ND SAT COM

INSTALLING RELIABILITY

SHAPING
    THE FUTURE

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SKYWAN 5G

The ONE
Mastermind of
Satcom Networks

SKYWAN 5G

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ND
SAT
COM

SKYWAN 5G

SKYWAN 5G

ACM
TDMA
DVB-S2
P2P (SCPC)

DVB·S2

CONTENT

ND SATCOM's SKYWAN 5G is transforming the way communication networks are created and behave by converging VSAT & comprehensive IT capabilities into a single hardware device.
The multi-purpose SKYWAN 5G has full functionality on board. With simplified logistics, it is just a matter of configuring which functions SKYWAN 5G implements in the network. Adding new sites, managing spare parts, designing VSAT networks, ordering SKYWAN 5G – everything is straight forward and helps you make the ONE right choice.

SKYWAN 5G incorporates a comprehensive router supporting interior & exterior routing protocols and MPLS, providing a seamless integration into customer networks. The data is transferred over satellite per customer choice, either using the flexibility and network efficiency of MFTDMA or the spectral efficiency of DVB-S2, both resulting in an optimal use of costly satellite bandwidth.

Even though a single SKYWAN 5G unit is incredibly powerful, central sites potentially require more performance or more receivers. SKYWAN 5G's game-changing innovation of stackable units increases performance and scale, such that the whole is greater than the sum of its parts.

5G HIGHLIGHTS AND KEY FEATURES

Get all-in-one – the reliable ONE solution
Gain flexible topology – star to mesh networks
Gain space & portability – smallest unit available
Gain powerful performance – with easy interface
Generate savings – lower cost of ownership

BUSINESS & MISSION CRITICAL WIDE AREA SATCOM NETWORKS

SMART SYSTEM
Rooftop-to-Rooftop | Routed | QoS | Compression | Stacking | Load Balancing | Redundancy

USER INTERFACES
Multi-Customer | Multi-Service | Bandwidth on Demand | Secure | Service Guarantees

GROUND STATION
Fix | Transportable | On The Pause | On the Move

SAT INTERFACE
GEO | C-/X-/Ku-/Ka-Band | Wide Beam | Spot Beam | Beam Switching | Cross-Strap

SKYWAN 5G R2.0
GET ALL IN ONE

THE FUTURE IS NOW. THE FUTURE IS SKYWAN 5G.

Dive into a new dimension of satellite communication with SKYWAN 5G Release 2.0. Just when you thought you heard it all – from reliability to flexibility to scalability – ND SATCOM breaks the barrier with new engineering features that anticipate your business needs and further optimise the performance of your business. We listen, we innovate, we lead. This is why our standards of excellence, proven track record and 5th generation SKYWAN keep customers coming back for more. We are the only trusted solution provider in Europe for demanding market sectors such as aviation and the military, where the concept of reliability has far-reaching impact.

Change is ever-present. From climate to conflicts, pandemics to politics, ND SATCOM stand behind its customers to deliver on its reliability promise time and again, while pushing engineering boundaries to continually transform satellite communication. The SKYWAN 5G all-in-one solution represents such excellence by flexibly fitting all topologies, providing any-to-all full mesh connection, transmitting with single-hop efficiency, and scaling as business grows while keeping costs in check. This MF-TDMA modem with integrated DVB-S2 receiver supports both fixed and mobility satcom applications and remains the premium standard for satellite communication.

SECURE YOUR MISSION CRITICAL NETWORKS WITH SKYWAN 5G RELEASE 2.0

- Boost your network performance: **64x** boost throughput with True-Mesh ACM
  - Our unique and exclusive ACM with single-hop mesh
  - Highest link reliability regardless of weather
- Manage your network options: **3x** the choice with our triple mode within one modem
  - Flexibility decide which network topology you need: Hubless true mesh MF-TDMA, DVB-S2 or SCPC
  - New SCPC links provide highly efficient point-to-point connection
- Reap more from your investment: **4 years** software support for business continuity and cybersecurity
  - Diminish impact from cyber threats
  - Activate security and stability patches whenever you want
  - Save bandwidth with the smart new „over-the-air" update

TRUE MESH ACM

Adaptive Coding and Modulation manages Link Throughput
- Remote-2-remote
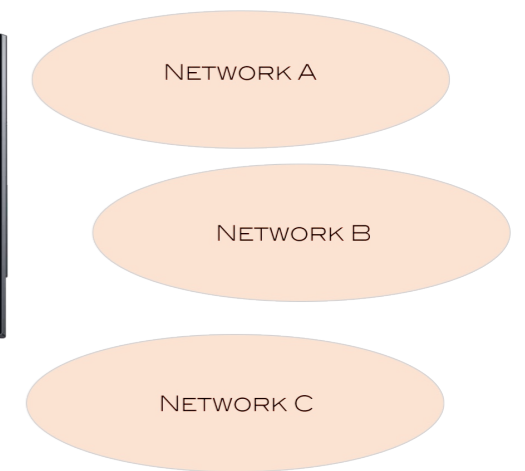- Dynamic weather response
- Robust link or sunshine bonus

Most Efficient   Mbps
x2 20
    10
    5
64x 2.5
    1.25
    0.62
Most Robust 0.31
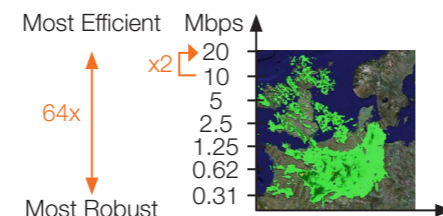
LONG TERM SUPPORTED SOFTWARE

LTS Software Maintenance
- Security and stability updates committed
- No expensive SW upgrades

R3.0 LTS

R2.0 LTS

4 years

SKYWAN 5G – PLATFORM FOR YOUR NETWORK EVOLUTION

SKYWAN 5G Release 2.0

Mini   AES-256   Outdoor   Indoor   DVB GW   Network Elements

SKYWAN 5G NMS

Network A

Network B

Network C
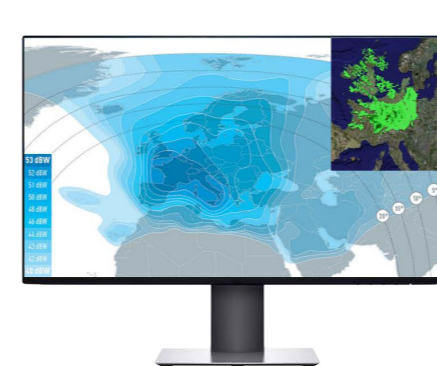
TRIPLE MODEM SYSTEM

Applications use ONE box
- SCPC/Point to Point
- DVB-S2/Point to Multi-Point
- MF-TDMA/Any-to-All

SKYWAN 5G
GET ALL IN ONE

ONE MULTI-PURPOSE PLATFORM FOR EVERYTHING

SKYWAN 5G is designed as an all-in-one unit having all features on board. Hub, terminal, satellite network control, star, hybrid, mesh, or router – SKYWAN 5G has the capability to implement it. Functions are enabled on the fly by means of configuration and licence keys in a matter of seconds. Changes are made failsafe thanks to the transaction-based changeset, ensuring the network is always in a consistent state. Operators get assistance for software roll-outs by an automated distribution process, thus minimising effort for maintenance tasks. SKYWAN 5G enables easy stacking of single units, which act as a single node. This way, performance or number of receivers is easily extended at any location. SKYWAN 5G is the platform of choice for smart and costeffective wide area satcom networks as depicted in the picture "Platform for Your Network Evolution" on the side.

