Networks Without Barriers

DVB-RCS Mesh Networks
for Data, VoIP and GSM

Karl Petter Sundby, Sr. System Engineer
STM Norway
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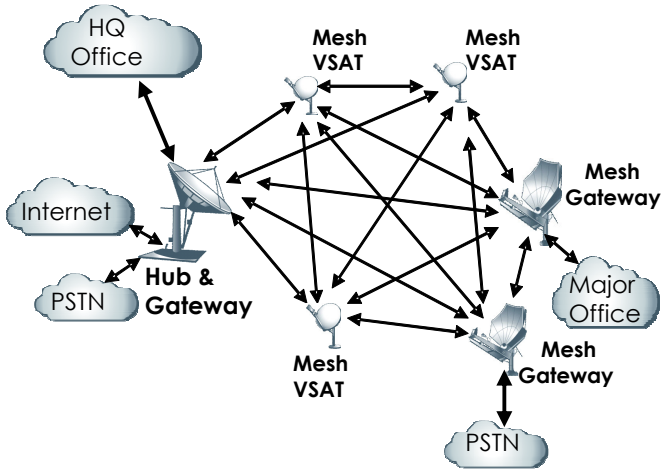
Adapting DVB-RCS to the Bent-pipe Mesh Environment

Key Challenges

- Distinguishing Star vs. Mesh Links:
  - In measuring & managing link performance
  - For capacity requests by VSATs
  - In the Terminal Burst Time Plan (TBPT) – use of TBTP also for controlling reception
- Concurrent TDMA burst reception
- Full-mesh or subnet limited IP routing
- Efficiency for “thin route” mesh traffic

