ND SATCOM

INTRODUCTION TO SKYWAN 5G

SKYWAN 5G launches the fifth generation of the SKY-WAN product family. Like its predecessors, SKYWAN 5G denotes a VSAT network product to be operated via geostationary satellites with transparent transponders. Like the previous generations, SKYWAN 5G supports multimedia services and offers the users the main benefit of VSAT networks which is the direct access to the satellites' widespread coverage via small antennas installed at the user's premises.

SKYWAN 5G is the next evolutionary step for the previous SKYWAN generations in many respects. For the modem part, supporting two satellite access schemes in parallel, both MF-TDMA and DVB-S2, additional higher-order modulation schemes, adaptive coding and modulation, a 50 % wider fast frequency hopping range, symbol rates twice as high as before, and therefore also much higher peak rates and total bandwidth throughput, SKYWAN 5G beats the matchless flexibility, efficiency and performance of its predecessors. In combination with a seamless cascading of multiple units to get additional TDMA demodulators for each location (starting with one additional unit in the first release), but acting as one node, flexibility in topology design and extension is unmatched by other systems.
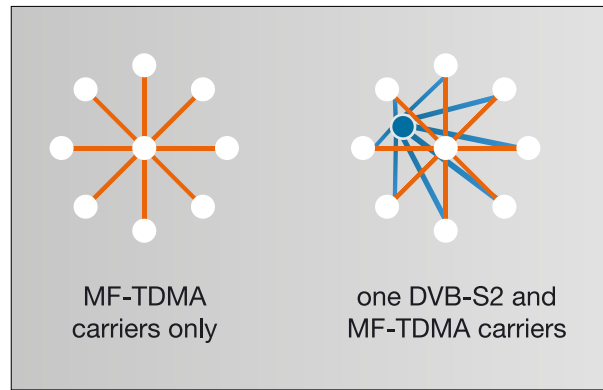
Since there is no difference in hardware between a remote station and the master station, the master function can be easily re-located and activated if required on every station within the network. Even a split of one network in multiple smaller networks or vice versa can be done without changing the hardware. The unique master/backup-master concept with the built-in geographical redundancy possibility without network interruption as provided by the previous SKYWAN generations, is also improved by this approach, since each remote station could take the role of a master station – in the future even automatically (round robin approach).

SKYWAN unit – The ONE

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As SKYWAN's signaling is based on TDMA, it is not limited, like most other systems are, to act as a mainly star based system. The main traffic access point (HUB) must not necessarily be the master station; there is no need to limit the network to only one main traffic access point, that means multiple star topologies with multiple HUBs can be realized. By this, also multiple DVB outbound channels from different locations can be used in parallel or in an alternating way, since the network signaling and synchronization is not linked to the DVB carrier, as in most other system. A reconfiguration of the embedded DVB receiver in the SKYWAN 5G can be done on the fly without losing contact to the remote station – the connection is upheld by the MF-TDMA network.


MF-TDMA
carriers only

one DVB-S2 and
MF-TDMA carriers

Star based systems:
● MF-TDMA carriers only
● One DVB-S2 and MF-TDMA carriers

MF-TDMA
carriers only

One or multiple
DVB-S2 &
MF-TDMA carriers

One or multiple
DVB-S2 &
MF-TDMA carriers
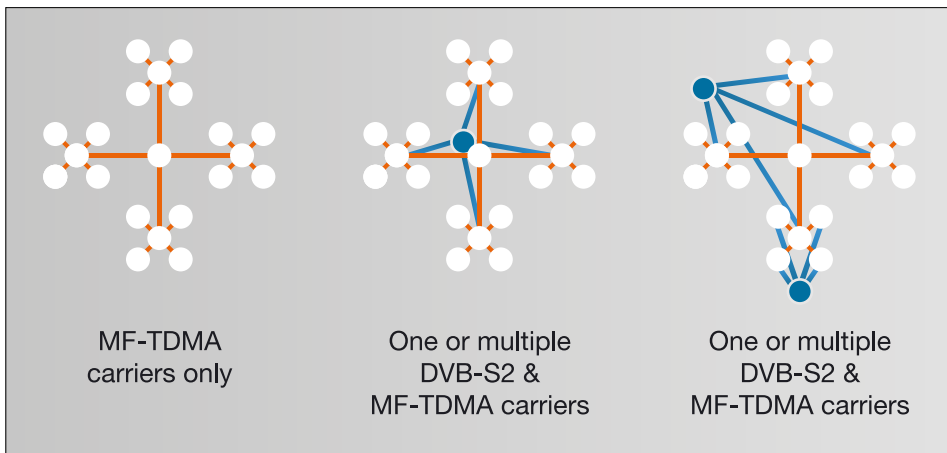
Multi-Star based systems
● MF-TDMA carriers only
● Multiple DVB-S2 and MF-TDMA carriers

