

Solution Concept for REDDIG II Based on SkyWAN Technology

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Dr. Wunderlich // 19.07.2011

Solution Concept for REDDIG II

Agenda

- ND SatCom Involvement in VSAT for ATC
- Can the expectations for REDDIG II be met
- Design Elements of a VSAT Network - Methodology
- Practical suggestions

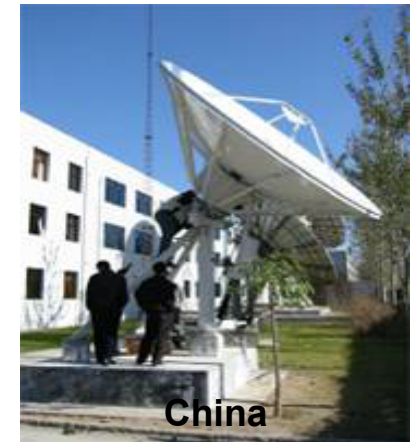
Air Traffic Control Networks

ND SatCom provides satellite based aeronautical communications solutions since 1999 to

- National air traffic management agencies and
- supranational associations

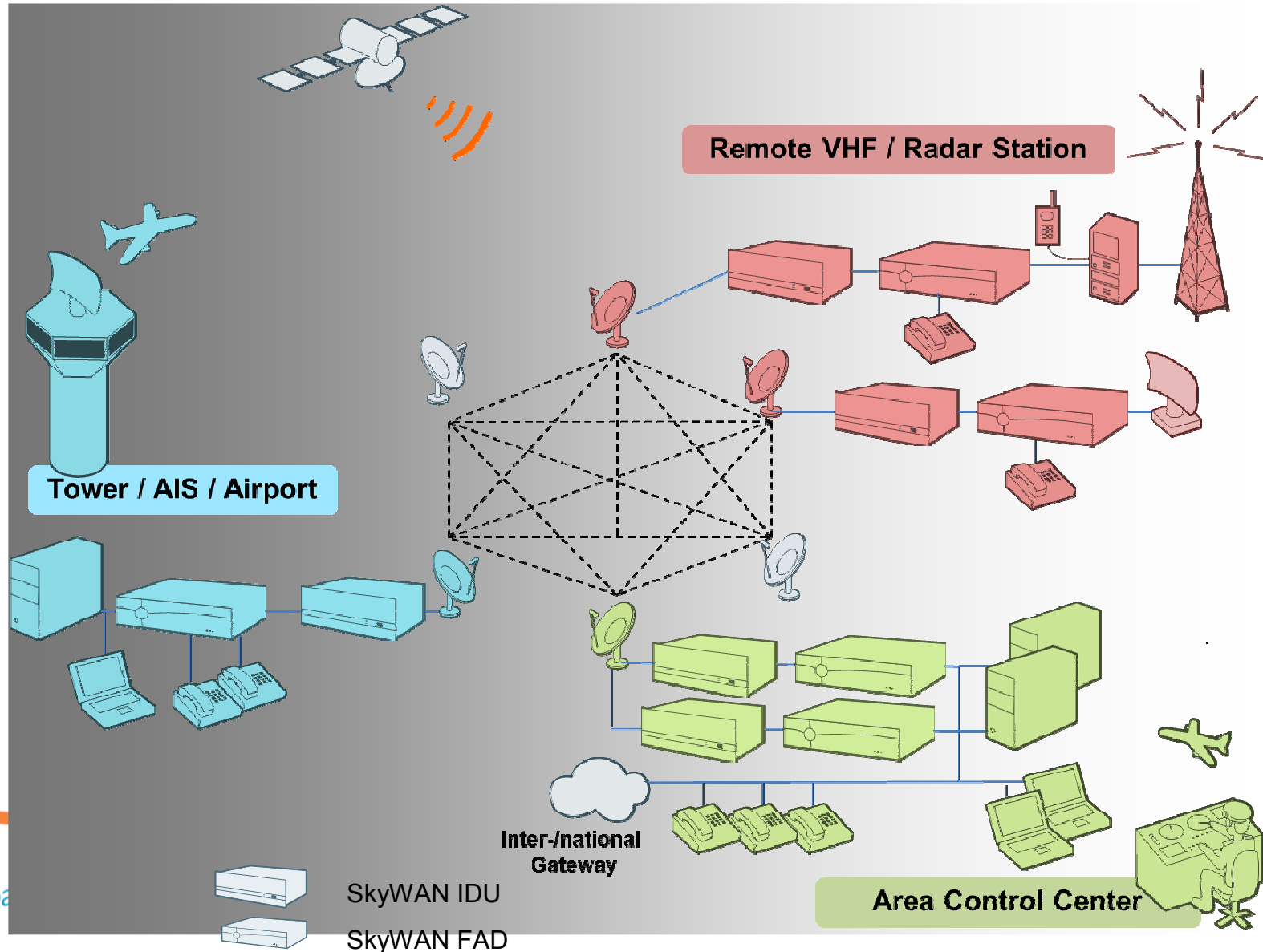
in cooperation with the respective organizations and