BENEFIT

"One Box does it all"
- Look & feel the same, whether configured as a hub, terminal or stacked units
- Roles (e.g. hub function or satellite network control) can be easily transferred to another location without hardware change
- Perfectly suited for "pay as you grow"

Simplified Logistics
- Easy spare part handling, just one type of hardware in stock
- Hassle free documentation and customs process for procurement
- Design, ordering and calculations are all based on the same hardware

SKYWAN 5G – PLATFORM FOR YOUR NETWORK EVOLUTION

Multi-Star

Hybrid

Full Mesh

Licence key

Star

- Remote
- Hub
- Master / Backup Master

▶ Full feature set already built in
▶ Simple spare part handling, buy now and decide later on the usage

Easy stacking and redundancy

Switch to SCPC/P2P mode

Each remote unit can become a hub for a meshed/star sub-network

Add a mesh licence once the network evolves

Just one simple licence for the Hub / Master / Backup Master

Each unit is pre-configured as remote

▶ ready to increase performance and reliability

▶ ready to assign bandwidth exclusivley

▶ ready to change

▶ ready to meet new customer needs

▶ smart start for a minimum-sized star-mode network

▶ ready to use

▶ select SKYWAN 5G Outdoor

▶ select SKYWAN 5G Manpacks

SKYWAN 5G
Software-**D**efined VSAT **N**etwork

▶ Add DVB Gateway for further points to multipoints

Licence controlled:
Master, Mesh, Prime (16APSK), Exceed (>4 Msps), Cascading, BGP, Shared Amplifier, Redundancy, COTM, Compression, Beam Switching, TDMA ACM, Pure Data Channel, P2P

GAIN SPACE & PORTABILITY

SOFTWARE-DEFINED UNITS COVERING ALL ENVIRONMENTS

SKYWAN 5G comes as a rack unit intended for use in server rooms, as an outdoor unit for harsh environments, or as a module for terminal integration.
All have in common "The ONE" software and compact size, with the capability to serve as a full hub with network control function and DVB outbounds management.
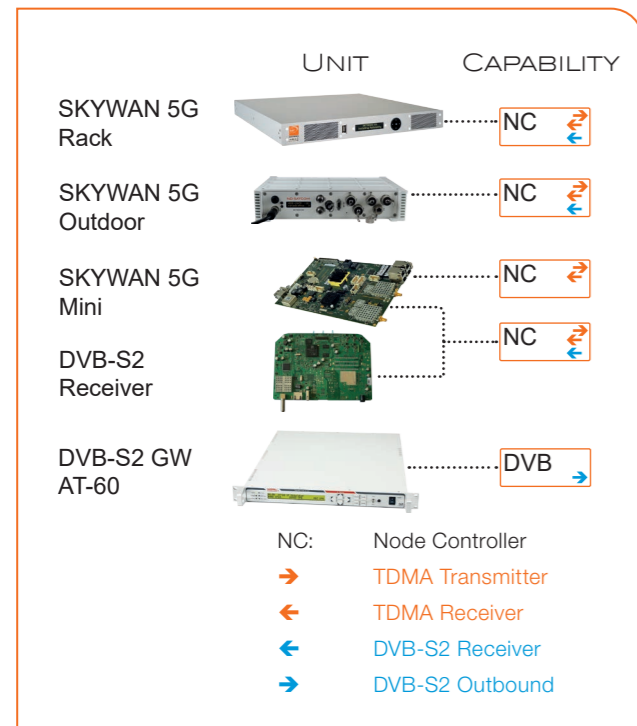
CASCADING: SMART RECEIVER UPGRADE FOR ANY SITE

Interconnecting SKYWAN 5G to a cascaded stack, possible as an upgrade for any location, adds another dimension of advantages in serving customer requirements economically. Cascading increases the number of TDMA receivers by adding more units with demodulators enabled only, while the first SKYWAN 5G acts as node controller. Therefore, the whole stack acts as a single node with one station ID and IP address.
Of course, multiple stacks can be placed in parallel if needed.

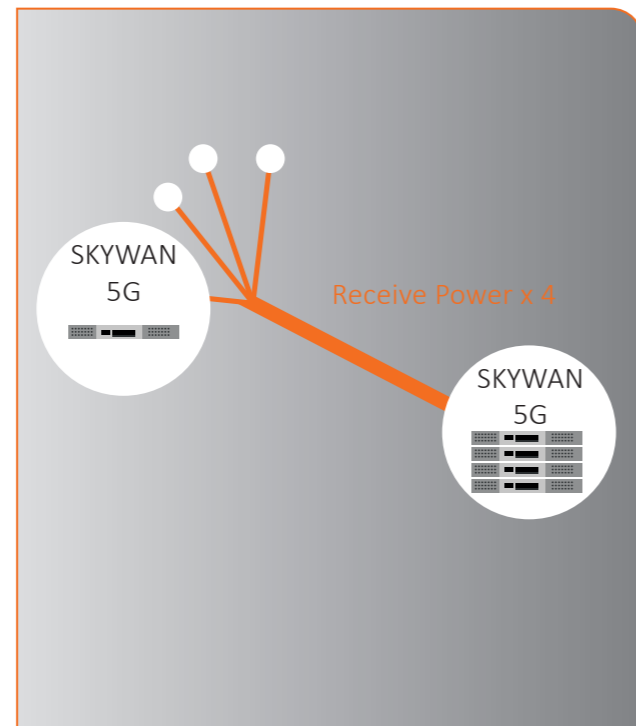| Unit		Capability
SKYWAN 5G Rack		NC ⇄
SKYWAN 5G Outdoor		NC ⇄
SKYWAN 5G Mini		NC ⇄
DVB-S2 Receiver		NC ⇄
DVB-S2 GW AT-60		DVB →

NC: Node Controller
→   TDMA Transmitter
←   TDMA Receiver
←   DVB-S2 Receiver
→   DVB-S2 Outbound

Units and its functions

SKYWAN 5G

Receive Power x 4

SKYWAN 5G

Cascading up to 4 TDMA Receivers

PERFORM POWERFULLY

NODE CONFIGURATIONS

A SKYWAN 5G network node consists, in its minimum configuration, of a node controller and the attached radio frequency equipment (RF). The node can grow up to 4+4 SKYWAN 5G units (4 active units & 4 redundant units in warm standby) plus 4 DVB gateways. The node controller manages all units and processes all user traffic using the TDMA wide area network.

THE NODE CONTROLLER INTERACTS WITH RF EQUIPMENT IN SPECIFIC WAYS

- Clock the RF-transmitter (BUC) and receiver (LNB) by providing a reference signal for optimal performance
- Provide power to BUC/LNB, perform receiver band selection (DiSEqC)
- Exchange data with antenna control unit using the OpenAMIP protocol

Node Overview

Min Node	NC ⇄	RF
Shared Amplifier	NC ⇄ / NC ⇄	RF
Node with • 1+1 Redundancy	NC ← / NCB ⇄	RF
Node with • Stacking	NC ⇄ / Rcv ← 1...3	RF
Node with • Stacking • N+M Redundancy	NC ⇄ / Rcv ← 1...3 / NCB ⇄ 1...4	RF
Node with • DVB GW(s)	NC ⇄ / DVB → 1...4	RF
Max Node with • Stacking • Redundancy • DVB GW(s)	NC ⇄ / Rcv ← 1...3 / NCB ⇄ 1...4 / DVB → 1...4	RF