Mesh Logical Diagram and Key Elements

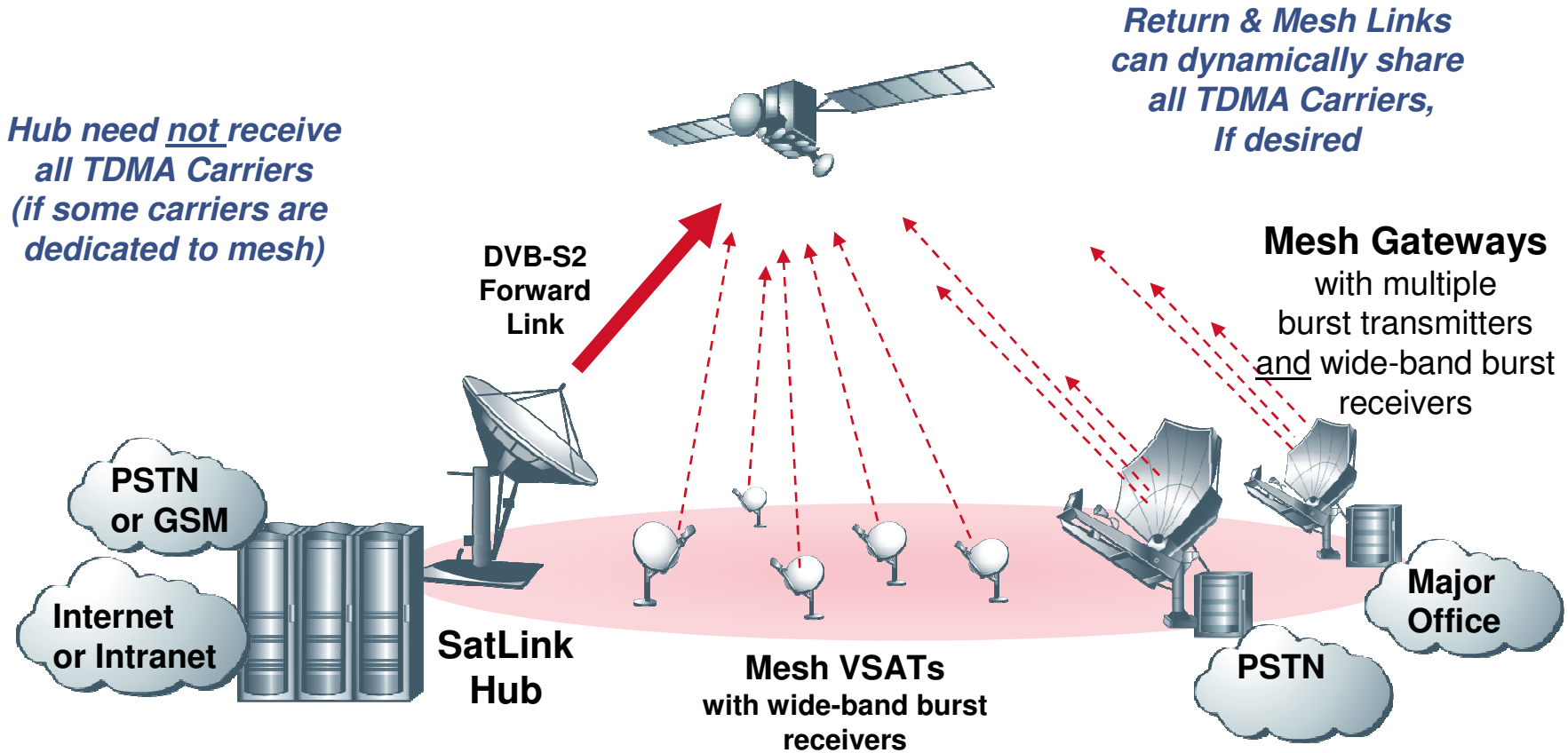


The mesh link is a logical link concept, it may employ various TDMA Carriers. A given TDMA Carrier may be shared by both mesh & star links

Key Enabling Technologies for Mesh Networking

- Wideband Burst Demodulators for mesh VSATs
  - Low-cost, 36 MHz wide, 4 concurrent TDMA bursts received
  - Reducing burst blocking probability to $<10^{-5}$ (vs. > 5% for single)
- Extended NCC functionality
  - Capable of 1000's of active mesh VSATs and 10,000's of mesh routes
- Extended terminal processing and queuing logic
  - TCP Acceleration on all active mesh links
  - Applying seven (7) QoS Groups on all active mesh links
  - Local routing table for all active mesh links
  - Efficient processing of capacity requests for all active mesh links
  - Time-out on inactive mesh links; Reports on degraded mesh links

Mesh Functional Diagram and Key Elements



All Mesh VSATs & Gateways can receive the TDMA transmissions of all others, plus the DVB-S2 forward link (if within same beam footprint)

Mesh Applications

- Dedicated Hub Applications:
  - Large, general purpose Govt. / Corp networks (voice, video and data all over IP)
  - Large rural telephony networks (sold to telecom operators)
- Shared Hub (i.e., Teleport) Applications:
  - Bandwidth flexible “private lines” (point-to-point) for any media
  - Small video conferencing mesh networks
  - SCADA applications with multiple control centers
  - Smaller general purpose Govt. / Corp. networks
  - Smaller rural telephony applications (10 to 100 sites)

