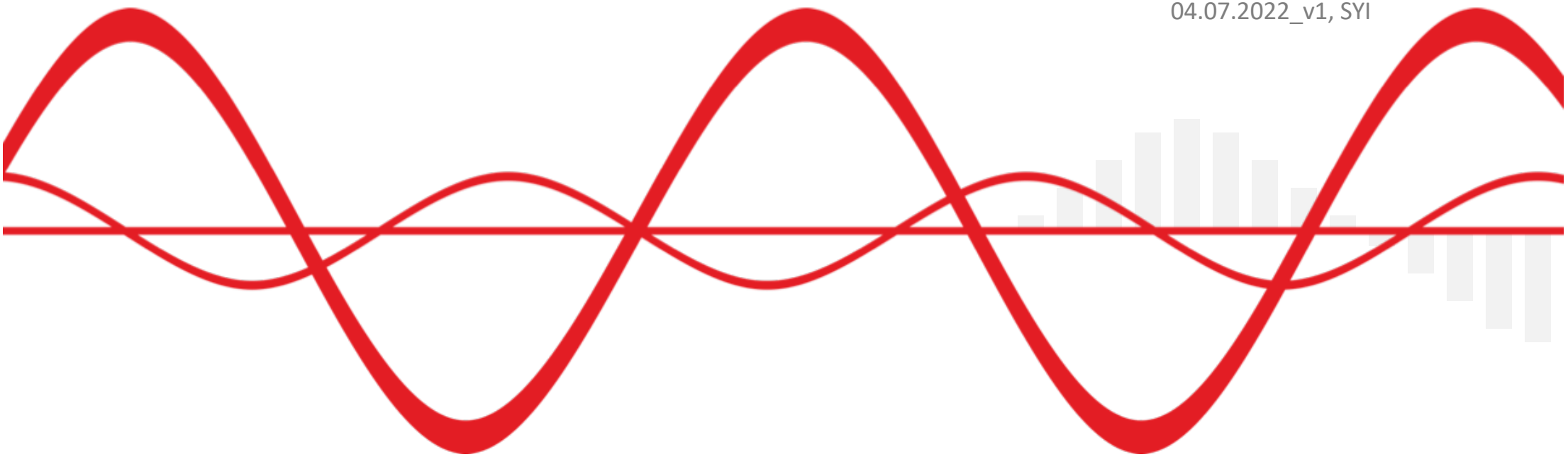
WORK MICROWAVE

we are the wave –
excellence in high frequency

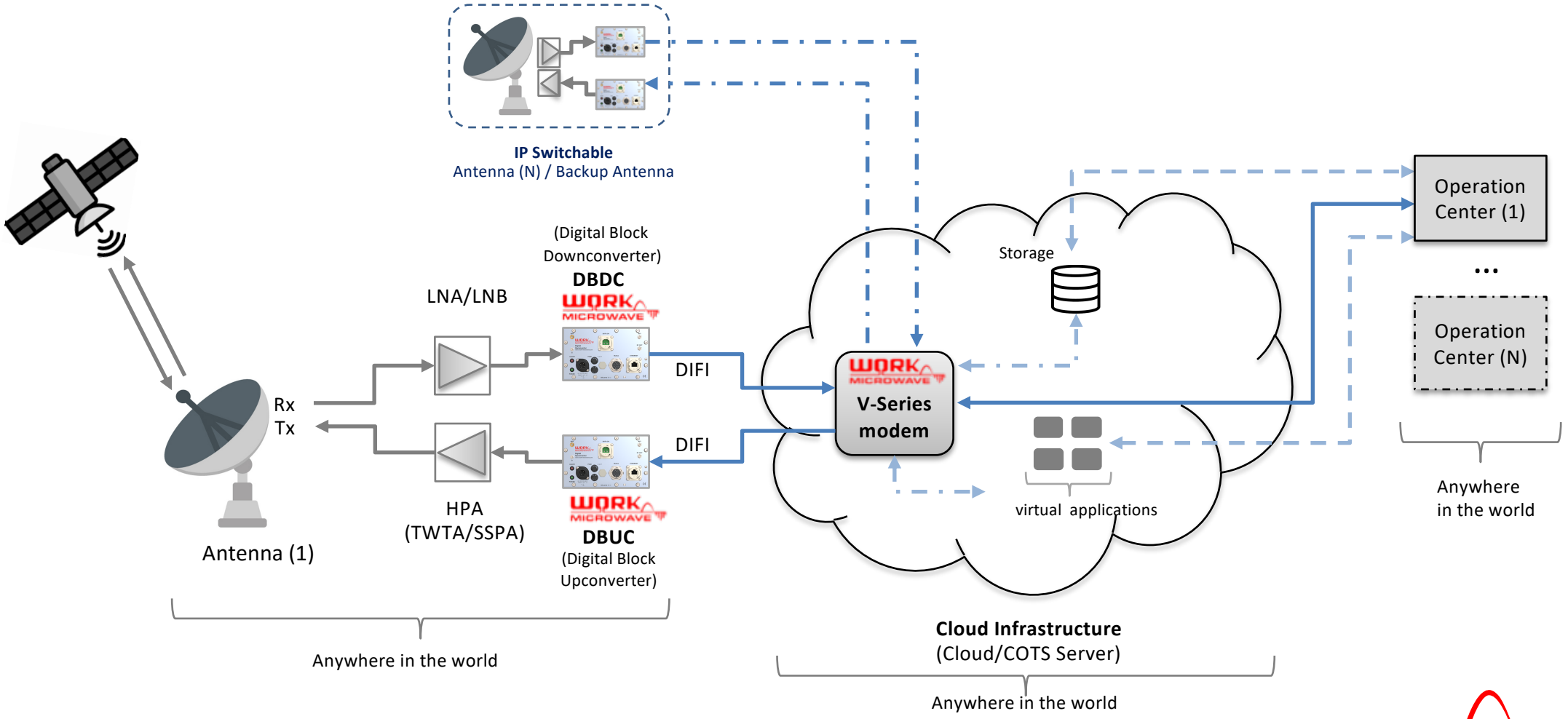