Rcv: TDMA Receiver
NCB: NC or Rcv Backup
RF: Radio Frequency Equipment
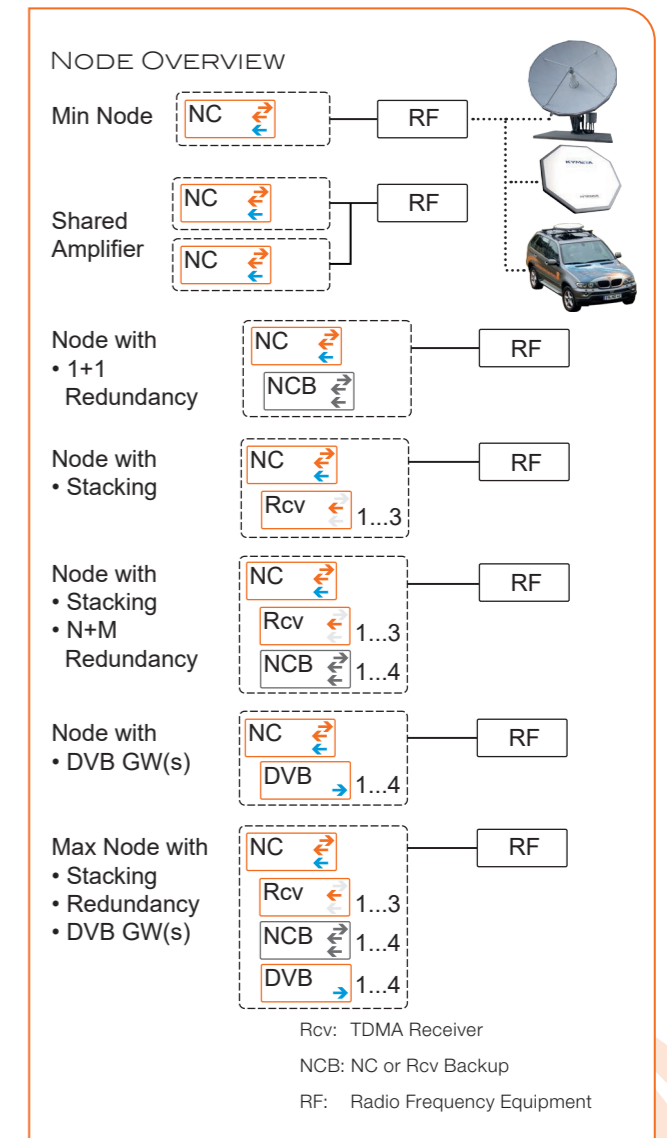
SKYWAN 5G Node Configurations at a Glance

PERFORM POWERFULLY

TDMA LINK ENCRYPTION OPTION

The AES-256 link encryption, available as a hardware option, encrypts and decrypts traffic sent and received over the TDMA WAN interface. As an integrated service including key management, the AES-256 link encryption is com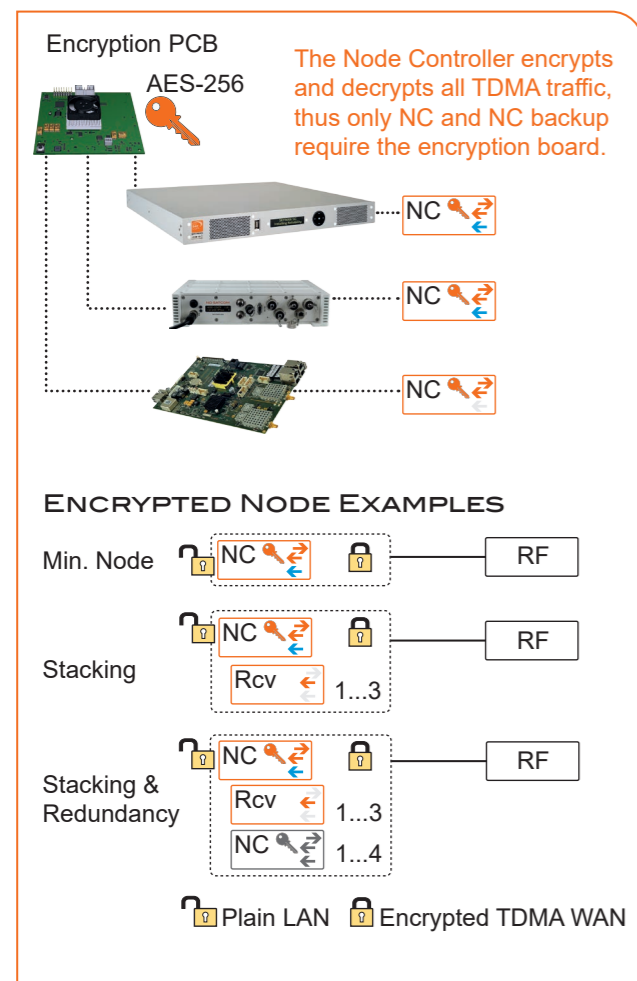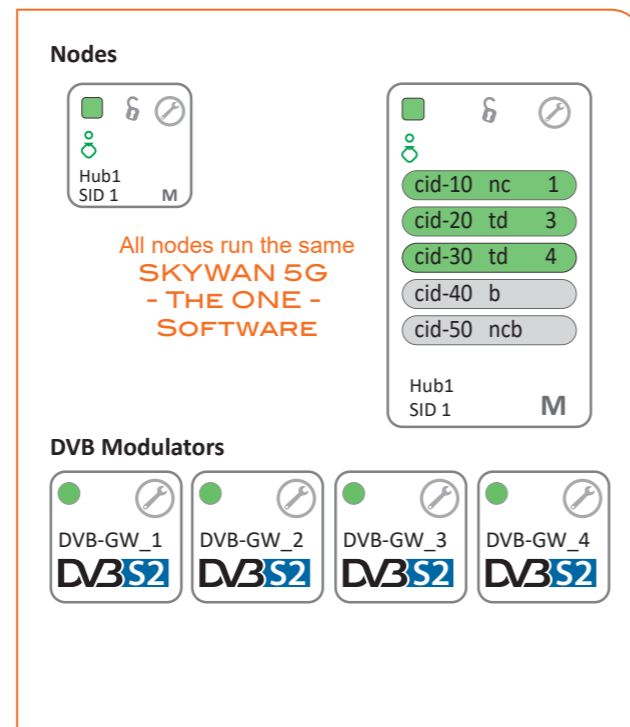pletely independent from any external equipment. The SKYWAN 5G NMS WebUI provides an easy to use yet secure configuration in a point-and-click interface.

Encryption PCB
AES-256

The Node Controller encrypts and decrypts all TDMA traffic, thus only NC and NC backup require the encryption board.

NC
NC
NC

Encrypted Node Examples

Min. Node   NC   RF

Stacking   NC   RF
             Rcv   1...3

Stacking &   NC   RF
Redundancy   Rcv   1...3
              NC   1...4

Plain LAN   Encrypted TDMA WAN

AES-256 Encryption Option

NETWORK MANAGEMENT SYSTEM

The SKYWAN 5G NMS provides the operator an immediate overview of the network status either in a collapsed view (small icons) or a detailed view showing a nodes configuration with potentially stacked and redundant units.
All SKYWAN 5G units in the network operate with the same software revision. A software upgrade is easily done using the NMS Software Manager and its automated Over-the-Air distribution and activation process. The NMS manages 250 SKYWAN 5G nodes distributed over up to 60 networks; a node can comprise up to 8 units (node controller & stacked and redundant units), so in total 2000 SKYWAN 5G units plus up to 4 DVB GWs per node are handled.

Nodes

Hub1
SID 1   M

All nodes run the same
**SKYWAN 5G
- The ONE -
Software**

cid-10	nc	1
cid-20	td	3
cid-30	td	4
cid-40	b	
cid-50	ncb	

Hub1
SID 1   M

DVB Modulators

DVB-GW_1   DVB-GW_2   DVB-GW_3   DVB-GW_4
DVB·S2   DVB·S2   DVB·S2   DVB·S2

SKYWAN 5G NMS Node View

STACKING/CASCADING

- Up to four active units per stack, multiple stacks per location
- First SKYWAN 5G is node controller and single transmitter of the node, therefore no additional ODU backoff is needed. Synchronisation and data transfer are done over a separate VLAN
- Suitable for any station type (hub, terminal)

REDUNDANCY

- 1+1 up to 4+4 with automatic handover

AES-256 ENCRYPTION OPTION

- Plug and play hardware with AES-256 encryption
- Software API option for customized encryption solutions available

BENEFITS

- Scale inbound capacity of any location without interrupting service or changing schemes
- Single SKYWAN 5G transmitter per stack – no additional ODU backoff required
- Capacity split to several smaller TDMA channels to connect power-limited remotes or enable mesh
- Upscale and downscale Rx data rate based on customers' choice for their peak/non-peak periods
- Capacity pooling with more channels enhances TDMA efficiency and further lowers OPEX
- Optimised CAPEX: most economical solution to serve higher inbound bandwidth requirements by adding just a demodulator

Flyaway Terminals

BENEFITS

- Extremely reliable and ready for immediate action
- Integrated Feed/Boom/BUC/LNB package for each frequency band
- Manual, field upgradable to motorized version

FLYAWAY TERMINALS

Flyaway terminals follow a modular approach of high throughput VSAT terminals in the range of 1.2 m to 2.4 m packed in a few shipping cases. Assembly of a 1.5 m dish can be done by one person in less than 15 min. Bigger antenna sizes might require two person assembly and about one hour of time. The SKYWAN 5G outdoor unit with its ruggedised design perfectly fits the flyaway application for use in rough conditions.

