IP Networking projects in the European Space Agency

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ESA Member States and Establishments

- Establishments
- Offices
- ESA Ground Stations
- Ground Stations used by ESA
- Ariane Downrange Stations

ESTEC (Noordwijk)
Kiruna
Brussels
ESA HQ (Paris)
Toulouse
Redu
EAC (Cologne)
ESOC (Darmstadt)
Villafranca
ESRIN (Frascati)
Fucino
CDN
Washington
Houston
Kourou
Maspalomas
Natal
Ascension
Libreville
Malindi
Moscow
Perth

D A B DK E FIN F P GB IRL I N NL S CH CDN

ESA Telecom

- ESA Telecommunications funds via different programs:
  - Research into satellite communications system
  - Prototyping and development of elements of satcom systems (user terminals, network, space segment)
  - Roll-out of new services using satellite communications, e.g.:
    - Interactive television
    - Content delivery networks
    - MHP
    - MediaSpace
    - Telemedicine in Bagdad
    - …

Presentation overview

Summary of on-going and future network related ESA projects addressing:

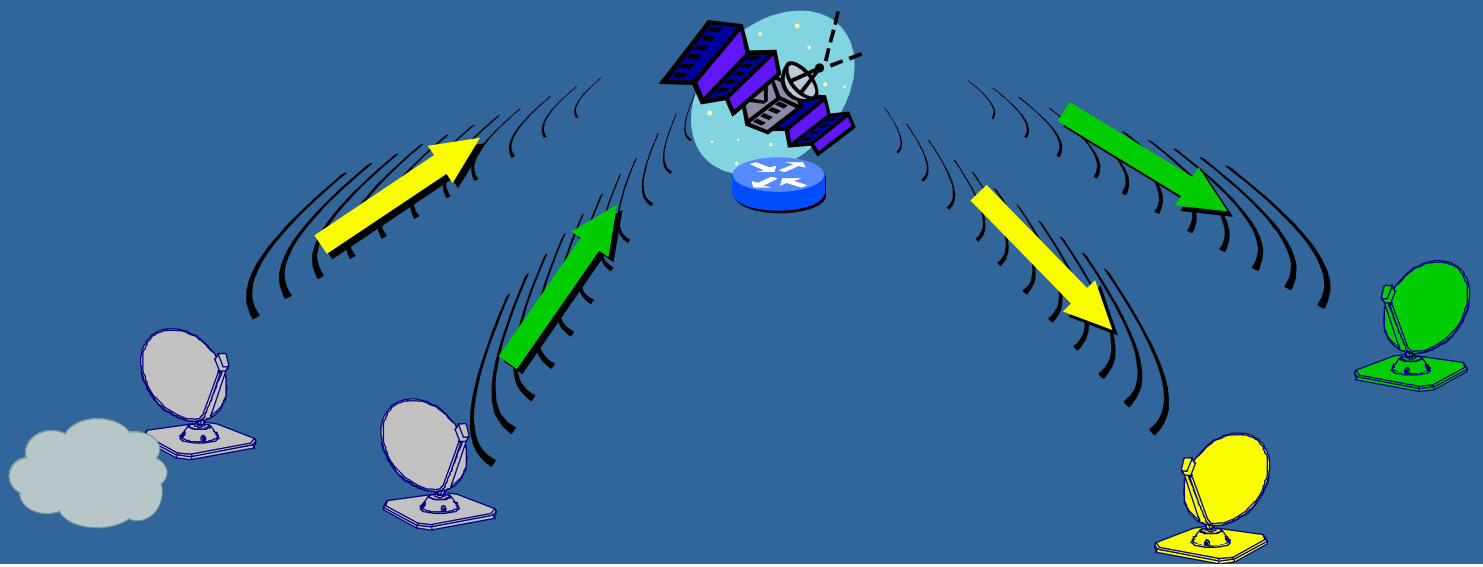
- Satellite architectures and their impact on networking
- Link-layer issues and IPv6
- Multicast and service announcements
- QoS
- PEPs
- Security