Virtual Ground Station

Overview

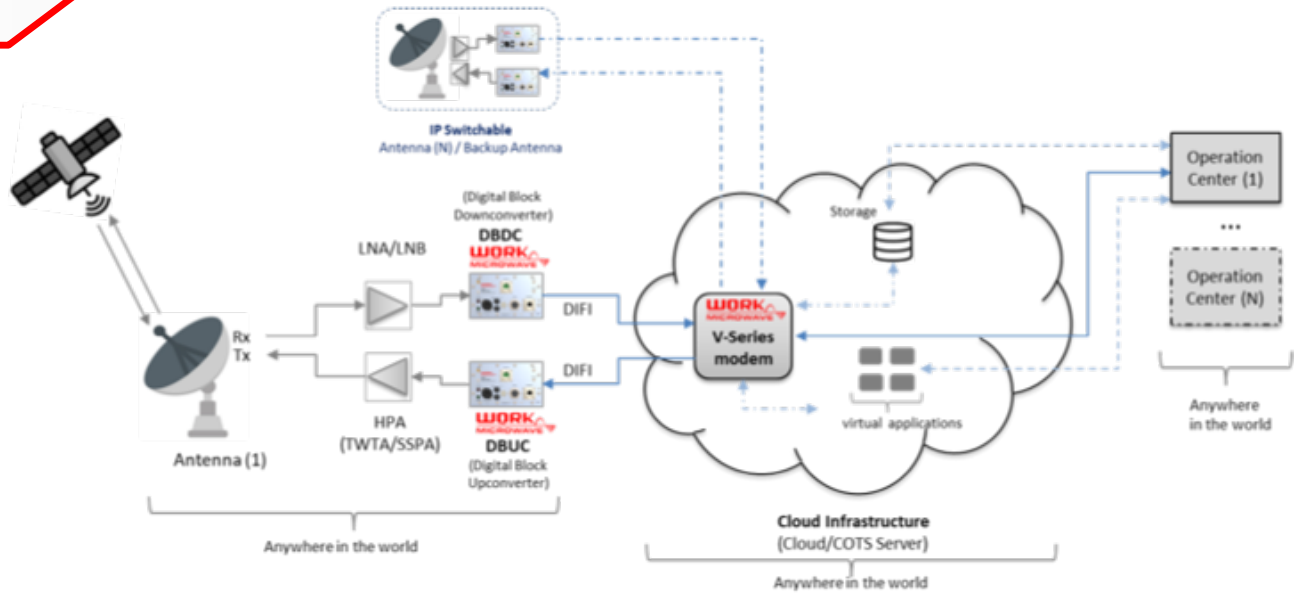
04.07.2022_v1, SYI



General Overview



What is the VGS?