GAIN PORTABILITY

Integrated Network Nodes – Powered by Skywan 5G

SKYWAN 5G is always the right choice for reliable business and mission-critical satellite communication networks where small man-portable up to larger transportable terminals are needed. SKYWAN 5G was designed with the full range of typical ground stations in mind and thus integrates seamlessly into fix stations, manpacks and flyaway solutions.

In typical fix earth stations the VSAT router is located indoors in a server room together with the baseband equipment and connected to the antenna using an interfacility link. For this kind of application the SKYWAN 5G 19" rack unit is the right fit. For integrated terminals, the SKYWAN 5G is fully integrated into manpack or flyaway terminals.

SKYWAN 5G with its MF-TDMA access scheme supports all these ground station types within the same network. The following examples show various manpack or small flyaway ground stations with integrated SKYWAN 5G.

MANPACK TERMINALS

Manpack terminals are rugged, portable and fully integrated VSAT and modem solutions, facilitating rapid deployment anywhere in under ten minutes. With its compact size and lightweight yet robust design it typically fits into a backpack to carry-on.

BENEFITS

- Manual or Motorised
- Typically less than 20 kg
- Single person setup & operation

Mobility SOTM

GAIN MOBILITY

Integrated Network Nodes – Powered by SKYWAN 5G

Keeping pace in a mobile world requires communication everywhere. Thanks to SKYWAN and its adapted modem technology including Doppler shift compensation, reliable in-motion communication at high speed is given.

Whether its live reports from sports events, emergency services like search & rescue, police, fire brigade, homeland security, or in defense for troop communication, convoy protection – the full range of applications looking for „always on" communications is supported.

SKYWAN 5G with its SOTM enhancements, combined with a tested and suitably selected on-the-Move landmobile or maritime antenna comprise a perfectly tailored Comms-on-the-Move package.

MOBILITY: SATCOM ON THE MOVE (SOTM)

SOTM provides mobile users communication services from the first second without noticeable antenna deployment. The system reliably manages the in-motion effects by Doppler shift compensation and fast link re-acquisition within subseconds of any interruption.

These are a few samples of SKYWAN 5G integrated network nodes.

MOBILITY: COMMUNICATION ON THE PAUSE (COTP)

Vehicle mounted, auto-acquire COTP VSATs all deploy and stow (for driving) with the push of a single button. The VSATs are typically deployed and online within just a few minutes.

DUAL DEMODULATOR
(DVB-S2 & TDMA)

SKYWAN 5G is a MF-TDMA modem with integrated DVB-S2 receiver. The Rx signal is injected to one common Rx port, split up internally and passed to both demodulators (DVB-S2 and TDMA receiver). The uniqueness of SKYWAN 5G is both traffic types are received simultaneously up to full speed and forwarded by the router without limiting the throughput. The dual demodulator SKYWAN 5G perfectly supports higher throughput applications where bandwidth management is a pain point by utilising the TDMA link for configuring ad hoc DVB-S2 links.

For any ad hoc or temporary events (e.g. covering large exhibitions, sports events or providing Internet broadband access) where higher data rates are occasionally needed, both receivers can be independently and dynamically used to fulfill the bandwidth expectations. Customers can easily upscale and downscale Rx data rates by choice for peak/non-peak periods.
With an additional DVB-S2 Modulator installed at a remote site, a customer can immediately establish DVB SCPC links to any other SKYWAN 5G site thanks to the integrated DVB-S2 receiver.

SKYWAN 5G is the ONE VSAT platform for service providers to provide flexible TDM/TDMA solutions to their end customers.

RXTDMA & DVB-S2

SKYWAN 5G

TDMA

DVB-S2

LAN
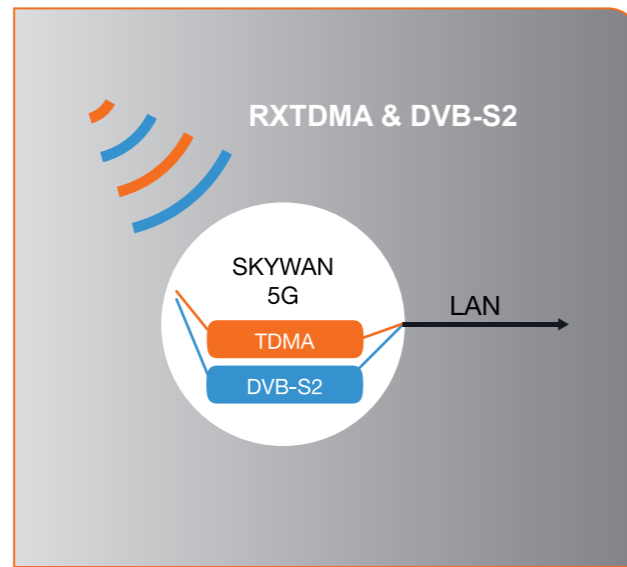
BENEFITS

- Receive simultaneously on TDMA up to 20/80 Mbps & DVB-S2 up to 80 Mbps
- High performance carrier-grade router
- TDMA link is utilised to manage DVB-S2 links
- Easily upscale/downscale throughputs for events

HIGH EFFICIENCY AND PERFORMANCE
FOR TRAFFIC CARRIERS

Performance in the DVB-S2 path is up to 80 Mbps at the receivers' LAN port and up to 20 Mbps for each TDMA carrier in receive and transmit, thus providing assurance to drive high performance throughput networks as expected in a SCPC environment. The SKYWAN 5G modem gives you the flexibility to support more than 24 MODCODs while designing TDMA carriers. Modem performance is the indicator of choice when making a technology platform decision. The SKYWAN 5G provides the best bits/Hz efficiency in the TDMA world, Eb/No performance almost at SCPC modem level and high inbound carrier data rates. The modem delivers the highest throughput, both in DVB/TDM with ACM implementation and at TDMA level, by supporting higher efficiency 16 APSK MODCODs.

BENEFITS

- Enhanced TDMA efficiency, more bit/s/hz by using industry leading 16 APSK
- Huge bandwidth savings with application of 16 APSK in TDMA and up to 32 APSK in DVB
- Savings in recurring bandwidth OPEX
- CAPEX savings with inbuilt DVB receiver for higher multiple share bandwidth requirements

TDMA

MODULATION & CODERATE			
BPSK	QPSK	8 PSK	16 APSK
1/3	1/3		
2/5	2/5		
4/9	4/9		
1/2	1/2		
2/3	2/3	2/3	2/3
	3/4	3/4	3/4
	4/5	4/5	4/5
	5/6	5/6	5/6
	6/7	6/7	6/7

DVB-S2

MODULATION & CODERATE			
QPSK	8PSK	16 APSK	32 APSK
2/5			
1/2			
3/5	3/5		
2/3	2/3	2/3	
3/4	3/4	3/4	3/4
4/5		4/5	4/5
5/6	5/6	8/9	
8/9	8/9		
9/10	9/10	9/10	

GAIN COMPETITIVE ADVANTAGE WITH UNIQUE DESIGN FLEXIBILITY

SIGNALING INDEPENDENT FROM DVB

Since the signaling is done via TDMA carriers, temporary or even multiple DVB links in one network are possible.