- Prime Contractors of turnkey projects
- System Integrators and Service Providers



All the space you need

Communication links for Air Traffic Control



All the spa

SkyWAN Solutions meet the requirements

■ Key Features

- Digital multi service communication platform supporting
 - *Real-time service for Radar data*
 - *highest Quality-of-Service for voice applications (PAMA and DAMA)*
 - *Aeronautical message transfer service TCP/IP based*
 - *administrative phone/fax/data services*
- enhanced with ATC-specific access devices for:
 - legacy interfaces*
 - remote VHF communication controller-to-pilot*
- High network reliability, based on customized redundancy concepts
- High available Network Management System, SNMP based
- Capable for fully meshed network topologies
- Bandwidth efficient with lowest operational costs

Aeronautical VSAT Networks with SkyWAN

Prime Contractor	Country	Customer / User Organisation	Stations	Primary Applications	Year
IATA, Afghanistan	Afghanistan	Ministry of Civil Aviation Afghanistan	10	GAC, ATS	1999
Ministry of Transportation PNG	PNG	CAA Papua New Guinea	15	Radar, GAC	2000
Hua Ying Company, China	China	Air Defence	106	various applications (encrypted)	2001
ND SatCom	Sudan	CAA Sudan	10	Air Traffic Control	2002
Hua Ying Company, China	China	Air Defence	94	various applications (encrypted)	2003
IATA, Irak		IATA Irak	12	Radar, GAC	2004
LTT	Libya	LCCA	9	Air Traffic Control	2004
IATA	Afghanistan, Iran, Pakistan, Uzbekistan	IATA, Central Asia	32	GAC, ATS	2004-2007
Hua Ying Company, China	China	Air Defence	9	various applications (encrypted)	2005
ATNS, South Africa	28 South&East-African States	Network for SADC & NAVISAT	40	Regional Exchange	2006
IATA, East Asia	Korea	IATA East Asia	6	GAC, ATS	2006
Ineo Engineering, France	Venezuela	INAC Venezuela	31	Radar, GAC	2006
Flightcraft, South Africa	Angola	ENANA, Angola	7	Radar, GAC	2008
Ineo Engineering, France	13 Westafrican States	ASECNA States	15	GAC	2008
Thales Air Systems, France	Nigeria	NAMA	9	Radar	2009
BTC, KSA	Saudi Arabia	GACA	29	Radar, GAC	2009
Ineo Engineering, France	Peru	CORPAC Peru	8	Radar	2010
Indra, Spain	Paraguay	DINAC Paraguay	6	Radar, GAC, ATS	2010
Mocom, Nigeria	Nigeria	NAMA	23	GAC, AMHS	2010

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Can the Expectations for REDDIG II be met