WORK Microwave's **Virtual Ground Station** (VGS) solution is a state-of-the-art ground station architecture based on digitalized RF signals over IP with DIFI standard, and wideband signal processing on cloud platform by virtualised software modem (SDR).

In this architecture, it is not necessary to install all ground station subsystems and components in the same place. Instead, the antenna subsystems *(location-1)* and the cloud-based signal processing systems (*location-2*) can be installed in different cities or countries. Additionally, also the operations *(location-3)* can be managed anywhere in the world.

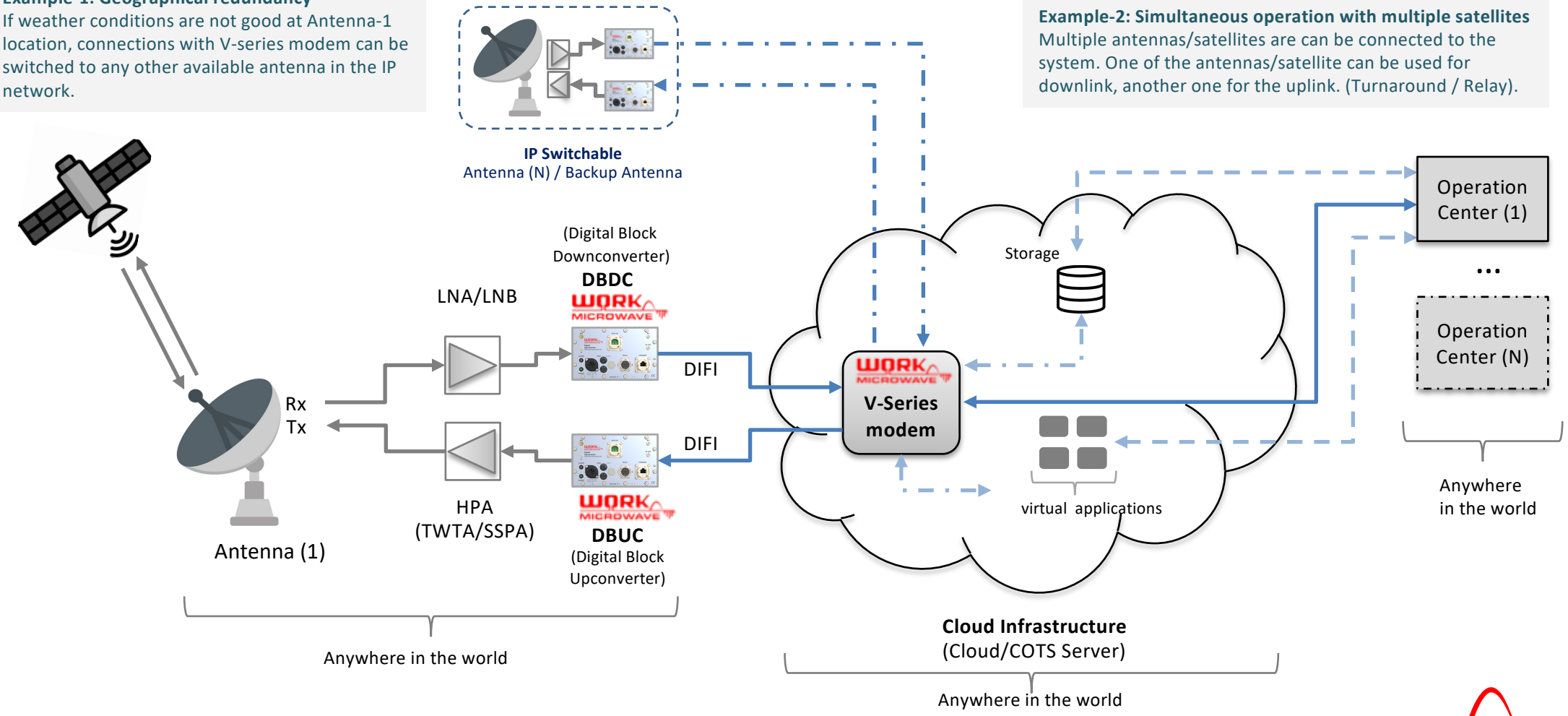
As technical concept, the antenna Rx signals at the output of the LNA/LNB are converted to digital packets that are transported over IP network to the software based **V-series** modem on the cloud platform for downlink operation. For uplink, the digital signals from the cloud platform are converted to RF signals, amplified and transmitted to satellite. The digital signal processing (modulation, demodulation) of the satellite data is done by Work Microwave's software based modem that is called as V-series modem. It is possible to manage all operations remotely after system integration.