With SKYWAN 5G the service provider is given total freedom to plan, design and realize the VSAT network he needs for his project and requirements. A seamless extension from a small star based system up to a complete meshed infrastructure with multiple DVB outbound channels can be easily realized without a total change of already procured VSAT network equipment.

X   C   Ku   Ka

TDMA   DVB-S2

TCP-A
PHB
VRF
ACM

SKYWAN
5G

IPv4/6
OSPF
BGP
GRE
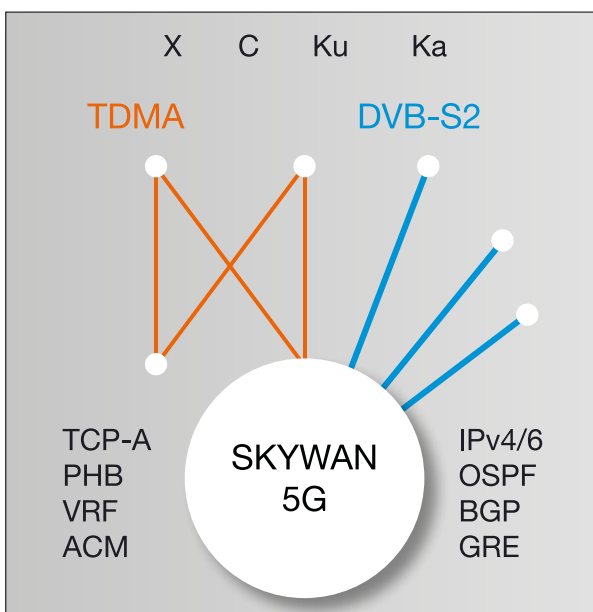
SKYWAN 5G – Flexibility in almost every direction

SKYWAN 5G SETS A NEW STANDARD!

With regards to the world's ever-increasing orientation towards IP-protocol-based communications, SKYWAN 5G presents itself as a classical IP access device enabling wide area communications. In consequence, SKYWAN 5G incorporates the full feature set of a powerful multi-functional IP access router, like for example support of IP versions four (IPv4) and six (IPv6), fluency in the language of multiple routing protocols as OSPF and BGP, network address translation NAT, service differentiation, traffic shaping QoS, firewall security by definable filter rules and stateful packet inspection (SPI), virtual private network protection, L2 encapsulation by GRE and therefore also support of MPLS, etc. The four port Ethernet device is not acting as a simple switch, but every port can be configured in a different way with reference to (multiple) IP addresses, VLAN, to be used as traffic or management port only etc.

By this, SKYWAN 5G is serving the needs of network service providers, the needs of self-operating customers and the needs of end users. Deploying SKYWAN 5G, network service providers are able to offer network services to a variety of customers, each being completely isolated from the others. Thanks to virtual router technology (VRF concept), SKYWAN 5G allows the network service provider to provision virtual IP backbones and create a virtual IP backbone service. Following the subdivision of the physical router into virtual routers each being dedicated to a particular customer, each virtual IP router acts like an independent router, but does so much more efficiently because of shared common resources. Beyond that, virtual IP routers enable independent IP traffic management, independent IP routing, and independent administrative control for each IP backbone customer.
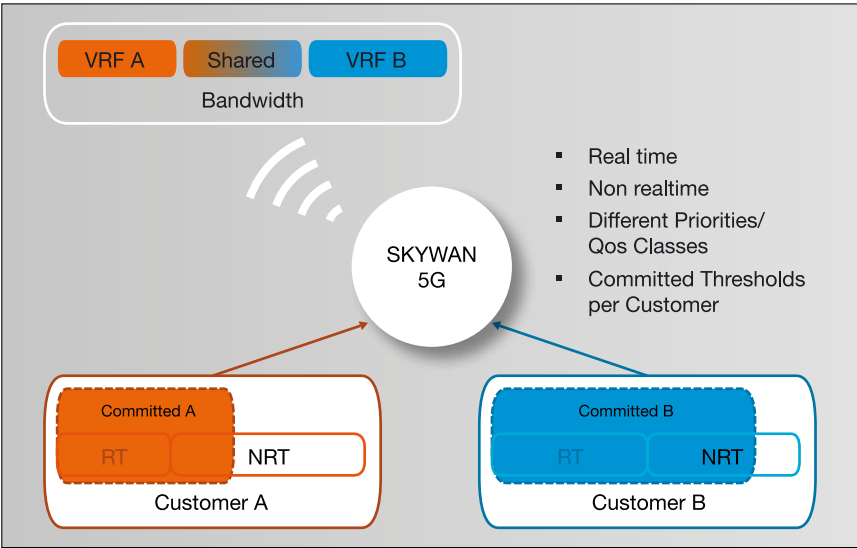