One decade later in the SatCom Industry



Improvements in cost effectiveness



Improvements in system performance



System adaptable to new requirements



Long term hardware support

Can the Expectations for REDDIG II be met

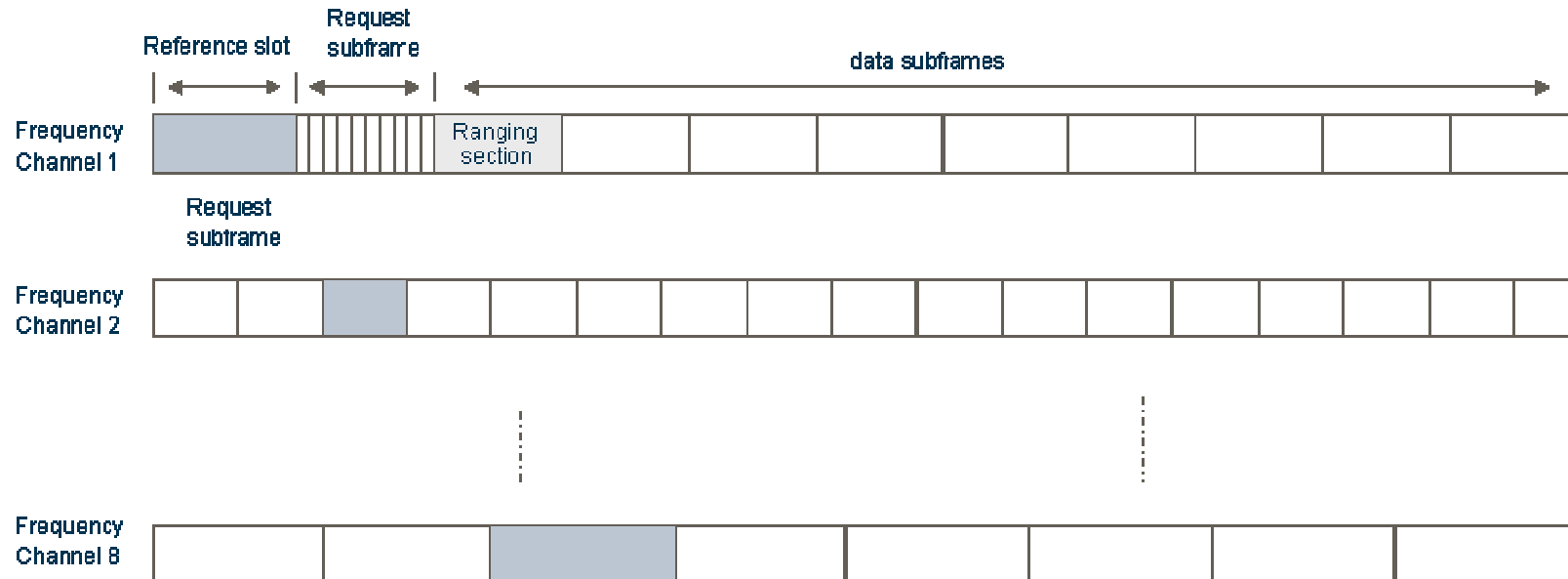
Modem related Improvements in cost effectiveness

- Superior TDMA Architecture
 - time slot size can be customized for the applications