WORK Microwave's Virtual Ground Station brings high flexibility, scalability, switchability and efficiency for ground segment operations as the all mentioned locations (antenna side, processing side, operation side) act as **IP nodes**. It is also optimal solution for "As a Service" business models like Ground Station as a Service, Software as a Service.

Advantages: IP Switchable Antenna

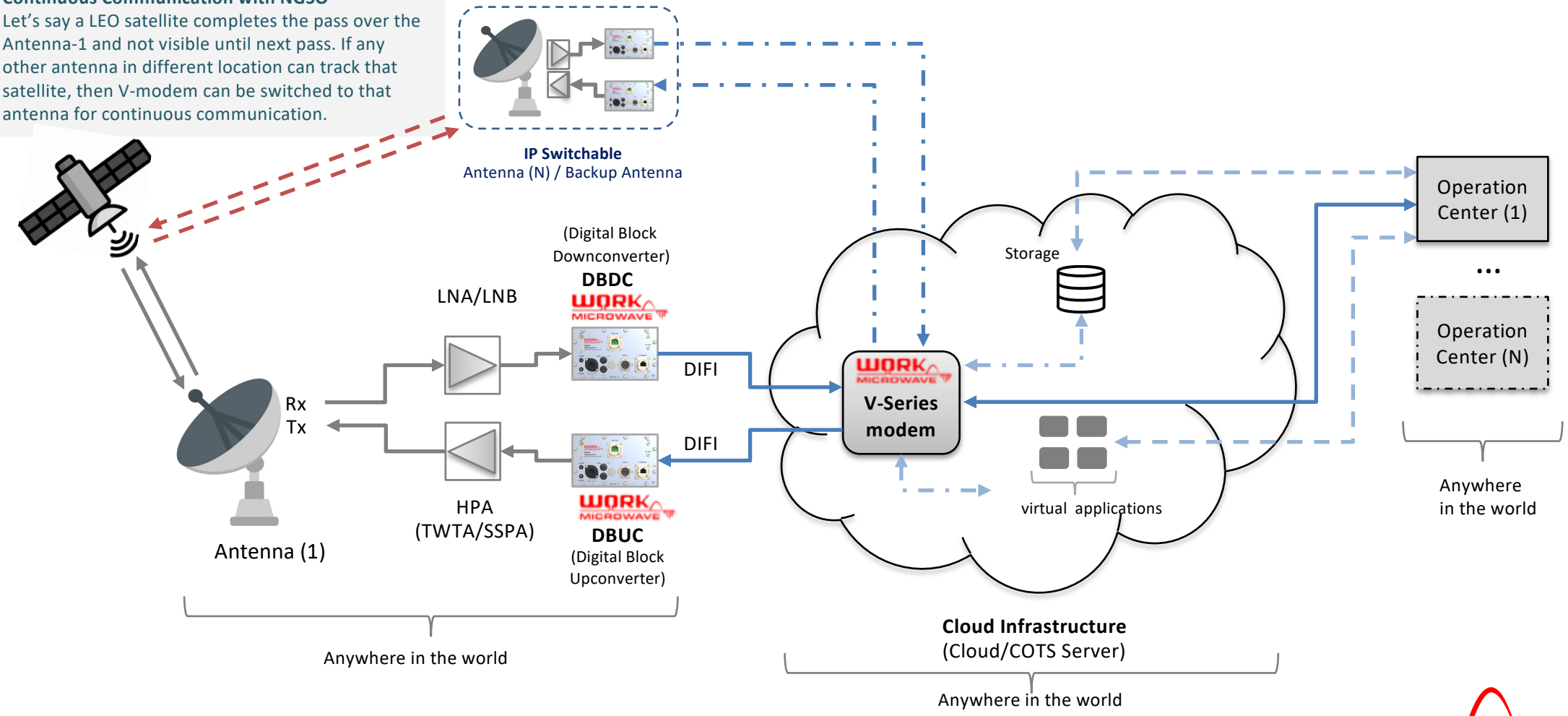
Example-1: Geographical redundancy
If weather conditions are not good at Antenna-1 location, connections with V-series modem can be switched to any other available antenna in the IP network.

Example-2: Simultaneous operation with multiple satellites
Multiple antennas/satellites are can be connected to the system. One of the antennas/satellite can be used for downlink, another one for the uplink. (Turnaround / Relay).