With every remote having an inbuilt DVB receiver, this gives flexibility to host DVB outbound from any remote location. In addition, multiple non redundant DVB-S2 outbound channels can be established everywhere on each site (DVB receiver can be reconfigured). Activation of SKYWAN's meshed capability completes the flexibility of the network design.

The system design enables and supports multiple DVB outbounds in one network at every node. Up to four DVB gateways can be operated per site, managed by the SKYWAN 5G node controller either working independently or in redundancy mode.

BENEFITS

- Multiple DVB outbounds
- Independent of the location in the network
- Can be enabled and supported by the system design

RELIABLE FOR CRITICAL APPLICATIONS AND EVOLVING IP REQUIREMENTS

SKYWAN 5G supports Virtual Routing and Forwarding (VRF) in combination with multiple QoS Classes based on PHB.

In the SATCOM market, service providers have to support multiple customers in one network to benefit from the capacity pooling and therefore optimised OPEX (bandwidth). Quite often, customers are located in different vertical

market segments with different needs in terms of capacity, traffic classes, QoS aspects and IP address ranges, which limits the capability of many VSAT networks. SKYWAN 5G provides the needed solution by offering a multiple Virtual Routing and Forwarding (VRF) feature, where all these needs and requirements can be combined in one physical network.

Only SKYWAN enhances VRF on Layer 3 with Virtual Channel Groups on TDMA level to benefit from its:
- Real time (RT)
- Non-real time (NRT)
enhancements by assigning:
- Different priorities/QoS Classes
- Commited thresholds per customer
  to guarantee bandwidth but also enforce jitter bounds to customer generated delay sensitive traffic classes.

An extra bonus for service providers is the Shared VRF bandwidth pool allowing customers to temporarily exceed their committed bandwith without disadvantaging others.

VRF provides the advantage of implementing networks where multiple customers/departments are involved and the customer groups' networks are kept separated with respect to IP network design, bandwidth allocation and assignment. In addition, different customer-defined terminal groups and multiple customers' support on one remote station are supported, since the Ethernet port can be configured independently (not only a switch, but a complete router).

BENEFITS

- Ease of doing business for service providers
- Reduced CAPEX/OPEX by not investing in multiple hubs for multiple customers
- End user/customer can configure his own network and perform all functions remotely through VNO
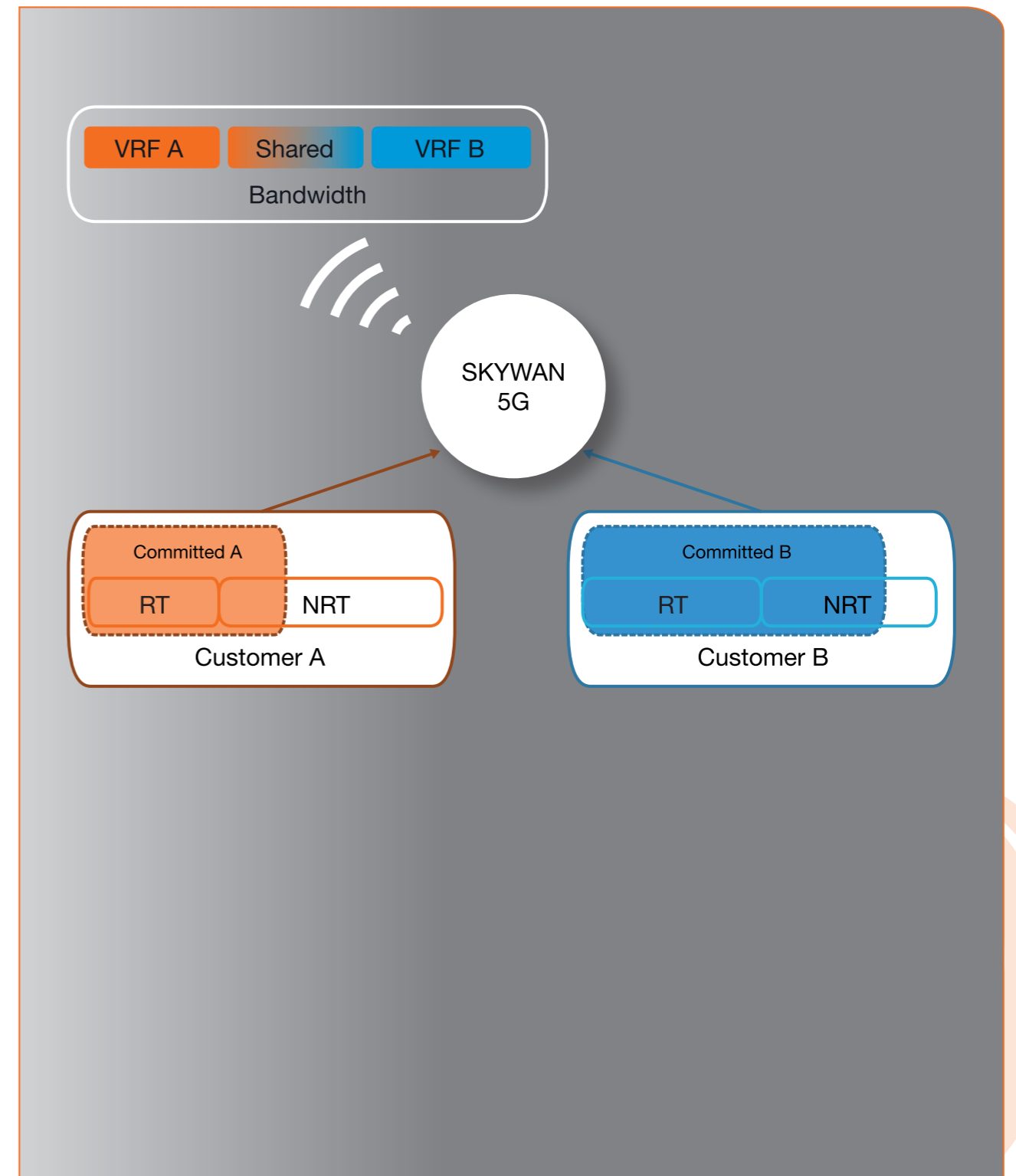
FLEXIBLE TOPOLOGIES

SKYWAN 5G OFFERS A MULTITUDE OF POSSIBLE TOPOLOGIES

You are not only able to mix topologies, but also have different customers with diverse requirements within one and the same system. A service provider can serve different vertical markets where the equipment is hosted at the end customers headquarters or at the service provider facility backed up by secure VPN connectivity.

POINT TO POINT

- SCPC style connection
- Cascadable

STAR-BASED SYSTEMS

- Based on MF-TDMA carriers only
- Based on one DVB-S2 and MF-TDMA carriers

MULTI-STAR BASED SYSTEMS

- Based on MF-TDMA carriers only
- Based on multiple DVB-S2 and MF-TDMA carriers

HYBRID SYSTEMS

- Extension of previous networks with several fully meshed terminals
- Complete fully meshed network (with or without one or several DVB-S2 outbounds)