 - every time slot can contain information to all nodes listening to the carrier
 - Carrier sizes can be adjusted to traffic requirements & optimized for ODUs
- 8PSK Modulation and Turbo Phi Coding
- Reduced Channel Spacing

All the space you need

Improvements in system performance

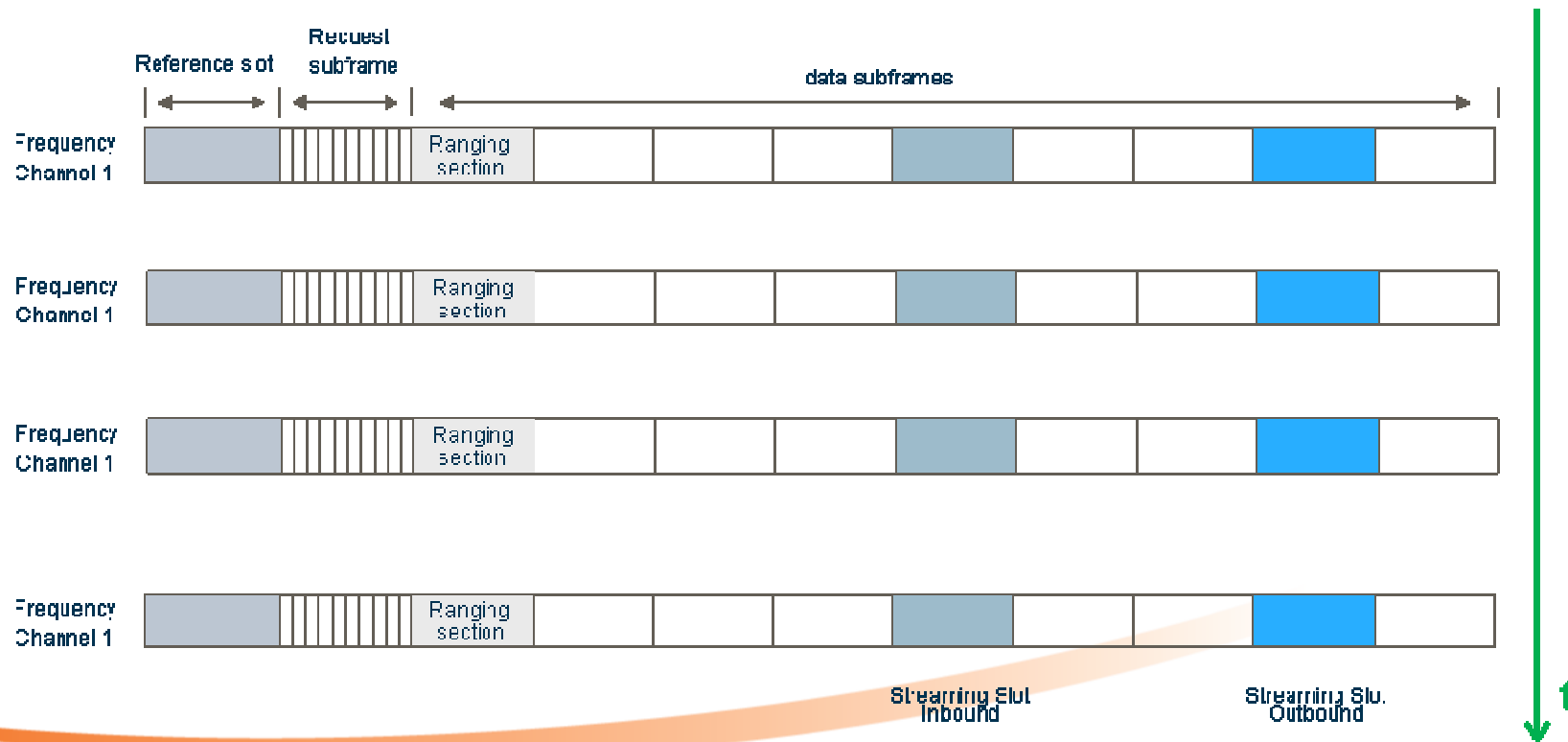
MF-TDMA Frame Layout – up to 8 Frequency Channels