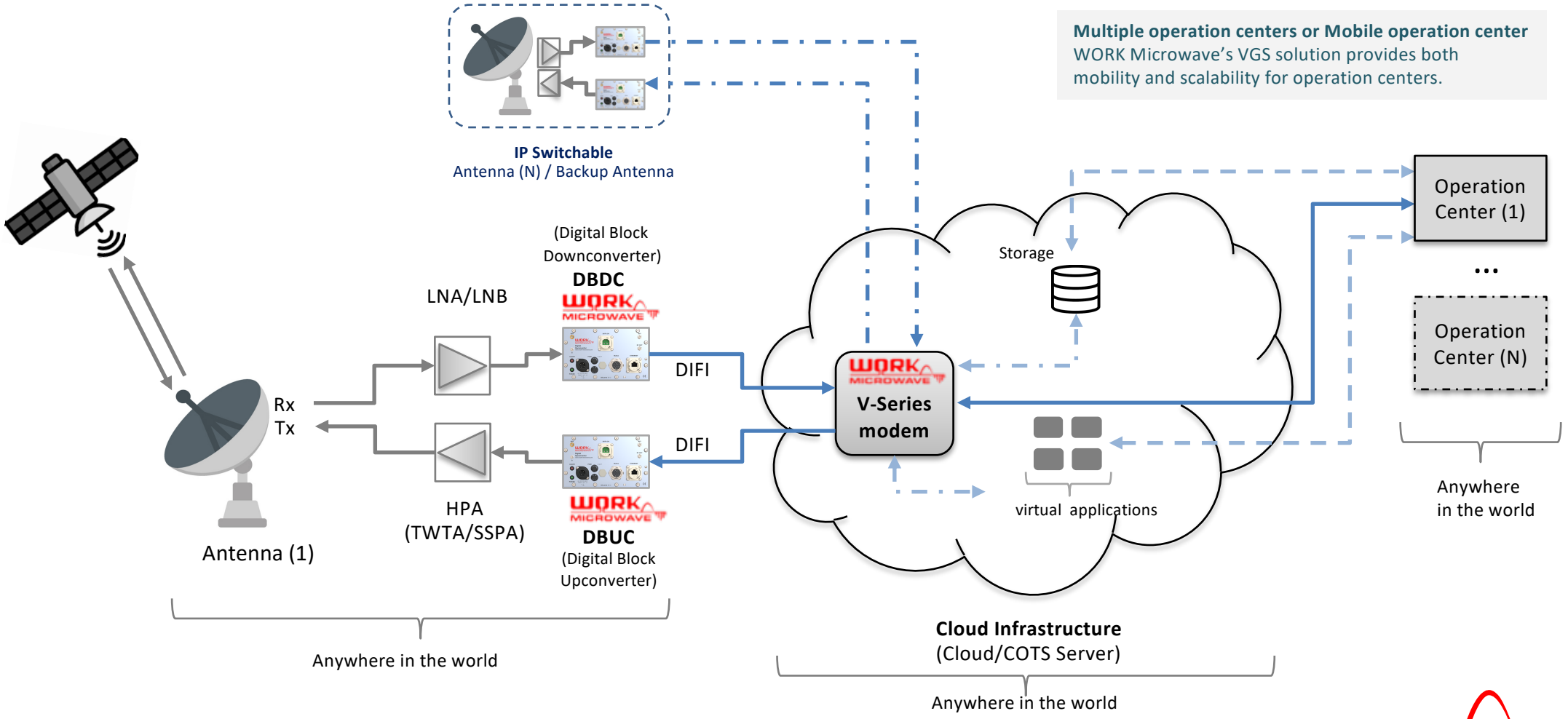
Advantages: Continuous Communication with NGSO

Continuous Communication with NGSO
Let's say a LEO satellite completes the pass over the Antenna-1 and not visible until next pass. If any other antenna in different location can track that satellite, then V-modem can be switched to that antenna for continuous communication.