All in their satellite specific context…

New satellite architectures

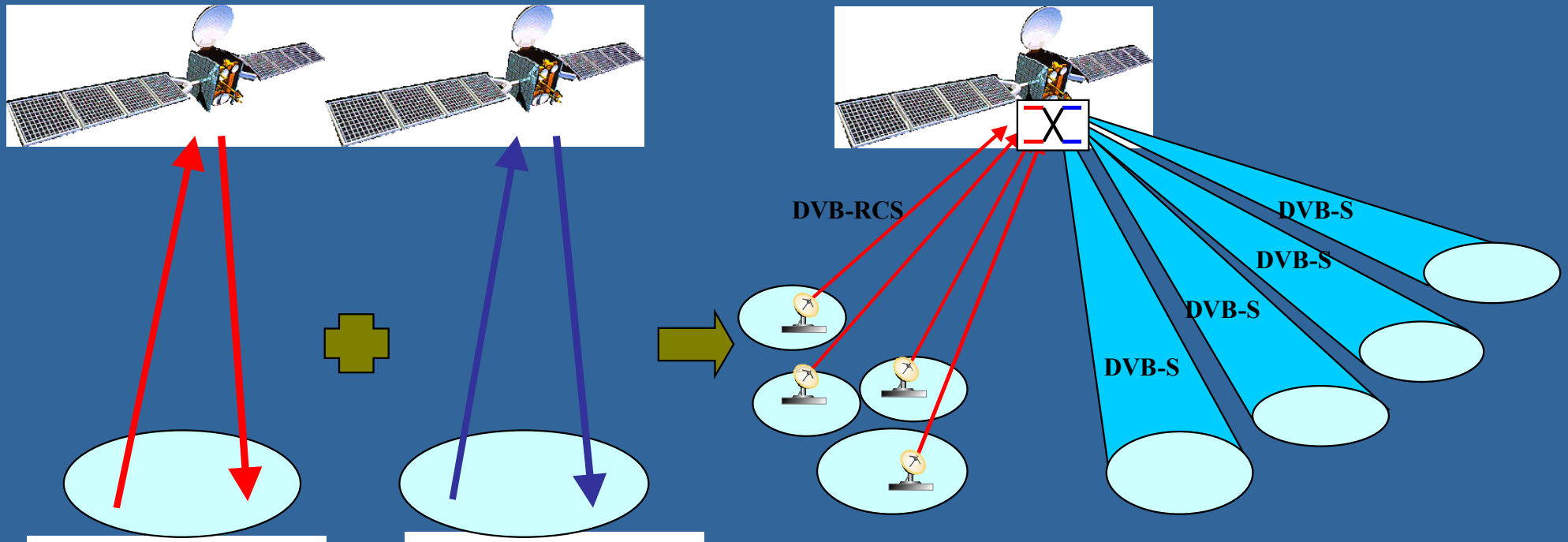
- More & more satellite networks allow for bi-directional communications via satellite (DVB-S/DVB-RCS)

- Newer satellite architectures propose a "bridge" or "MPE router" on-board
  - Research for on-board switching satellites stimulated by ESA since long