Web based graphical user interface for the SKYWAN 5G

For each virtual customer network a minimum and/or maximum bandwidth of the overall network capacity pool can be assigned, a certain common capacity can be assigned as shared used capacity for all virtual networks. For each virtual network specific QoS parameter can be configured for real-time (assigned stream slots to reduce jitter) and non-real time traffic with the same wide range of filter sets used in common IT infrastructure (PHB filter and QoS).

Each SKYWAN 5G IDU can be configured by a graphical user interface, but also by pre-configured installation files uploaded via IP or via the local USB port. The number of parameters for a remote station joining an existing network is reduced since only a few initial parameters to receive the first TDMA carrier are needed – all TDMA parameters are transferred from the active master station to the remotes later on.

In order to assist the network operator in managing the vast feature set of SKYWAN 5G, the VSAT modem comes along with a new network configuration approach, new network configuration intelligence, new network configuration interfaces, and new network configuration tools. Following the new network configuration approach, a SKYWAN 5G network and its network nodes appear to the most extent as a classical IP core network with classical feature-rich IP access routers and are managed accordingly. Moreover, whenever feasible and with ongoing next releases, SKYWAN 5G is managed at a service level hiding the complexity and specifics of the underlying satellite link layer. Last but not least, the effort for initial commissioning is further reduced.


General VRF Concept in SKYWAN 5G

1 Basic implementation available, but not in management part and commercial release V1.0, since market feedback gave a general request for future availability and support, but no practical and actual use.

2 In future release configurable via GUI and NMS

3 http://en.wikipedia.org/wiki/Virtual_Routing_and_Forwarding
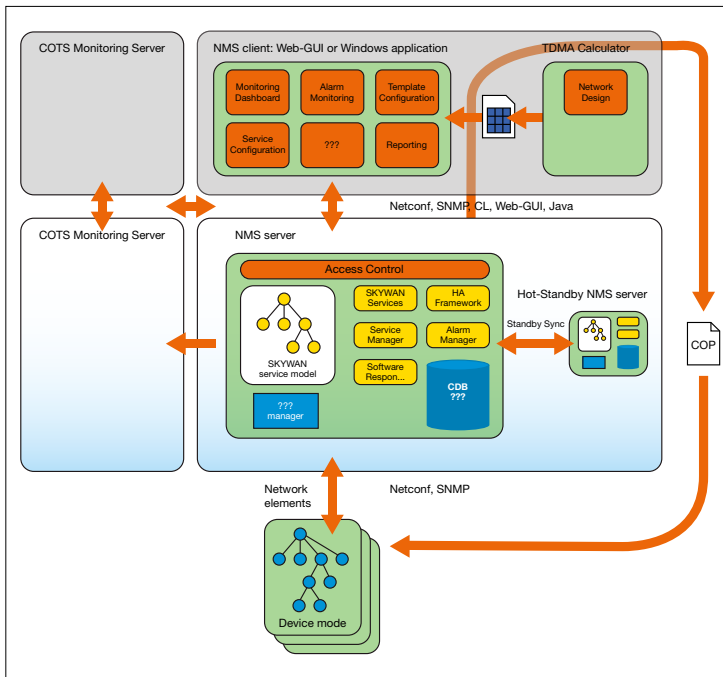
The SKYWAN 5G NMS mainly focuses on the configuration tasks and basic monitoring views, since the SKYWAN IDU supports any standard NMS tool using SNMP (v2 and v3) by standard and private MIBs for monitoring purposes. Therefore, each customer can use his current tools and environment or other preferred systems. The SKYWAN 5G NMS concentrates on the network configuration management in combination with a transaction based approach, ensuring possible rollback scenarios (in case not all remotes got the new configuration as expected). The system is multi-user, multi-role capable and operates as a web based application to allow a possible access from every location with any system, if secure access is given and allowed. Templates and intelligent algorithms facilitate system-wide changes of parameters.