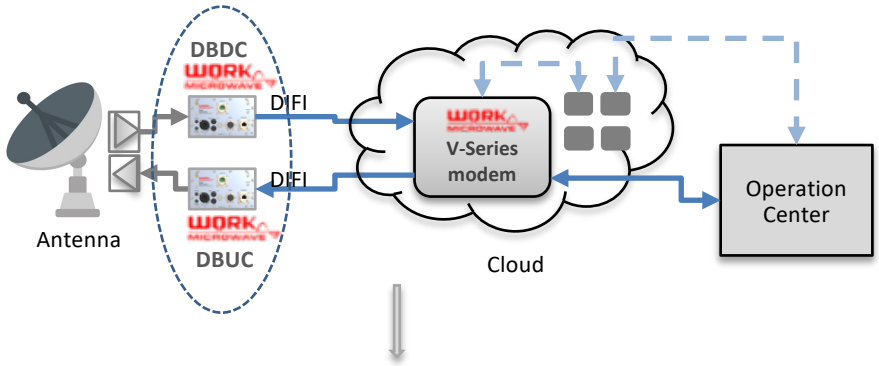


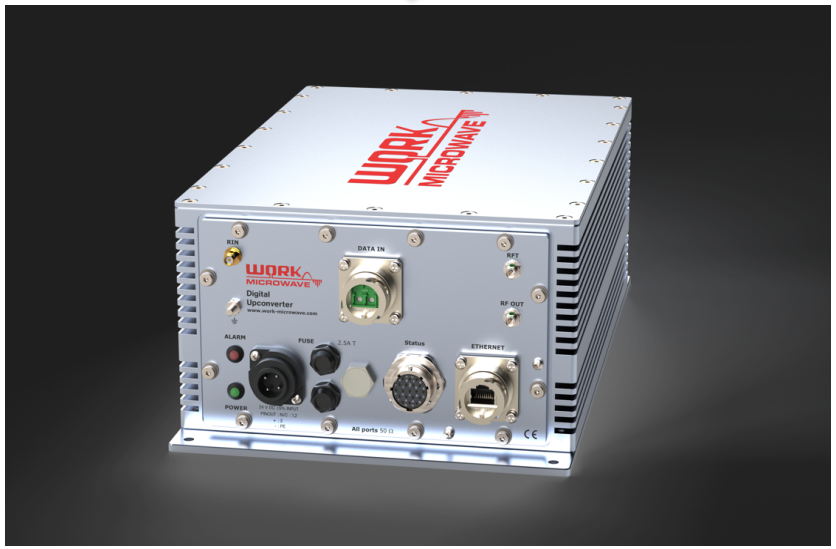
Advantages: Access from Anywhere

Multiple operation centers or Mobile operation center
WORK Microwave's VGS solution provides both mobility and scalability for operation centers.



RF - Digital Converters (Digitizers)





DBUC / DBDC outdoor chassis can be mount in antenna hub

WORK Microwave's **Virtual Ground Station suit** (VGS) has two main units for digitalization of RF signals:

- **DBDC:** Digital Block Upconverter (for uplink line)
- **DBUC:** Digital Block Downconverter (for downlink line)

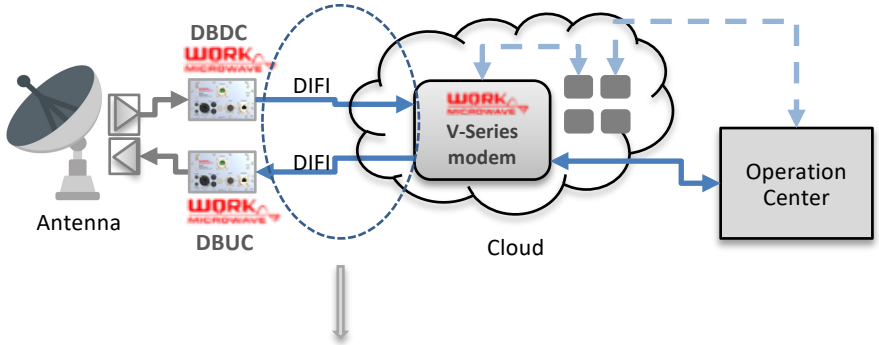
DBDC receives antenna signals from LNA (or LNB) directly in the input and converts them to digital packets. It does block down conversion from RF to digital baseband. At the output, the digital baseband signals are transported as IP packets in DIFI *(Digital Intermediate Frequency Interoperability)* standard to the V-series software modem.

DBUC receives digital baseband signals as IP packets in DIFI standard from the V-series software modem and converts them to RF signals. It does block up conversion from digital baseband to RF. At the output, the RF signals are sent to the HPA for amplification and uplink to the satellite.