Routing on board: AMERHIS

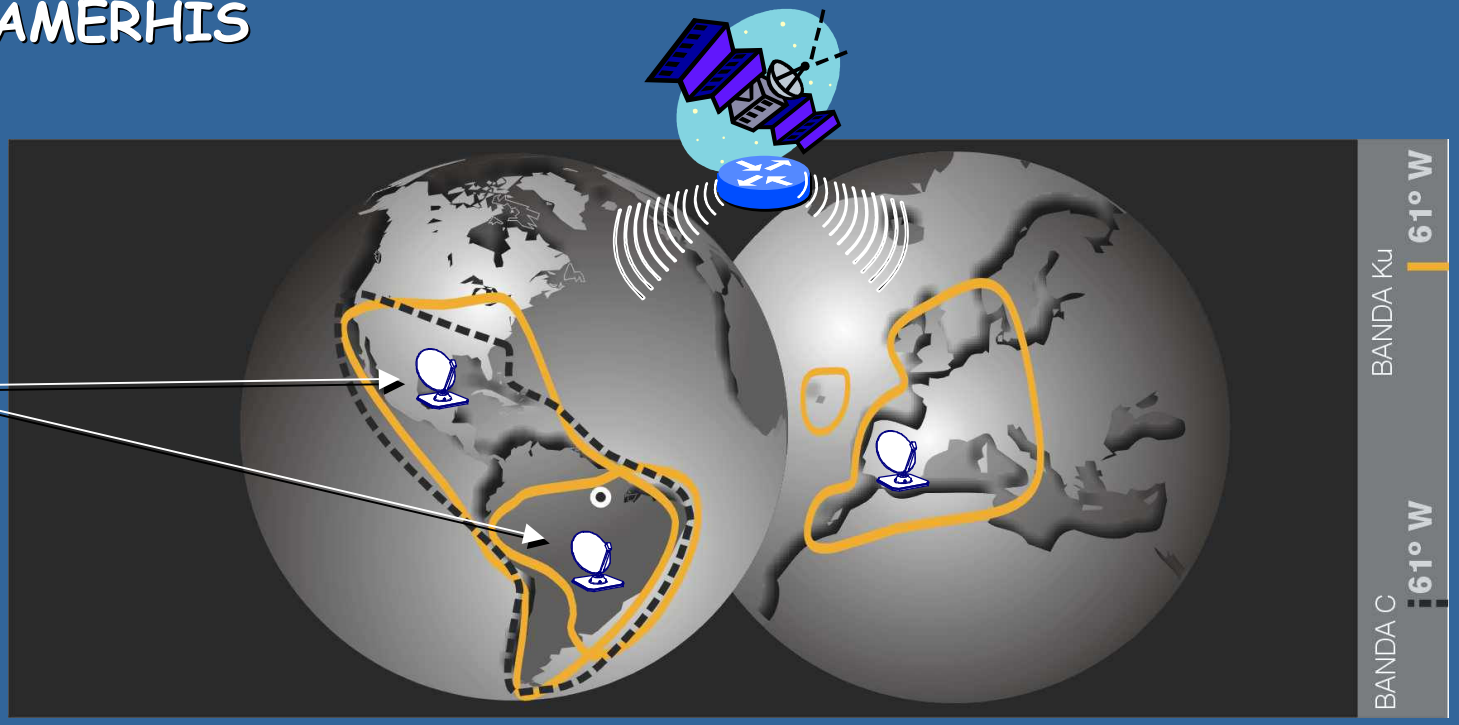
Co-funded project will demonstrate this technology on a commercial satellite as a piggy-back payload



AMERHIS
Regenerative Cross-Connected Multi-Spot

Routing on board: AMERHIS

Network of AMERHIS



- Many user terminals
- Injection of user multicast for micro-broadcasters
- Services: ISP & VPN access, LAN2LAN, Multicast, QoS.
- Fully compatible with DVB-S and DVB-RCS

Multicast

Multicast is inherent to satellite communications:

- Currently, multicast = broadcast
- New satellites with multiple spot beams do only multicast in areas where there are members
- Satellite topology is something in between a broadcast, UDLR, NBMA or P2P

Missing elements for seamless satellite IP multicast are:

- Service announcements (SDP/SAP is not enough in large flat networks, integration with DVB information is required)
- Adaptation of IGMP proxying timers/rebroadcast of IGMP reports
- Special placement of PIM RP to avoid double hops
- Integration with the satellite on-board routing capability
  (like PIM-SP Join's linked to ATM Add-Party)

QoS in satellite networks

Problems for practical QoS in satellite networks

- Missing tools for specifying and provisioning QoS in FW and RT link
- No MIBs (or PIBs) available or agreement on COPS/SNMP/other interface for provisioning
- No Cookbook for doing e.g. Voice over IP
- No guidelines for mapping Internet QoS on e.g. DVB-RCS Capacity Allocations (or DSCP handling, queuing – policing –shaping recommendations related to channels/RBDC/VPNs/DAMA functionality)

Two ESA studies:

- QoS in FW link for a DVB-S Gateway
- Integrated QoS Management for DVB-RCS networks