With use of “Mesh Gateways” for all larger sites

VoIP in the Mesh
The "Thin Route" Efficiency Challenge

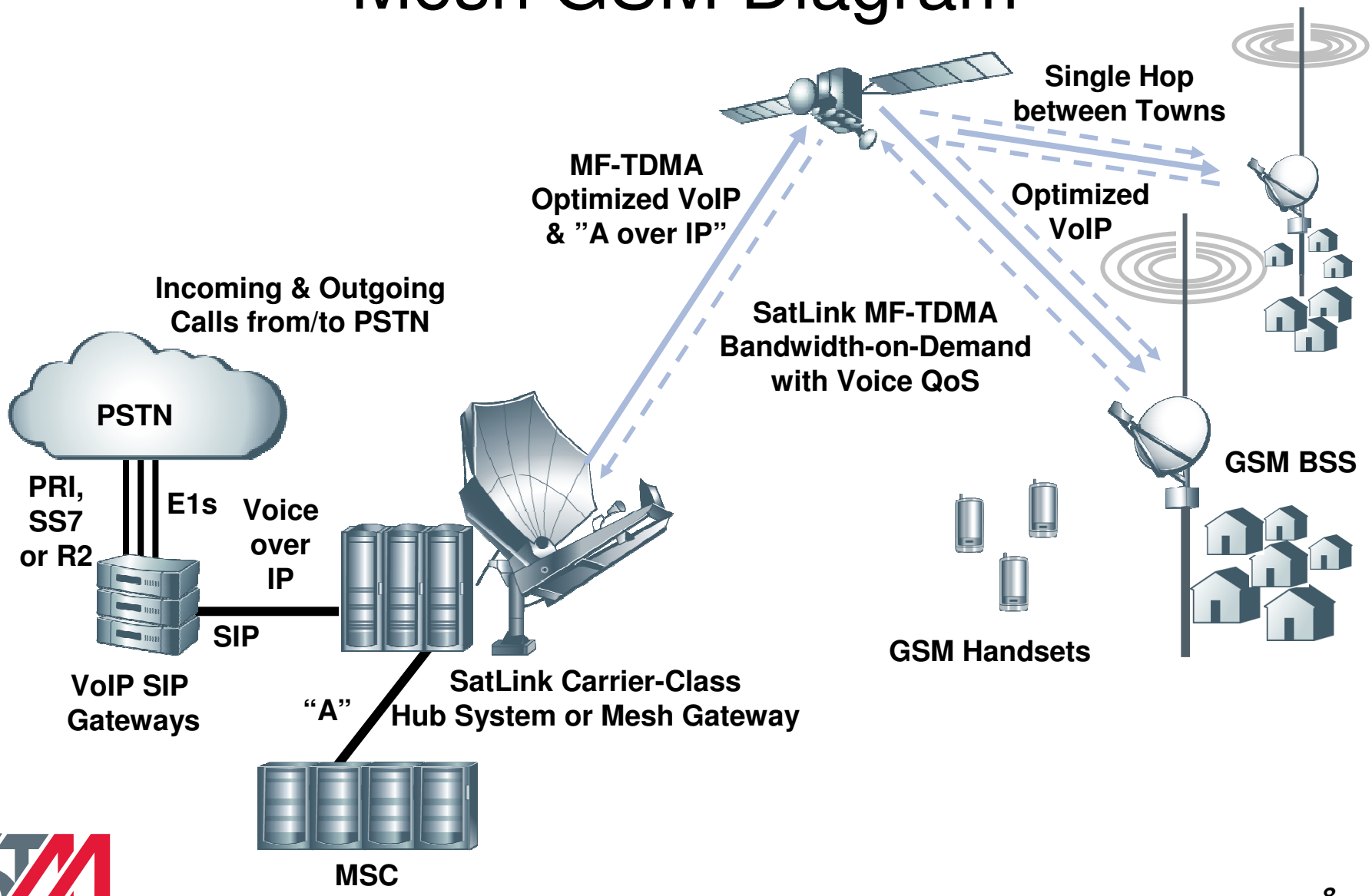
VoIP mesh networks with 1000's of VSATs
(e.g. for rural telephony solution)

- Higher packet latency for low traffic on mesh links
  - low slot rate for one voice call on link (no multiplexing)
- Low rate voice codec need minimum latency in VSAT
  - inherent high voice codec latency
- For reasonable bandwidth efficiency this necessitates:
  - Encapsulation and IP stack (i.e. IP, UDP, RTP) header compression
  - Consideration of a smaller TDMA burst size
    - Facilitates higher burst frequency
  - Improved performance for these short bursts