The main features and advantages of these units are:

- They includes block converters (direct S/C/X/Ku/DBS/Ka/Q/V-band port is possible, and IF/L-band as well). This feature makes the system very compact and eliminates additional need for separate frequency converters, redundancy switches, additional RF connection points and signal attenuations.
- They are designed as outdoor type that can be mounted in antenna hub directly. This feature eliminates a need of big RF shelter near the antenna or saves significant space in terms of system integration.
- Multiple-band options (triple for Ka-band, dual for Ku-Band… as example) for simultaneous Tx and Rx at high/medium/low bands.
- Switchable LO option (selectable high/medium/low… band)
- Lossless transport for IP networks with QoS (Quality of Service).
- Fiber optical output for block downconverter and input for block upconverter.
- Wide temperature range: -40° to +60° C operational, -50 °C to 80 °C for storage
- Degree of Protection: IP 67 (acc. IEC 529)

DIFI (Digital Intermediate Frequency Interoperability)



WORK Microwave is a member of DIFI Consortium to actively support standardization and shape the future digitization of ground segment.

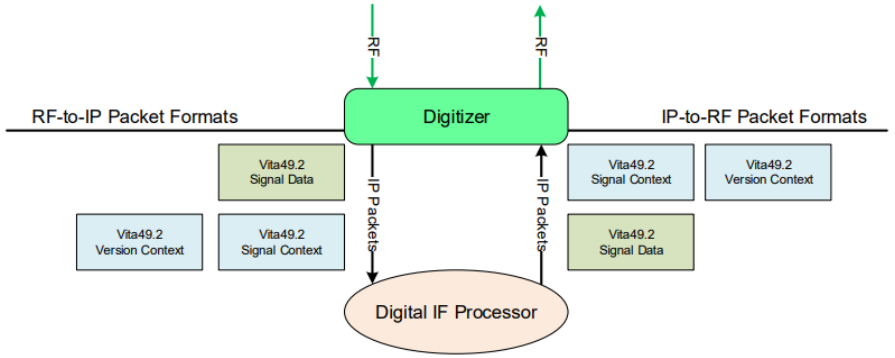
DIFI Consortium including WORK Microwave and other industry leaders in the ecosystem (cloud platform providers, ground station service providers, antenna manufacturers, software application providers..) together work on interoperable standard based on (and fully compliant with) VITA-49.2 radio transport protocol.

WORK Microwave uses DIFI standard for digital signal transfer between DBDC/DBUC units and V-series modems in Virtual Ground Station.

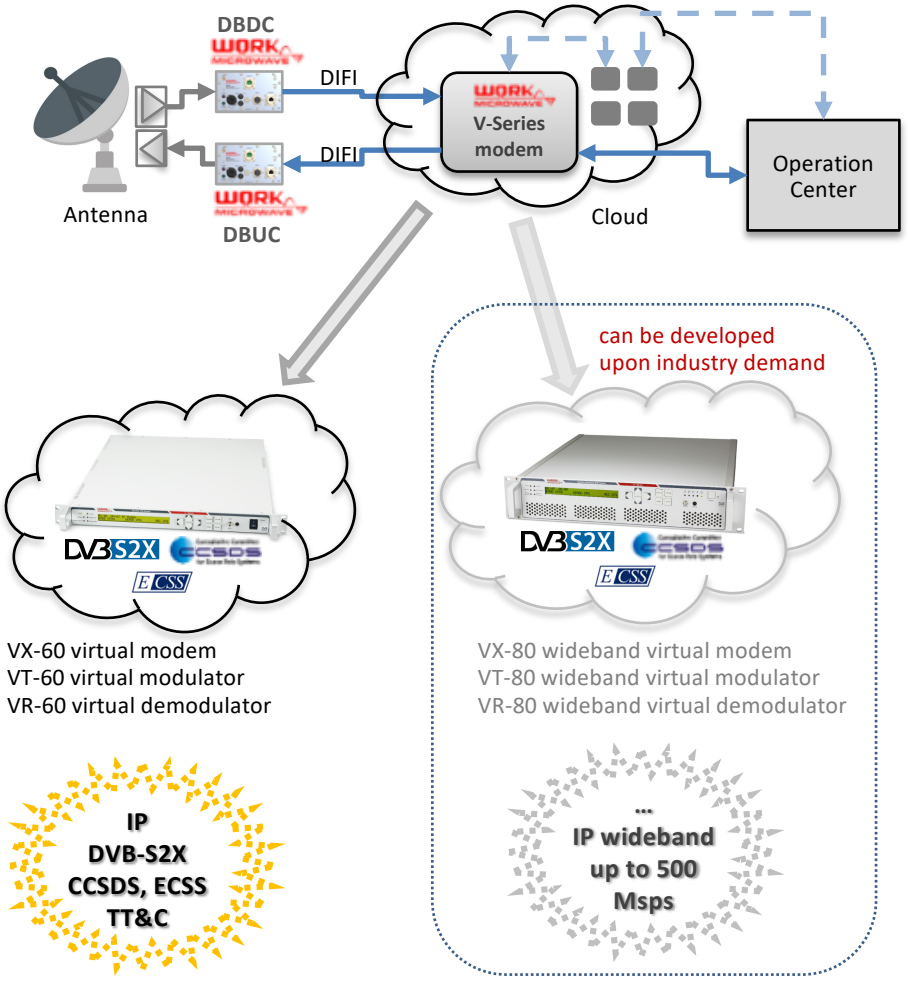
Thanks to the DIFI standard, the data plane interface provides the ability to transmit and receive digitized IF/RF data and corresponding metadata over standard IP networks.