SKYWAN 5G NMS – General Approach
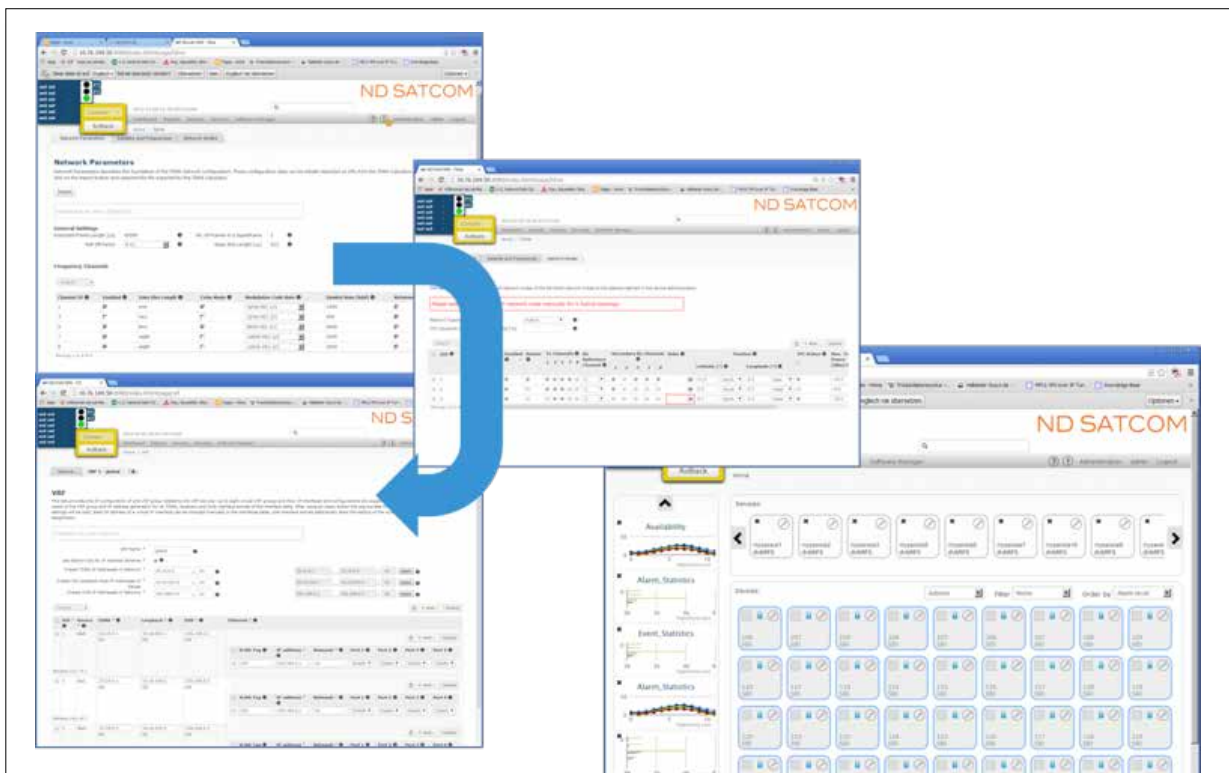
SKYWAN 5G NMS – Main Screen and Configuration Tabs (examples)

The benefit of the SKYWAN core to be independent from the NMS system is still given with 5G. Even if the management system has a failure or is unreachable, the SKYWAN network itself stays stable and in operation. Changes in the local configuration (i.e. not affecting the total network) are still possible during this time via the SKYWAN IDU configuration interfaces (Web UI, CLI). In addition, a redundant configuration of the NMS – also in a geographical way – can be realized. The NMS is deployable everywhere – as long as an IP connection to the network is given. To allow an independent and simple usage, the SKYWAN 5G NMS is provided as a complete virtual appliance image bundle (VMware compatible VMDK image). This allows comfortable installation of the NMS to a different physical host within a short time. Also, network growth is easily supported, since it allows running the NMS in the beginning or testing phase on a workstation first (VMware, Virtual Box or other container compatible virtual machine software), but the usage on a dedicated server with complete hypervisor support is also possible without reinstalling the available system and configuration.