POINT TO POINT
CARRIERS ONLY

MF-TDMA
CARRIERS ONLY

ONE DVB-S2 AND
MF-TDMA
CARRIESS

MF-TDMA
CARRIERS ONLY

ONE OR MULTIPLE
DVB-S2 AND
MF-TDMA
CARRIESS

ONE OR MULTIPLE
DVB-S2 AND
MF-TDMA
CARRIESS

EXTEND   ADAPT

TDMA   DBV-S2   Skywan 5G Station   DBV-S2 Gateaway
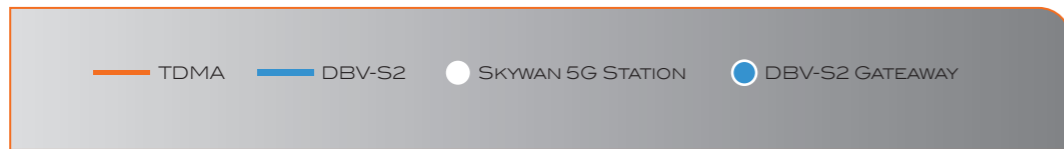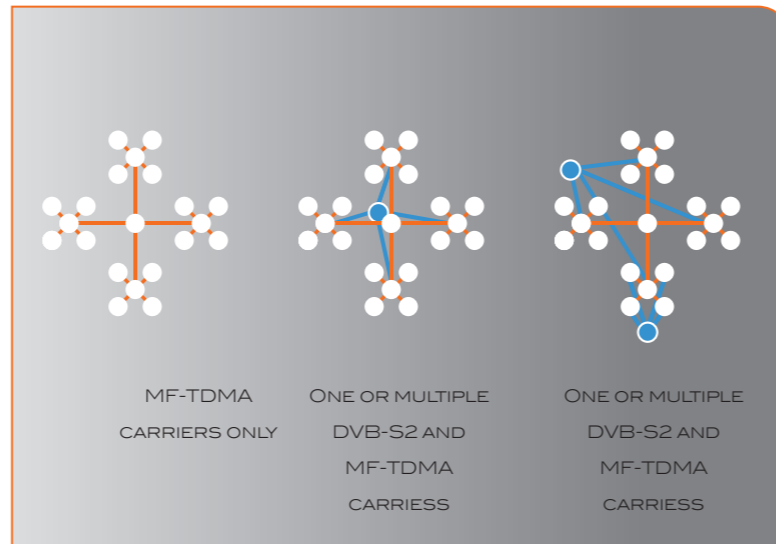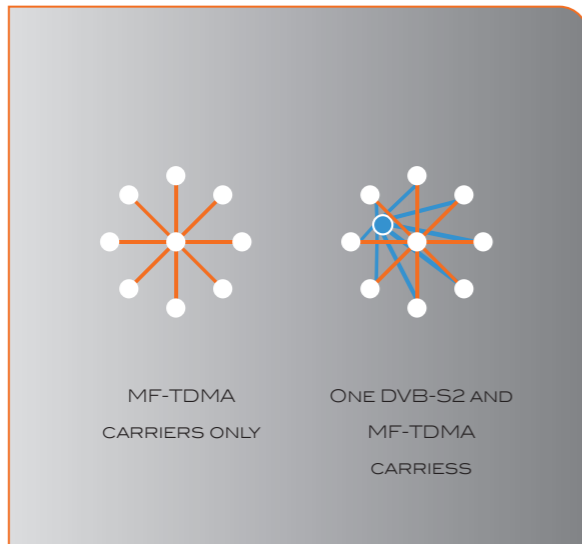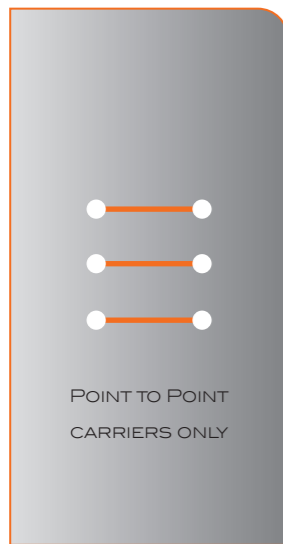
RELIABLE FOR CRITICAL APPLICATIONS …

SKYWAN 5G NODE SET-UP

SKYWAN 5G two-way VSAT broadband stations are composed of the satellite router and the RF components inline with the used space 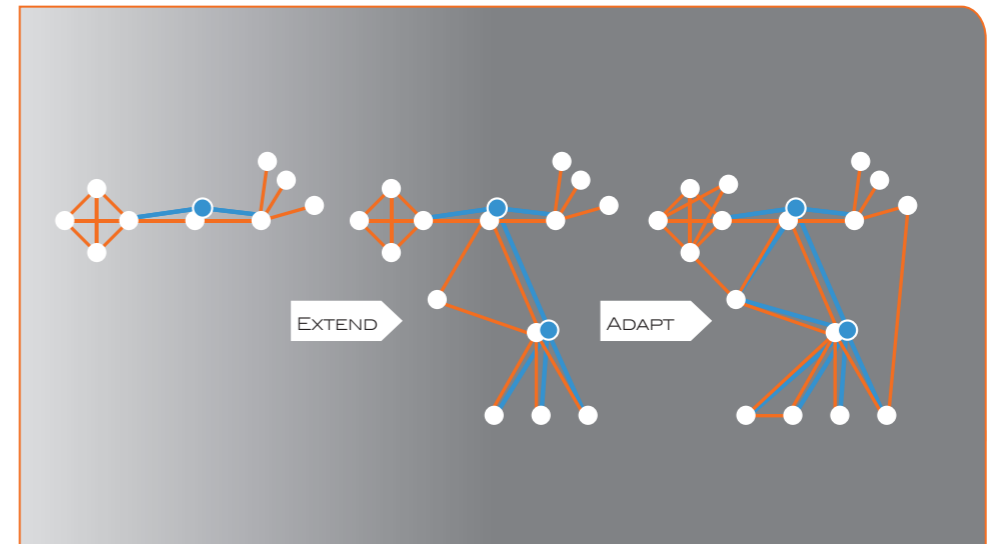segment enabling stationary communication to communication whilst moving. This is outlined in the diagram below: "Structure of SKYWAN 5G Network Nodes".

VSAT Router
SKYWAN 5G combines a comprehensive IP router and the satellite modem in one box. The satellite link layer aware router with tight integration of network and link layer benefits from cross-layer optimisations:

- Immediate MF-TDMA link status (up to 16 links with up to 20 Mbps) and routing updates
- Immediate status of queue system/fill level, the router proactively adapts its bandwidth on demand
- List of alternative paths for load balancing
- COTM-adapted hold timers for routing information
- Encryption with QoS support SKYWAN 5G is operating on a Linux RTOS with deterministic system responsiveness even under heavy load or network congestion
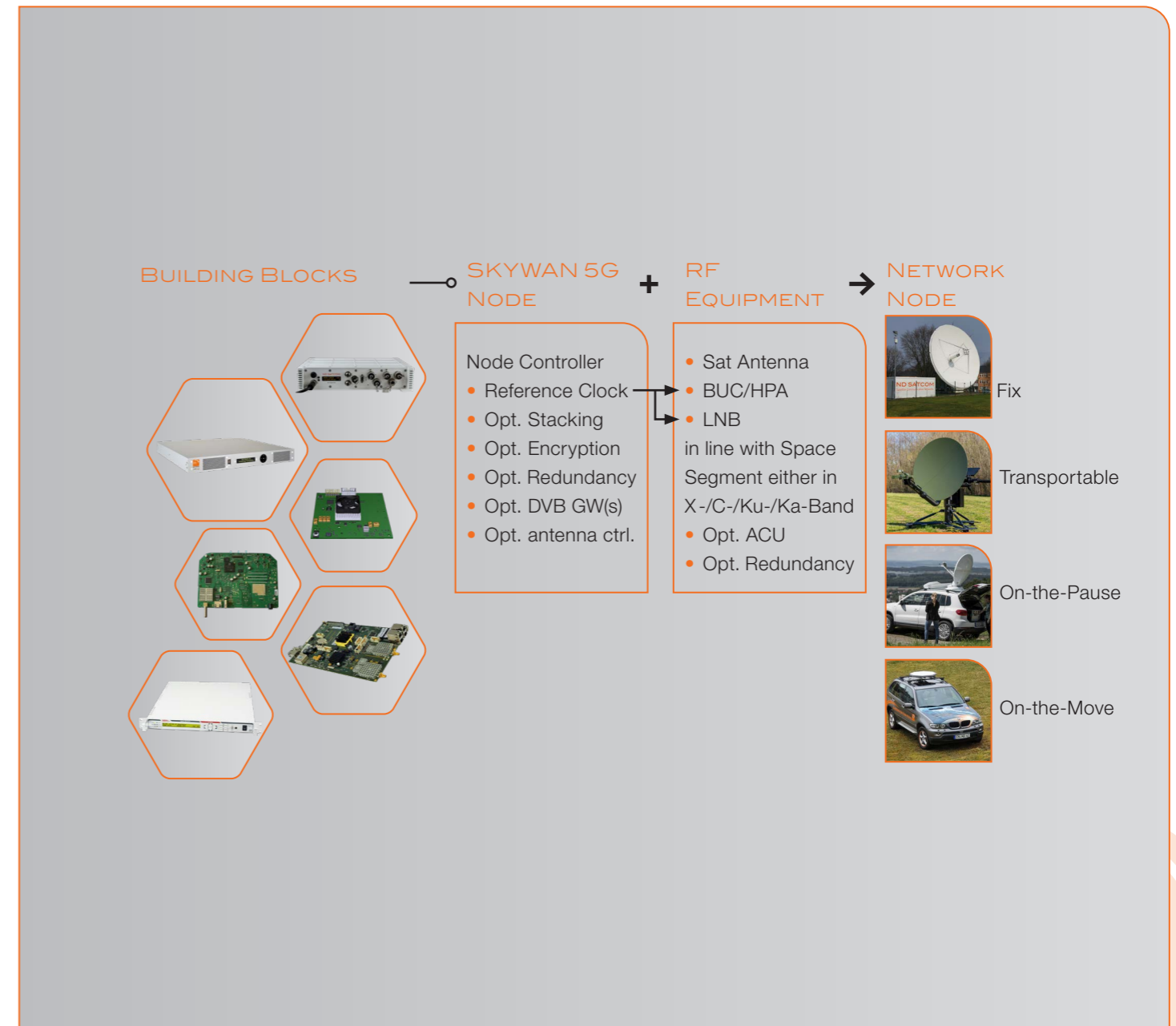
Reference Clock (10 MHz OCXO)
The SKYWAN 5G node controller provides an Oven Controlled Crystal Oscillator-based 10 MHz reference signal to the RF transmitter and receiver. Using such an accurate and low noise clock as input for the frequency conversion delivers small frequency offsets and drifts, low implementation loss and enables fast TDMA link reacquisition. This pays off in terms of system reliability, service quality and connectivity in COTM applications, which keeps the operational costs in line with the calculated link budget and user throughput.