The detailed information about DIFI standard can be accessible via:
https://dificonsortium.org/standards/

WORK Microwave uses DIFI standard for digital signal transfer between DBDC/DBUC units and V-series modems in Virtual Ground Station.



V-Series modems



WORK Microwave's **V-series** software based modems are the key component of the **Virtual Ground Station** suit (VGS).

V-series modems are fully compliant with DIFI standard to receive/transmit digitized RF signals from/to DBDC/DBUC.

The main features and advantages of V-series modems are:

- Virtualized software modems with capabilities of WORK Microwave's A-series modems (AX/AT/AR-60/62) that supports wide range waveforms and symbol rates.
- Compliance with DVB-S2/S2X, CCSDS and ECSS standards
- Minimum 100 ksps to 36 Msps symbol rate (higher symbol rates are optional)
- Minimum 36 MHz bandwidth support (larger bandwidths are optional)
- Support CCM, VCM and ACM
- Support Time Slicing (Annex-M ETSI EN 302 307-1)
- Full processing chain from digitized IQ samples to decoded BBFRAMEs over IP
- Web GUI, SNMP for remote control and automation purposes
- Support DIFI standard as RF over IP & cloud
- Modular design for future extension to different waveforms
- Can be customized fastly (as software based)
- Replaces dedicated hardware modems, brings modem as service model for multi-operational efficiency
- Without replacement of hardware, implementing new features and options (Multistream, multi-channel, high symbol rates)
- Designed for local and cloud deployment
- Running on CPU and/or GPU on consumer hardware platforms
- Lossless transport for IP networks with QoS (Quality of Service) and enough bandwidth.

Note: Wideband (VX/VT/VR-80) models are can be provided upon industry demand.

As a Summary

WORK Microwave's Virtual Ground Station suit:

- Brings high flexibility, scalability, sustainability, switchability and efficiency for ground segment
- Reduces significant cost and time in terms of installation, operation, maintenance and man power
- Allows faster system integration (for large LEO/MEO satellite constellations, e.g.)
- Allows access from anywhere to any digitized antenna for satellite and space communication
- Provides easy upgrade on the system according to the additional needs
- Provides high efficiency especially for the "**as a Service**" **business models** (like Ground Station as a Service, Satellite as A Service, Software as a Service…), as use of the systems can be shared in contrast with dedicated ground stations.
- Based on IP network, routing and cabling instead of RF cabling and switching
- Provides longer lifetime for the system
- Can be customized for different applications (communication, broadcasting, earth observation, deep space…)

WORK Microwave GmbH (Headquarter / Engineering & Production)
Address: Rudolf-Diesel-Ring 2, 83607 Holzkirchen, Germany
Phone: +49 8024 6408 222
Email: sales@work-microwave.com
Web: www.work-microwave.com

WORK Microwave Inc. (US Office)
Address: 2220 Northmont Parkway, Suite 250 Duluth, GA 30096 USA
Phone: +1 7702 4126 45
Email: waylon.sun@work-microwave.com
Web: www.work-microwave.com

WORK Microwave Representative (Asia-Pacific Office)
Address: C/O One Sky Enterprises Pte Ltd.,37 Pasir Ris Drive 3 – #02-04, 519494 Singapore
Phone: +65 8617 9355
Email: eric.lossouarn@work-microwave.com
Web: www.work-microwave.com