortium

ST Engineering

ST Engineering iDirect and Microsoft Azure Achieve Important Milestone to Virtualize Satellite Modem in Microsoft Azure Cloud

Last year ST Engineering iDirect and Microsoft Azure entered a strategic partnership to drive the adoption of virtualization and cloud to enable the digital transformation of the ground segment.

Over the last months we have been working on the first phase in the development of a virtualized modem that can be deployed on a Microsoft Azure based cloud solution.

To see the demo in action, **check out this video**, and hear from Sean Yarborough, ST Engineering iDirect's VP of Product Management, and Paul Tilghman, Sr. Director of Spectrum Technologies with Microsoft Azure Space, on the strategic importance of this milestone.

Today, we are excited to announce the successful demonstration of this important milestone in our Proof of Concept. The demodulation capability of an iDirect virtualized high-speed SCPC modem running as containerized software on a COTS server located in the Azure Cloud. It is also the first time we are demonstrating how this virtualized modem is receiving high-speed traffic via a digital interface instead of the traditional analog L-band interface, furthering our innovation with the DiFi standard. DiFi stands for Digital IF Interoperability consortium and is an independent space industry group of which Microsoft Azure and ST Engineering iDirect are part of formed to advance interoperability in satellite and ground system networks.

Our joint development partnership is aligned with our phased approach in enabling our satcom solutions on the Microsoft Azure platform. Already, we have migrated our network management system to the cloud, and now have successfully demonstrated the first milestone towards fully virtualizing our remote modem. Next, we plan to migrate our network processing functions and lastly baseband processing functions to the cloud.

Why is this milestone important?

We believe that the next generation of satellite communication systems will demand funder
before.

SHAPING THE FUTURE THROUGH SATELLITE INNOVATIONS

The next generation of satellite communication systems will demand fundamental cloud capabilities to enable satellite operators to maximize their strategic investments.

Cloud deployment allows satellite operators to build out large scale networks in less time and with less capex investment. A virtualized ground segment enables greater orchestration of service delivery with network resources and business systems. And when this is built on shared networking standards, it will transform the economics and engagement models of satellite operators and major network operators so they can expand the accessibility of satellite communications around the world.

That's why over one year ago **ST Engineering iDirect** started to collaborate with **Microsoft Azure Space** on driving the adoption of virtualization and cloud to enable the digital transformation of the ground segment.

Through our development, we set out to virtualize key aspects of our modem and baseband ground segment to enable our satcom solutions to run in Azure. For that, we have been working on the abstraction of the software functionality from the hardware to allow for the processing to run in the cloud while leveraging the Azure software radio tools.

Over the last 12 months we have successfully demonstrated two key milestones of deploying a virtualized iDirect modem on Azure.

- In late 2022 we showcased the demodulation capability of an iDirect virtualized high-speed SCPC modem running as containerized software on a COTS server located on Azure. It was also the first time we demonstrated how this virtualized modem is receiving high-speed traffic via a digital interface instead of the traditional analog L-band interface, furthering our innovation with the DiFi standard. This is important because once virtualized modems are in the cloud, we need to make sure they can easily interoperate with the other components through standard interfaces.
- In May 2023 we showcased the virtualization of the modulator capability of the modem to run on Azure. That marked our proof of concept of fully virtualizing a satellite modem.

Next, we plan to migrate our network processing functions to the cloud. We want to prove that satellite network architectures can be built with commercial off-the-shelf components that leverage the cloud to its fullest potential.

Hear from Sef Senhaji, Senior Director Business Development at
and Paul Tilghman, Senior Director Connectivity with Mic
on the strategic importance of these milest

Plugfest: Working Together to Test Interoperability

We've spent two days in Colorado this week with fellow DiFi members taking part in an interoperability and networking plugfest. The event was held to help gain a better understanding of DiFi compliance and interoperability across the consortium members. Plugfests enable equipment manufacturers to test devices for interoperability with emerging standards by physically connecting them. Simply put, if the standard is compliant, then the devices should work when connected.

As you may know from previous blogs, we have been highly involved with the development of the DiFi v1.1 standard that supports the digitization of the interface between modem and RF components. By leveraging this new open standard, the industry will be able to utilize the latest virtualization, cloud computing and network function virtualization technologies as well as greatly improve the performance and scale of satellite hub, gateway, and modem equipment.

Why is this open standard needed?

There are fundamental changes happening within the satellite industry brought about by the advent of multi-orbit constellations, 5G and demand for cloud-based services. This is a complex step change that will see the industry move from traditional analog to IP, away from hardware and towards software-based functions. This transformation will open up broad avenues of opportunity for the industry, enabling access cloud capabilities that will enable satellite operators to maximize their strategic investments.

Through cloud-based services, satellite operators can build out large scale networks in less time and with less capex investment. Through virtualization of the ground segment there can be greater orchestration of service delivery with network resources and business systems. If this is built upon shared networking standards, it will transform the economics and engagement models of satellite operators and major network operators so they can expand the accessibility of satellite communication across the world. This will enable operators to offer advanced services that will provide customers, not only satellite connectivity, but also cybersecurity, hybrid network, application-based QoS, and end-to-end service orchestration.

The Setup and Interoperability Testing

Over the co
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The goal w
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profiles. So
sample rate
The iDirect
that output
participants
RF analog

Bringing Satellite's Role in the 5G Future to Life

5G rollout and its promise of **faster, smarter** and **more connected** devices is gradually becoming reality and it's something that we have been focusing our efforts on at ST Engineering iDirect for some time. The network of networks is still in its relative infancy but will gradually become more prominent in our everyday lives for just about every application you can think of.

It's been important to us to remain at the forefront of satellite-related activities and developments in 5G. We have a history of working with standards groups such as **3GPP**, **SGPP** and **5G-MAG** and have had deep involvement with initiatives such as **SatIoT**, **SatSG** and **OSMOSIS** to ensure that satellite's place in 5G is secured, because it will be an indispensable part of the 5G future, enabling ubiquitous and reliable connectivity where other access technologies cannot reach. Satellite 5G will be used for a plethora of use cases.

One such example was recently demonstrated as part of the **H2020 INGENIOUS Project** for intermodal asset tracking via a Satellite IoT. Here industry partners came together to demonstrate how **IoT sensor data** was being tracked from a shipping container on land and at sea over satellite. In the demonstration, the ST Engineering iDirect 5G-enabled ground system provided the **satellite backhaul connectivity** for the IoT devices to connect to the cloud. The 5G-enabled satellite system included a **satellite modem** that behaved like a **5G UE** to an **integrated 5G core network**, and was routed, controlled and registered through the 5G Core GUI.

Let's look at the demo components and how it worked in more detail:

1. Edge network

The edge network included the local network and a standard satellite terminal with a modification to allow the satellite terminal to appear as a 5G UE to the integrated 5G core network. The UE registered using standard 5G signal

The satellite terminal was connected to the satellite network using our standard

2. Satellite segment

iDirect