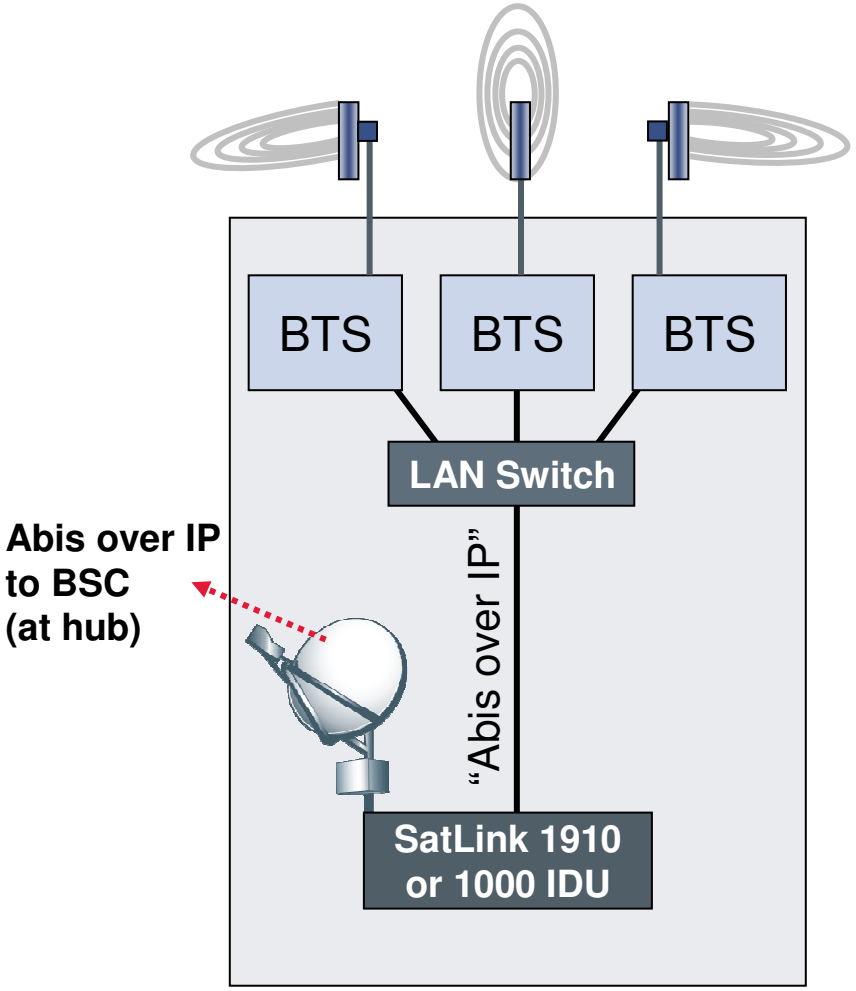
GSM in the Mesh
Thin & Thick Routes

- "GSM over IP" becoming common for back-haul
  - Thin Route efficiency requires powerful header compression
  - whereas Thick Route can also benefit from multiple voice samples per IP packet
- GSM has a centralized architecture (all traffic to MSC)
  - Local switching (at VSAT) possible if BSC is co-located with BTS
  - "GSM over Mesh" not possible unless MSC is also co-located with VSAT
    - This is not viable since MSC is large & expensive
- Blend of GSM and VoIP (with SIP routing) can offer mesh networking for rural GSM – but requires some "administrative enhancements"
- Solutions can be further adapted for future 3G/4G cellular