Interfacility Link (L-Band cabling)
Active and passive components used for L-Band cabling must forward or bypass the 10 MHz reference signal and potentially DC power if either BUC or LNB is directly powered by the SKYWAN 5G VSAT router. In the case of a stack with redundant node controller, the SKYWAN 5G software ensures that the DC and reference signal are provided by the current acting node controller.

Data Exchange with ACU
Antenna sub-systems, especially stabilised antennas on ships or for on-the-move communication, interface with the attached SKYWAN 5G for configuration, status exchange and – more importantly – control of the transmit signal in case the antenna is getting off-satellite. Information exchange is feasible using electric signals with the Auxiliary port and/or by means of the IP-based OpenAMIP protocol. For mobile stations roaming through different satellite spots, the antenna with OpenAMIP is used to update the GPS location to initiate beam switching at the spots' edges.

Building Blocks → **SKYWAN 5G Node** + **RF Equipment** → **Network Node**

Node Controller
- Reference Clock
- Opt. Stacking
- Opt. Encryption
- Opt. Redundancy
- Opt. DVB GW(s)
- Opt. antenna ctrl.

- Sat Antenna
- BUC/HPA
- LNB
in line with Space Segment either in X-/C-/Ku-/Ka-Band
- Opt. ACU
- Opt. Redundancy

Fix

Transportable

On-the-Pause

On-the-Move

Structure of Skywan 5G Network Nodes

... AND ENVOLVING IP REQUIREMENTS

Baseband Access
SKYWAN 5G provides four GbE ports to connect baseband equipment (switches, routers, end devices/clients). Each port can be individually configured, either as switch (w/wo VLAN tagging, jumbo frames) or router interface (VRF). All ports can be operated separately (security, multi-customer access) or several ports are assigned to one user group.

Network Services
SKYWAN 5G is the best economical solution for mid-sized and highly interactive VSAT networks. Service providers benefit from a dual-transport satellite WAN offering:

- Utmost flexibility in carrier design, the placement on the transponder and tailoring to the applications
- Built-in network resiliency with redundant network control function (Multi-Master)
- Cost-effective shared platform supporting overbooking
- Bandwidth on demand
- Multi-customer
- Multi-user
- Reliable and efficient data transfer

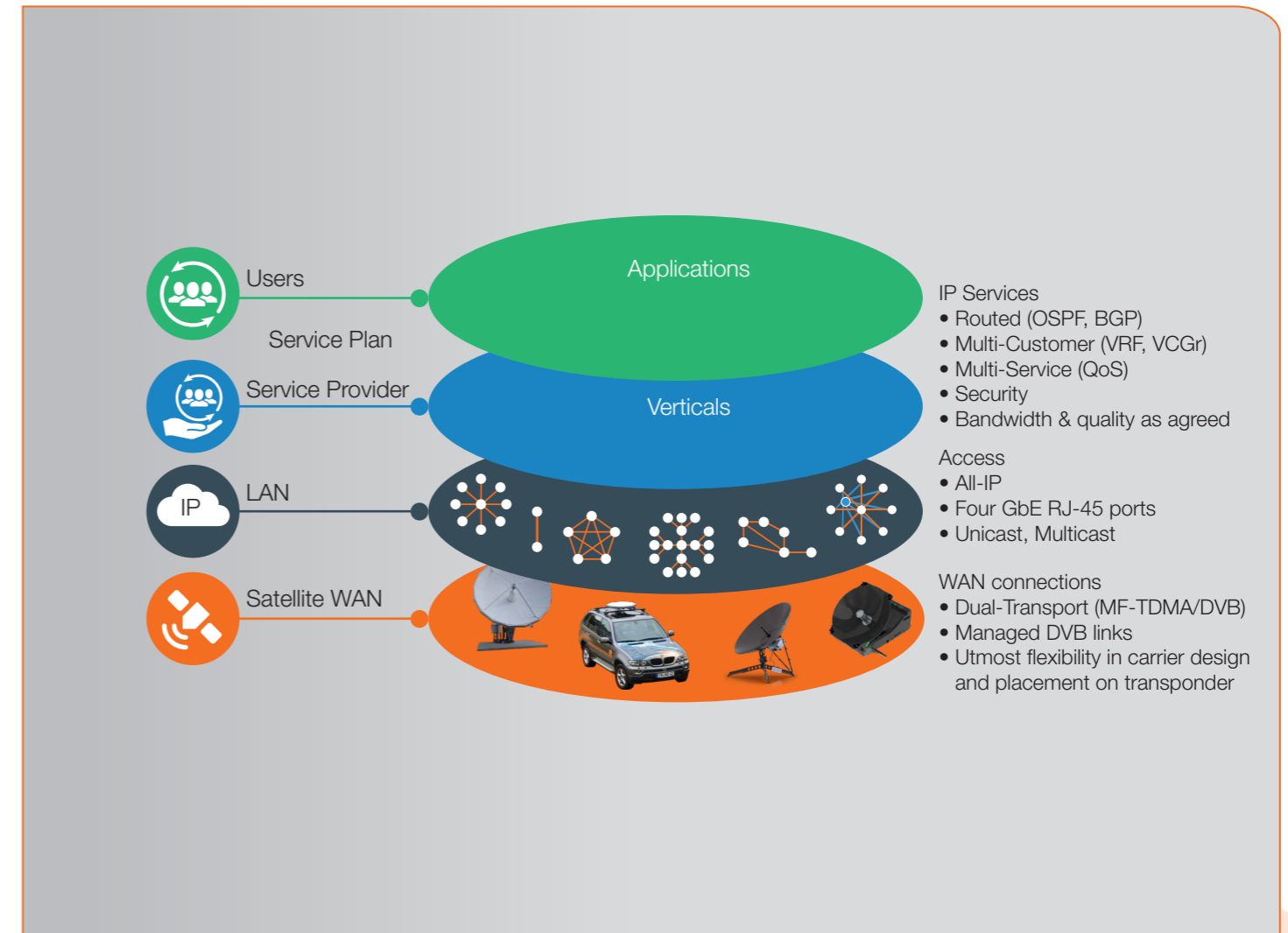The users access the all-IP service by Ethernet enabling:

- End-to-end unicast and multicast communication
- Bandwidth assignment and service quality according to service plan (CIR, MIR, excess rates, QoS, real-time/non-real-time traffic)

Combined Network Operation
All sorts of applications, from fixed to mobile terminals with data & real-time requirements, are supported within the same SKYWAN 5G network. The terminals are assigned to the channels according to their link budget, and thanks to the MF-TDMA channel access method, all work at their optimum, maintaining the ability to communicate with any other terminal.