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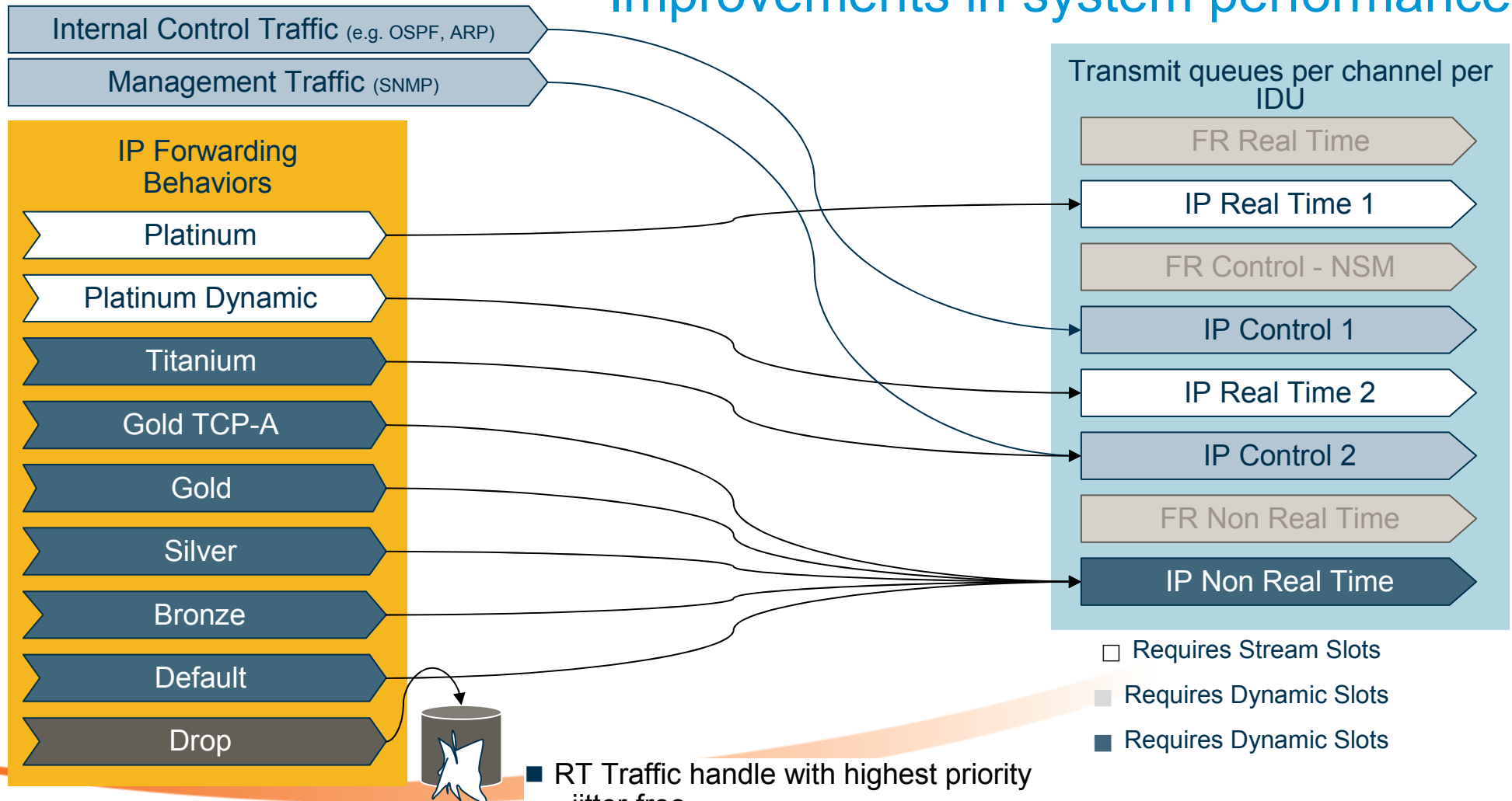
Improvements in system performance