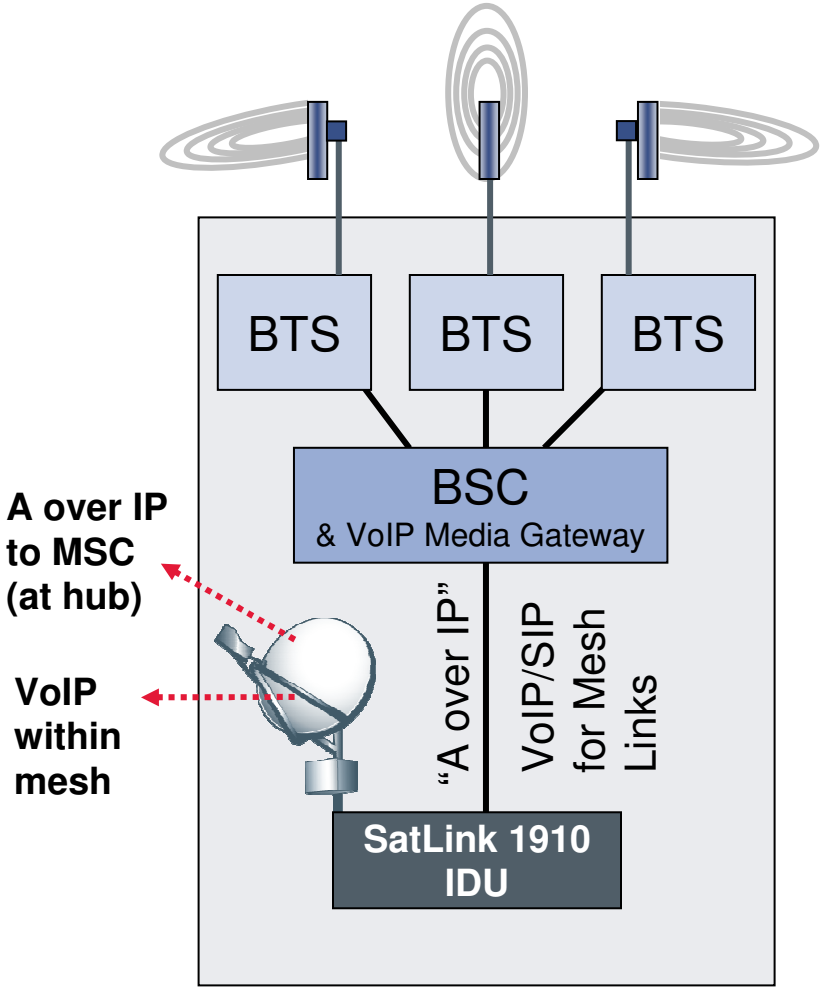
Mesh GSM Diagram



Example GSM Tri-Sector Configurations



BSCs reside at hub – no local switching



Local BSC enables local call switching
VoIP/SIP enable Mesh GSM calls

SCADA in the Mesh

- Deployed as one of several mesh subnets controlled by a shared satellite hub
- Shares resources with other applications like other SCADA networks
  - Benefits from statistical multiplexing
- Can be given precedence relative to other traffic
- Supported by high efficiency volume oriented BoD resource control
  - Suits traffic with low sensitivity to delay jitter

Conclusions

- Extension of DVB-RCS to mesh is straight forward, but with some technical challenges
- STM has implemented “DVB-RCS mesh” capabilities
- Mesh networks have variety of useful applications, but voice networking is the major mesh application – especially for rural telephony
- VoIP over mesh can be made very efficient
- GSM over mesh poses further challenges, but they are not insurmountable
- Solutions for GSM over mesh can be used as basis for voice networking in 3G/4G cellular

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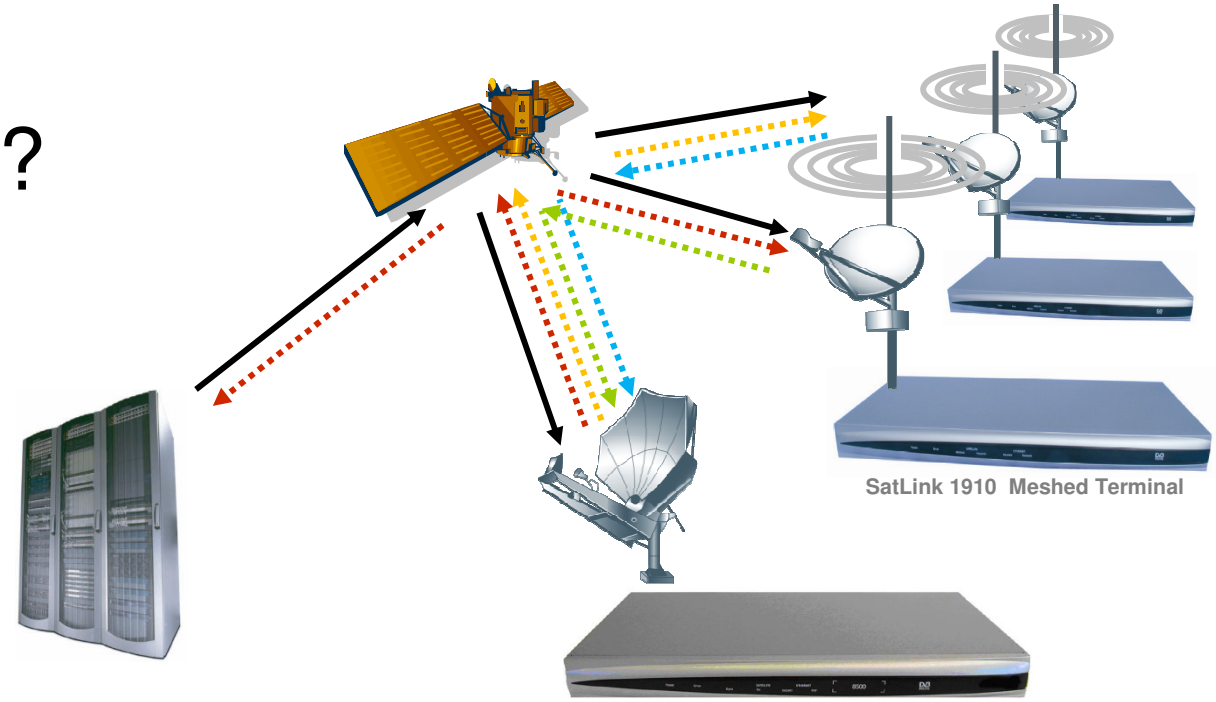
Questions ?



STM Group, Inc. | 2 Faraday | Irvine, CA, 92618 USA
STM Norway AS | Vollsveien 21 | N-1366 Lysaker, Norway

www.stmi.com