TECHNICAL SPECIFICATION

VSAT NETWORK

Network Topology	Star / Hybrid / True Full Mesh
Type & Number of Demodulators	1x MF-TDMA modulator, 1x TDMA demodulator (home channel) + 1x DVB-S2 receiver (ETSI)
Access Type TDMA	MF-TDMA for all direction communication with fast frequency hopping in Tx and fixed Rx home channel
Encoding for TDMA	Turbo-ɸ
Access Type TDM/DVB-S2*	DVB-S2 receiver with Adaptive Coding-and Modulation (ACM) support / MPE and ULE support
Access Scheme	Bandwidth-on-Demand / real-time / non-real-time / guaranteed throughput / QoS classes
Stacking	Cascading of multi (max 4) units to one stack (with prime controller) for ad. TDMA demods on each node

Modulation & FEC Code Rates	**TDMA**
	BPSK: 1/3 / 2/5 / 4/9 / 1/2 / 2/3
	QPSK: 1/3 / 2/5 / 4/9 / 1/2 / 3/4 /
	    4/5 / 5/6 / 6/7
	8PSK: 2/3 / 3/4 / 4/5 / 5/6 / 6/7
	16APSK: 2/3 / 3/4 / 4/5 / 5/6 / 6/7 **TDM - DVB-S2**
	QPSK: 1/4 / 1/3 / 2/5 / 1/2 / 3/5 / 2/3 /
	    3/4 / 4/5 / 5/6 / 8/9 / 9/10
	8PSK: 3/5 / 2/3 / 3/4 / 5/6 / 8/9 / 9/10
	16APSK: 2/3 / 3/4 / 4/5 / 5/6 / 9/10
	32APSK: 3/4 / 4/5 / 5/6 / 8/9 / 9/10

Es/No (BER 10-7, incl. margin)	from 0,6dB (QPSK 2/5) – 9,5dB (16APSK 6/7) from 1dB (QPSK 1/2) – 18,2dB (32APSK 9/10)
Channel Spacing/Roll-off TDMA	1.1 , 1.2 , 1.4 / 0.1 , 0.2 , 0.4
Modem Symbolrate – TDMA Tx/Rx	200 KBaud – 12 MBaud, variable in 1 KBaud increments
User Data Rate – TDMA	Up to 20 Mbit/s in each direction on LAN port / carrier user data rate starting ~64kbps, slot assigned traffic starting ~4kbps
Modem Symbolrate – TDM/DVB-S2	Up to 45 MBaud (in-build receiver)
User Data Rate – TDM/DVB-S2	Up to 160Mbps per DVB channel	Rx: Up to 55-60Mbps IP traffic on LAN port (dep avg packet length)
VSAT Data Throughput	Switching packet rate TDMA and LAN switch up to 140.000pps, DVB-S2 receiver up to 12.000pps

INTERFACES

LAN Interface	Four 10/100/1000 Base-T Ethernet RJ-45 ports, independent and individual configurable interfaces
Enhanced Features	IPv4/v6* / Static Routing / OSPF / BGP/ Load Balancing* / Robust Header Compression RoHC* / Multi VRF support (up to 4 groups) and VLAN / GRE* / Traffic Filtering and Shaping for QoS based on configurable PHB rules (up to 14 classes per VRF) / DiffServ / DHCP*
Serial RS232/Console	SUB DB-9S socket for management access via command line interface
Aux-Port	8 pin connector DIN 45326 – contains Rx lock signal (5 VDC) indicator and Tx inhibit with cable detect support
Display and 5-button switch	Notification of status information (reception level, IP-adr. etc.)
USB-A 2.0 ports	Front panel port for image updates and configuration loads, rear port for WLAN, UMTS/LTE projects (opt.)
Tx Modulator Port	F-connector (75Ohm female) L-Band 950 – 2150 MHz / -3… - 23 dBm (-43dBm for dynamic range)
Rx Demodulator Port	F- connector (75Ohm female) L-Band 950 – 2150 MHz / -30…-70 dBm common used Rx port for DVB-S2 and TDMA receiver