MF-TDMA Frame Layout – Streaming Slots – Jitter Free



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Improvements in system performance



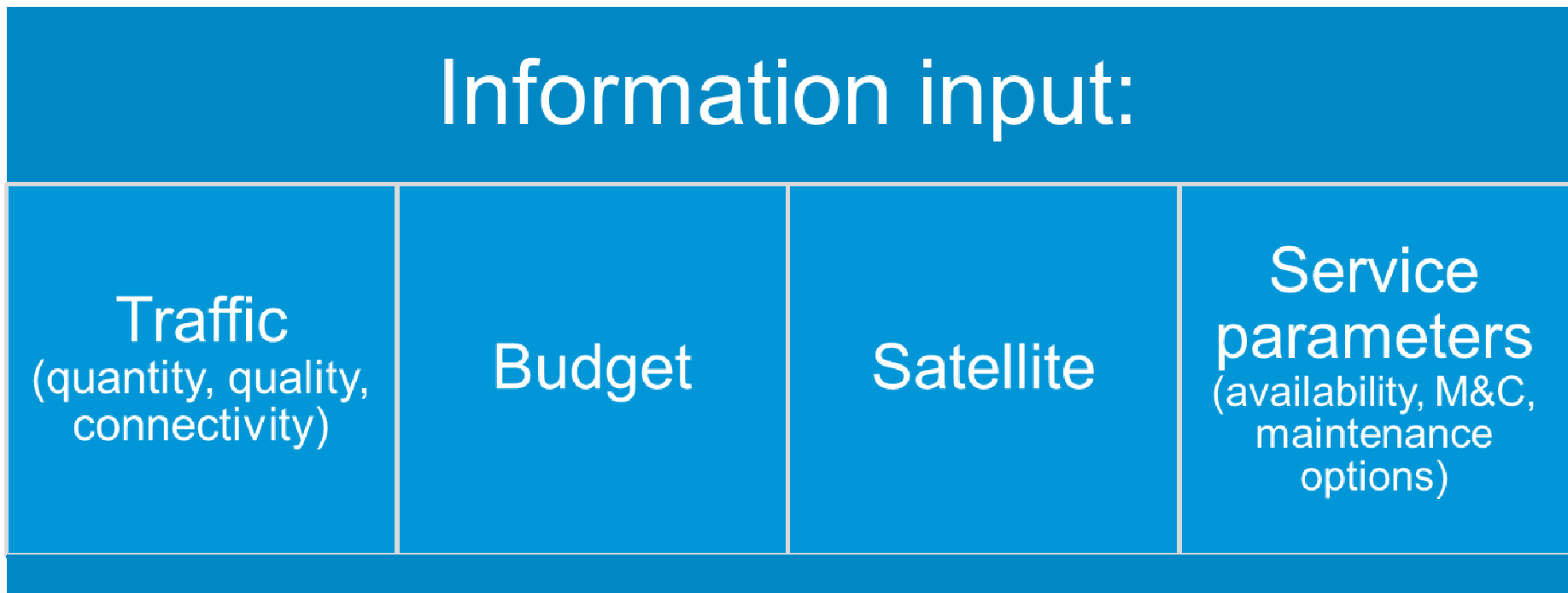
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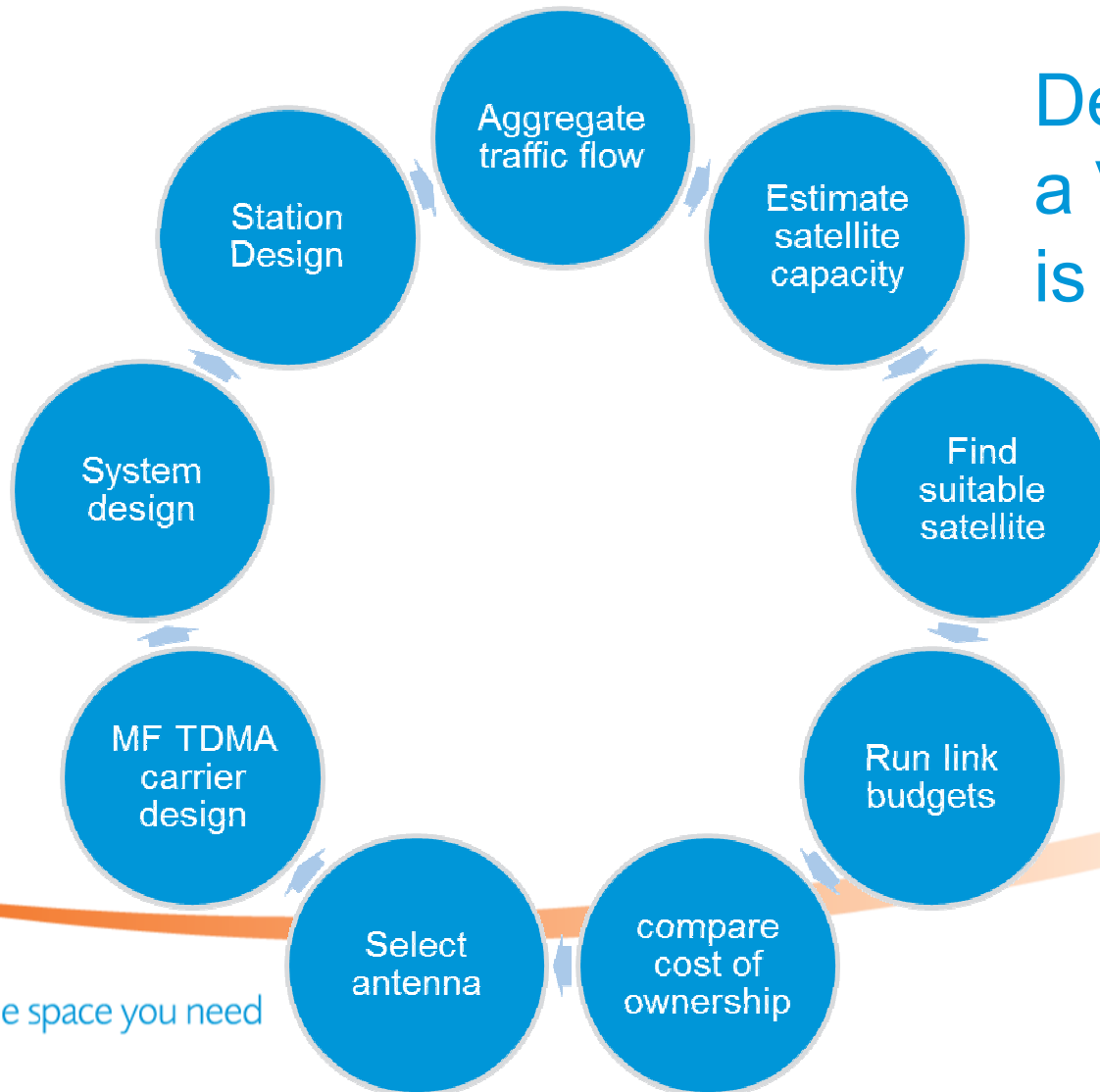
Design Elements of a VSAT Network Solution for REDDIG II ?