Bandwidth on Demand
A SKYWAN 5G network responds to bandwidth demands of individual stations within the blink of an eye, i.e. every frame (typical 100 ms, range 40 – 400 ms). The Demand Assigned Multiple Access (DAMA) perfectly fits todays packet based IP networks to make the most out of the leased satellite bandwidth by statistical multiplexing. A station derives its demand from the fill rate of its queueing system and requests real-time or non-real-time capacity based on its QoS settings. The operator is in control of the capacity assignments to user groups (VRF) and users (station or an individual Ethernet port) as agreed in the service contract. Based on the service provisioning, the users get their bandwidth guarantees (CIR), real-time or best effort service and even excess rates if available in the shared bandwidth pool. SKYWAN 5G delivers consistent performance with carriergrade availability and data integrity to the users.

Users
Service Plan
Service Provider
LAN
IP
Satellite WAN

Applications
Verticals

IP Services
- Routed (OSPF, BGP)
- Multi-Customer (VRF, VCGr)
- Multi-Service (QoS)
- Security
- Bandwidth & quality as agreed

Access
- All-IP
- Four GbE RJ-45 ports
- Unicast, Multicast

WAN connections
- Dual-Transport (MF-TDMA/DVB)
- Managed DVB links
- Utmost flexibility in carrier design and placement on transponder

BENEFITS FOR SERVICE PROVIDERS

- Standardised – qualified for a broad range of verticals and applications
- The ONE Service Platform – simple logistics
- Pay as you grow – low upfront costs
- Seamless integration to terrestrial infrastructure – carrier grade router with standard protocols
- Shared access with CIR for each user – high return on invest

BENEFITS FOR USERS

- Low latency/direct communication – excellent quality for all applications
- QoS – superior quality for voice, real-time & business critical applications
- Responsive network for growth, bandwidth adjustments, load balancing
- Secure

Cost Structure of Satellite Services

Visible costs

Antenna RF HPA
Modem Converters
Router Switches
Transport Duties

Underlying subsequent costs

Space Segment

Teleport Operations

Licensing

Cost of Ownership

Capital Expenses
• Network & Transmission Equipment
• Site Equipment
• Civil Works

Operating Expenses
• Operations & Maintenance
• Transmission OPEX
• Site Rental
• Power
• Spares/Support Training

Network Operations & Depreciation

Total Cost of Ownership

LOWER COST OF OWNERSHIP

Capacity is a substantial cost factor of a satellite service as shown in the picture "Cost Structure of Satellite Services" above. Monthly fees per 1 MHz capacity are in the range of several hundred to a few thousand dollars depending on the used frequency band. Considering a typical spectral efficiency of 1 to 5 bit/s/Hz, it yields a data rate up to 5 Mbps per MHz leased capacity.

Carrier Efficiency
SKYWAN 5G uses state-of-the-art waveforms for high spectral efficiency (bit/s/Hz). Depending on the transport method, the following characteristics apply.

Multi-Frequency TDMA:
• Turbo-φ coding
• Carrier spacing with roll-off factor down to 0.1
• Highly adjustable in terms of symbol rate, ModCod and container size (100 – 3,000 byte)
• Each of the 16 carriers is individually configurable
• Full flexibility in carrier placement thanks to hopping range of 1,200 MHz; no requirement of adjacent capacity for a multi-carrier network
• Online fail-safe carrier provisioning

TDM:
• DVB-S2
• Carrier spacing with roll-off factor down to 0.05
• Highly adjustable in terms of symbol rate and ModCod
• Adaptive Coding and Modulation
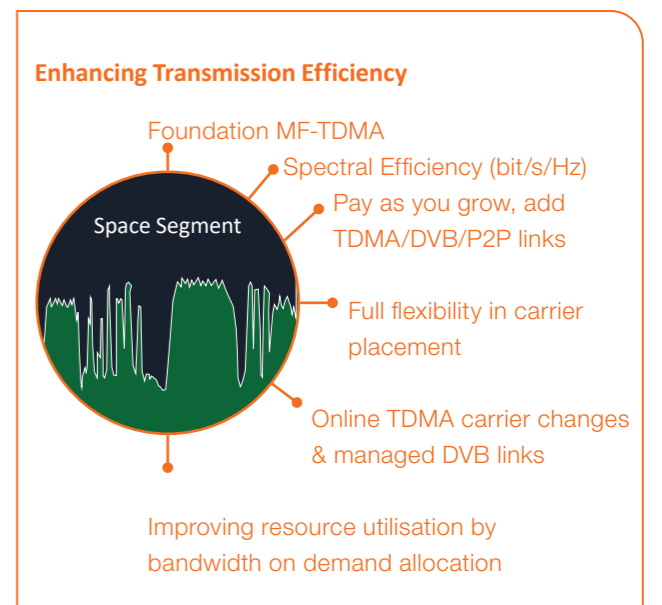• Managed DVB links due to MF-TDMA signalling path

End-to-End Effective Network
TDMA with its ability to share a pool of bandwidth among multiple users has become the industry standard for highly interactive networks. SKYWAN 5G with its MF-TDMA channel access and routed network has distinct advantages:

• Statistical multiplex in inbound and outbound
• Single hop communication requiring capacity just once
• No L2 broadcast over satellite saving bandwidth
• Segmentation based on VRF and patented Virtual Channel Groups (VCGr), enforcing bandwidth share settings per channel and VRF

SKYWAN 5G networks interconnect distant locations cost-effectively, providing high quality communication for multimedia services (voice, video) and data transport with guarantees as agreed in the service contract.

SKYWAN 5G is the most economic solution of hubless business and mission-critical VSAT networks connecting several hundred locations.

Enhancing Transmission Efficiency

Space Segment

Foundation MF-TDMA
Spectral Efficiency (bit/s/Hz)
Pay as you grow, add TDMA/DVB/P2P links
Full flexibility in carrier placement
Online TDMA carrier changes & managed DVB links

Improving resource utilisation by bandwidth on demand allocation

ND SAT COM

EXPLORE EVEN MORE MORE FEATURES OF SKYWAN 5G:

- Web browser access
- Pointing assistant
- NMS delivered as virtual appliance
- User friendly NMS, transactional configuration, dashboard
- Training/Support/Attractive Bundling

REFERENCE DOCUMENTS:

- SKYWAN 5G NMS
- SKYWAN 5G DVB-S2 solution

DIRECT LINK TO WWW.NDSATCOM.COM

Via Satellite
SATELLITE TECHNOLOGY
of the Year 2018
★★★ OFFICIAL NOMINEE ★★★

Rakesh Kukreja,
Managing Director
of iSAT Africa

CUSTOMER TESTIMONIAL

"

iSAT Africa especially like the real pay-as-you-grow concept, where we did not have to invest a great deal to buy a big hub, but we can scale networks as we like, being that any single network node can be upgraded to a hub with just a software licence. We were also amazed with overbooking capabilities of the modem, which are in the range of terrestrial systems like MPLS and microwave. Then, of course, there is the famous mesh capability, which delivers single hop connectivity between any two stations without limitations, slicing the delay and satellite cost in half. As for ND SATCOM, they have an impeccable reputation from decades of serving high-profile customers like governments, air traffic control and the military. Their understanding of the market, their delivery and support are simply first class.

"

SKYWAN 5G –
THE SERVICE PROVIDER'S X FACTOR

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