ODU SUPPORT

10 MHz reference signal	Configurable by software on Tx and Rx port
LNB	Software configurable 0/13/18VDC support, 22kHz signal – internal/external PLL
BUC	Software enabled internal 24VDC support, up to 85W on IDU F-connector (typical 6-8W Ku)
Others	Radios with L-Band interface – Ka, Ku, Ext Ku, C

NETWORK MANAGEMENT

NMS Platform	SKYWAN 5G NMS – virtual appliance (virtual host not provided)
NMS Architecture	Web based application, central NMS sever, can be placed everywhere (only IP connectivity needed) mainly for planning & configuration, network runs without NMS always on or connected
IDU Management Interfaces	Remote access with in-band management (from central NMS station over satellite), additional SNMP access for monitoring, local access via WEB-GUI and CLI or integrated console port (RS232)

MECHANICAL/EVIRONMENTAL

Dimensions (H x W x D)	44,45 mm (1 RU) x 483 mm (19") x 410 mm (Packing box: 580 x 540 x 159 mm)
Weight	Below 3,4kg (without extension cards, but in metal housing and power supply)
Input Power/Power Consumption	100-260 VAC, 50 / 60 Hz, 32 VA nominal (IDU only, without extension cards)
Operating Temperature/Humidity	+5 °C to +55 °C, 5%-85 % non-condensing
Provider Standards	Intelsat IESS 308, Rev.11 Eutelsat EESS 501, Issue 2, Rev.0
Radio Standards	EN 301 428 Harmonized EN for Ku-VSAT EN 301 443 Harmonized EN for C-VSAT
Safety Standards/Certification	EN 60950 CE compliant including RoHS and REACH / FCC CFR 47, Part 25 (satellite communication)
Emission Standards	EN 50081-1 (generic emission standard) EN 55022 (radio frequency and ITE emissions)
EMC/Immunity Standard	EN 55024 (immunity for ITE) EN 61000-3-2 (harmonics) EN 61000-3-3 (voltage fluctuation and flicker) EN 61000-6-2 (generic immunity) EN 61000-6-3 (generic emissions) FCC CFR 47, Part 15 (radio frequency devices) FCC CFR 47, Part 25 (satellite communications)

*software features available with release updates

MODEM PERFORMANCE TABLE

A) Supported MODOCDs for TDMA carriers

BPSK	QPSK	8PSK	16APSK
Rc	Rc	Rc	Rc
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

B) Supported MODCODS for DVB-S2 channel

QPSK	8PSK	16APSK	32APSK
Rc	Rc	Rc	Rc
1/4			
1/3			
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	5/6	5/6
8/9	8/9		8/9
9/10	9/10	9/10	9/10

C) Modem Performance Table for SKYWAN TDMA channels

BPSK	COTM	QPSK	COTM	Standard	8PSK	Standard	16APSK	Standard[a]
Rc	EbNo/EsNo	Rc	EbNo/EsNo	EbNo/EsNo	Rc	EbNo/EsNo	Rc	EbNo[b]/EsNo
1/3	3,5/-1,9dB	1/3	2,9/0,7dB	2,2/0,2dB				
2/5	2,6/-2,0dB	2/5	2,5/1,0dB	2,4/1,2dB				
4/9	2,8/-1,4dB	4/9	2,6/1,6dB	2,3/1,5dB				
1/2	2,9/-0,7dB	1/2	2,8/2,3dB	2,6/2,3dB				
2/3	3,8/1,3dB	2/3	3,6/4,3dB	3,4/4,4dB	2/3	5,9/8,6dB	2/3	6,6/10,5dB
		3/4	4,2/5,4dB	3,9/5,4dB	3/4	6,8/10,0dB	3/4	7,3/11,7dB
		4/5	4,6/6,1dB	4,4/6,1dB	4/5	7,4/10,8dB	4/5	8,0/12,7dB
		5/6	5,1/6,7dB	4,7/6,6dB	5/6	7,8/11,4dB	5/6	8,5/13,4dB
		6/7	5,4/7,2dB	5,2/7,2dB	6/7	8,3/12,0dB	6/7	8,8/13,8dB

Modem performance data differs between COTM and standard mode due to a different implementation of burst robustness.

[a] @ BER 10-7 and 350-500Byte gross container size

[b] based on simulation, Eb/No mapped to modem data rate, therefore for link budget calculations the EsNo figures are recommended to be used.