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Design Elements of a VSAT Network

Designing & Costing a VSAT Network is an **iterative** process



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Design Elements of a VSAT Network

Iterative Designing Process VSAT Network:

- Aggregate traffic flow in the network to a total required data rate capacity
differentiate between PAMA and DAMA traffic
- Estimate volume of required satellite capacity and secure budget for it
- Find suitable satellite with available capacity and make a reservation
- Run link budgets with variations of antenna size, modulation and FEC rates for locations with significant pattern (dis-)advantages in the footprint
- compare cost of ownership over the assumed life cycle for different scenarios of antenna sizes, RF power and bandwidth consumption

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Design Elements of a VSAT Network

Iterative Designing Process VSAT Network cont'd:

- Select antenna sizes and maximum carrier data rates (for min. RF power)
- MF TDMA carrier design according to
 - traffic volume'
 - connectivity and
 - efficiency
- → total minimum bandwidth requirement (to be contracted)
- System design, network layer diagrams
- Station design, equipment configuration diagrams

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Practical suggestions

All IP based network ???

- 👎 Ground air communications
- 👎 Dangerous applications
- 👉 Congestion avoidance (by design)

→ Go ahead !!!

Impact of IP based connections

- *Capacity and bandwidth planning: IP Voice communication is no longer planned according to number of voice channels, but according to Bandwidth and latency requirements*
- *QoS and priority handling: Mixing safety critical and administrative communication must be planned carefully as the network itself does not guarantee latency and packet-loss (especially in congestion scenarios)*

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Practical suggestions

Migration from REDDIG I:

The Options

Big Bang

REDDIG II will be implemented parallel to the still operational REDDIG I. Once complete and fully tested REDDIG I is switched off and all peripheral devices are connected to REDDIG II, which starts operation immediately thereafter.

Drawback: service interruption

Step by Step

The core of REDDIG II will be implemented and one node after the other is switched over from the still operational REDDIG I to the new network.

Drawback: complicated procedure;
temporarily reduced connectivity
(double hop)

In any case:

extra satellite capacity required in the transition period
a second antenna is advantageous (regardless whether the satellite remains)

Practical suggestions

Network Availability for REDDIG II

Where is the pain?

- Link availability variation 99.5% → 99.99% requires ~50% more power
- How to count for the other factors?
Per link / per total network (which metric?); per year / per worst month?
- What to assume for the MTTR?
- Terminal design must reflect differences in MTBF for components

Practical suggestions

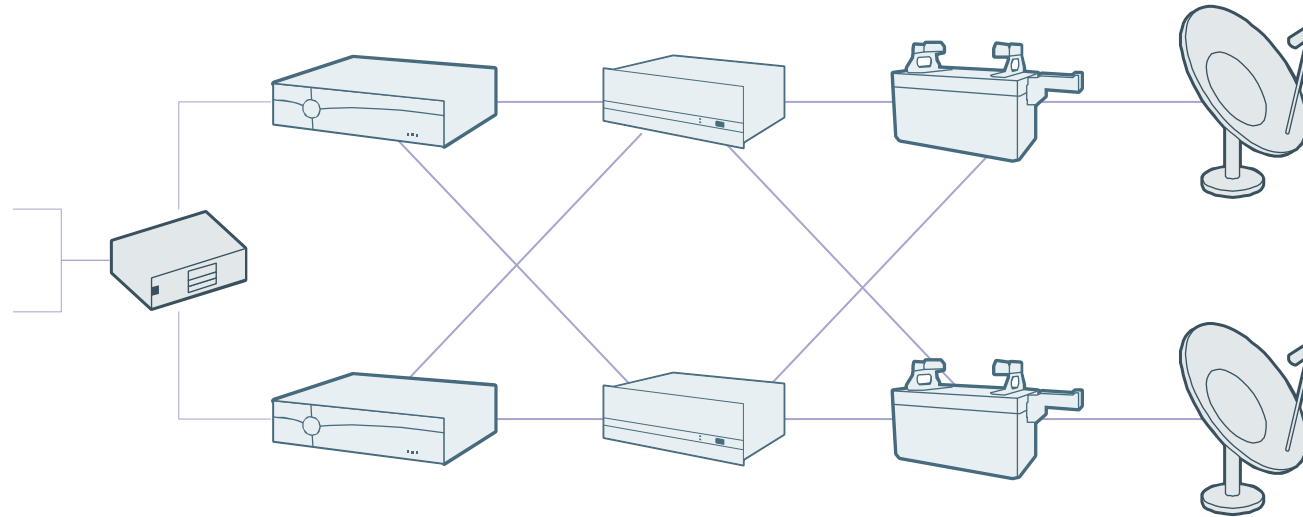
VSAT Network Problems

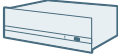



The causes for failures (by importance):

- Poor installation
- Power outage
- Lightning
- Satellite Interference/ Outages
- Interference from terrestrial and airborne sources

Redundant Chain

FR/ using FAD/ Layer 2 Switching

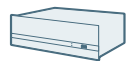
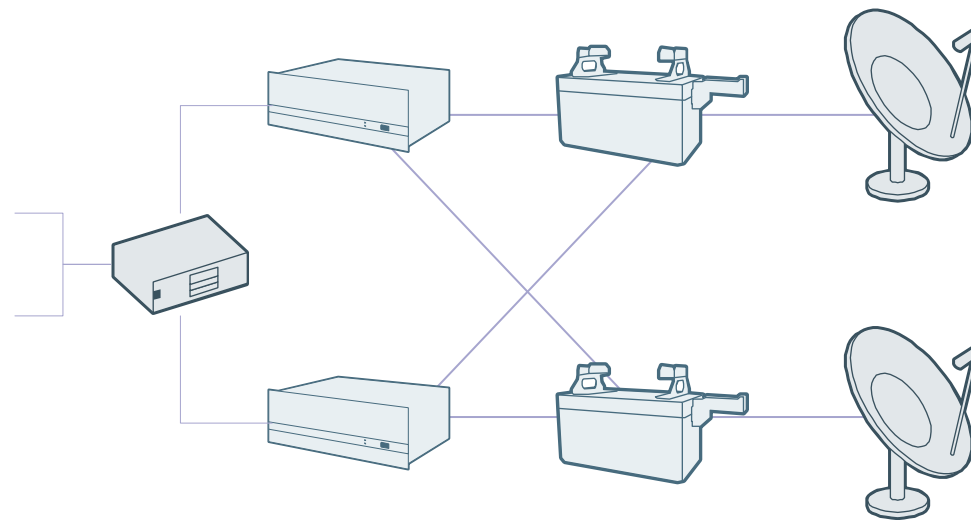


-  SkyWAN IDU
-  SkyWAN FAD
-  Switch
-  SkyWAN RFT

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Redundant Chain

IP/ no external Device/ Layer 3 Routing



SkyWAN IDU



Router



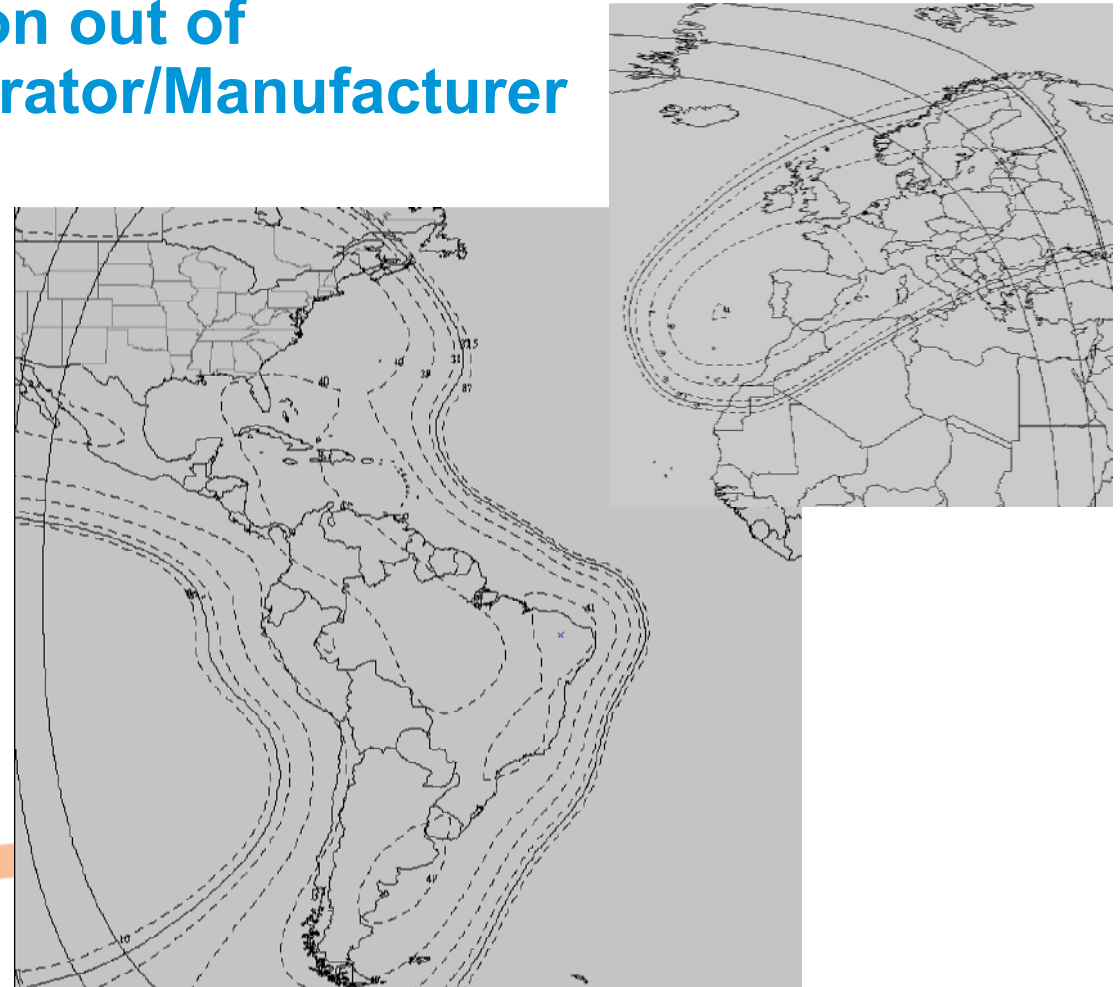
SkyWAN RFT

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Practical suggestions

Enhanced Support Option out of Europe for System Integrator/Manufacturer

Satellite Capacity
e.g. on NSS-806/SES-6



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Thank you for your attention!