QoS in Forward Link

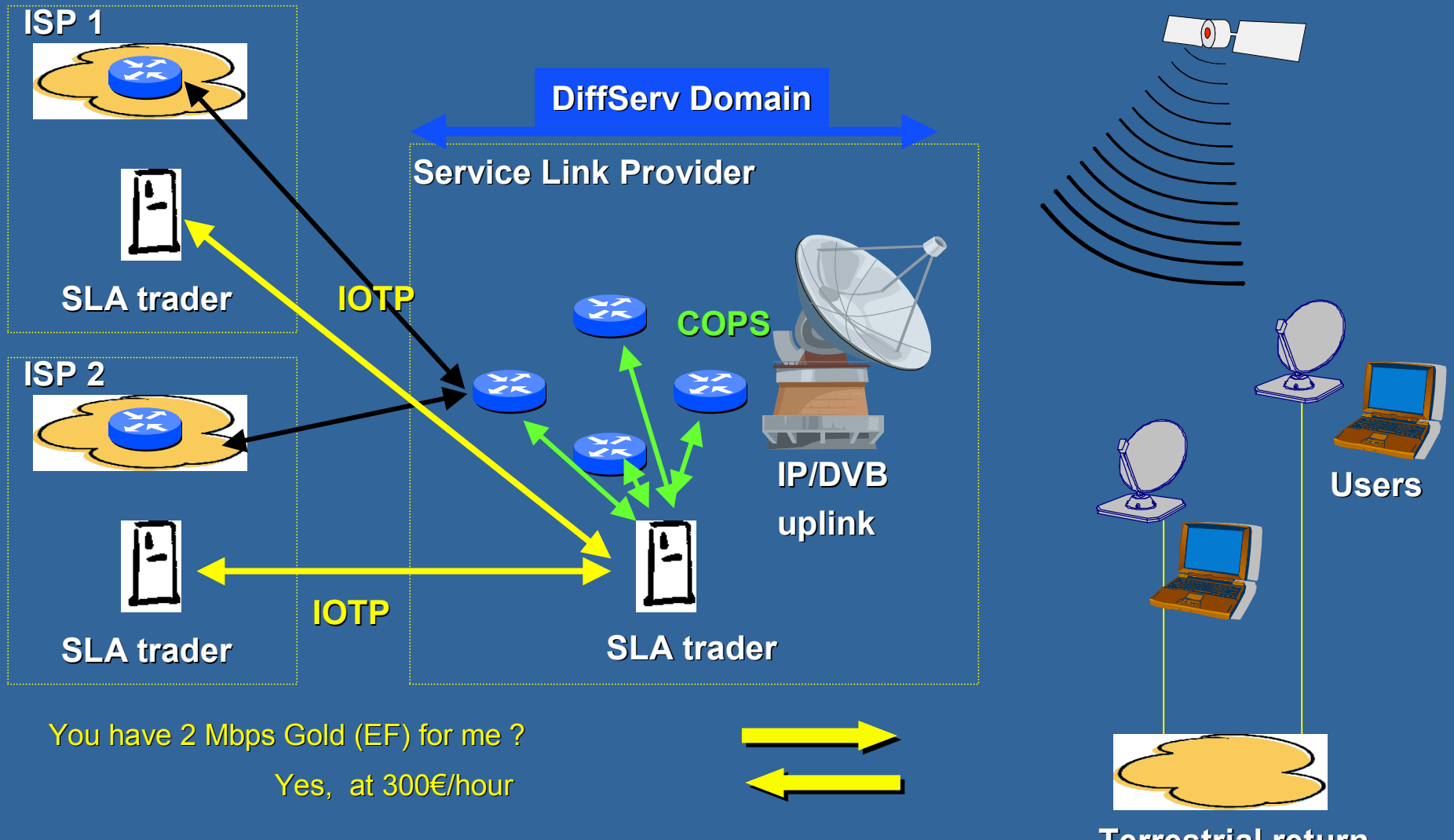
ESA Study performed by VCS Engineering,Salzburg University, Critical Software:

- methods to **provision QoS based on diffserv in DVB forward links**, including IPSec, multiple IP/DVB gateways
- **dynamic SLA trading** between ISPs and a Space Link Provider
- Architecture based on scaled-down **IOTP** for trading and **COPS-PR**/DiffServ for provisioning
- Simulation with modified ns-2 validated the concept
- Iteration with two Space Link Providers on requirements

Results:

- development **completed and tested end 2002**
- implementation with Linux DiffServ in a commercial IP/DVB gateway
- Policy Information Base for Gateway

QoS in Forward Link



QoS and DVB-RCS

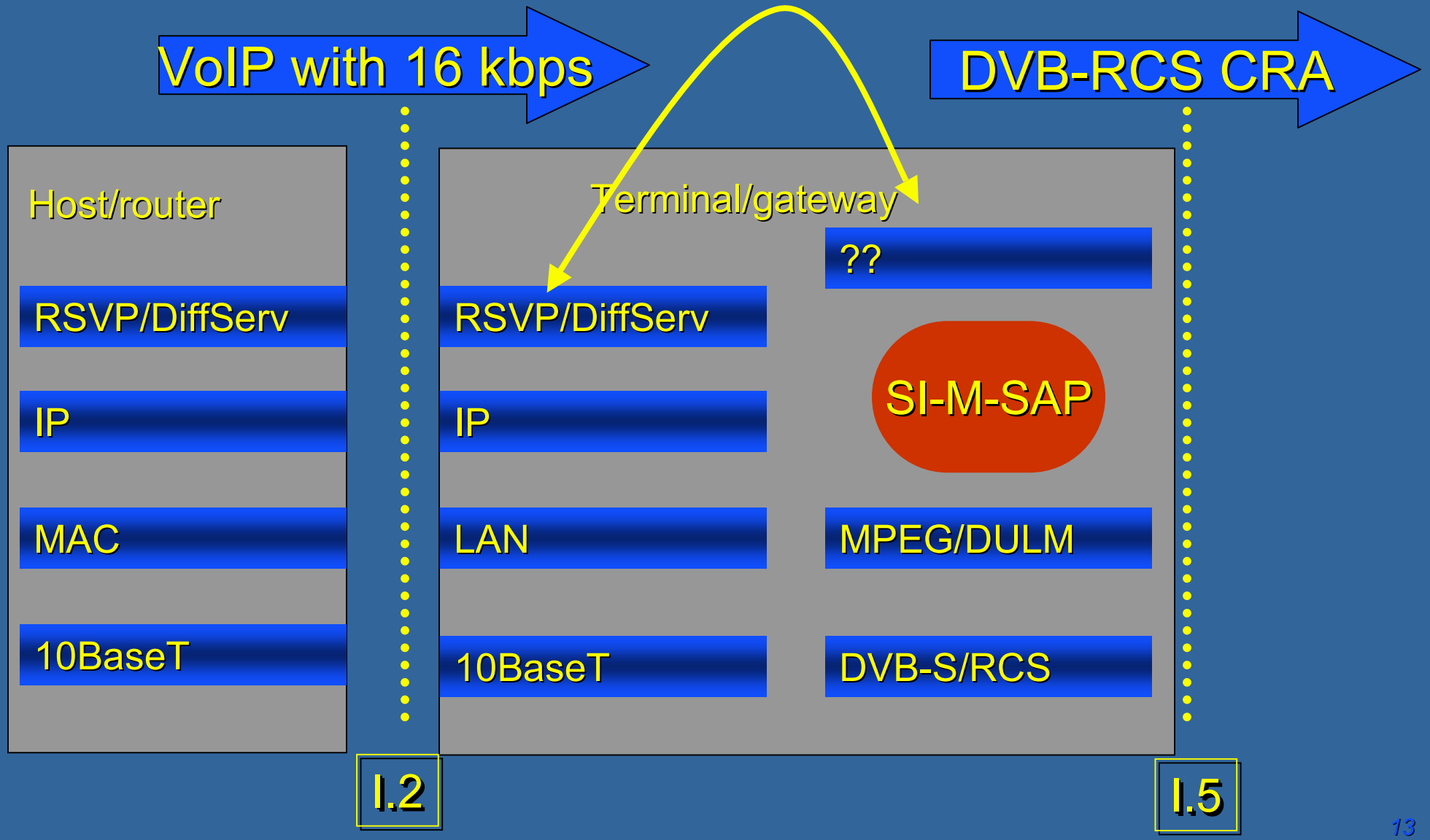
For the return link (from user-to-hub, or user-to-user) similar problems as in FW link exists, plus:

- no guidelines for MAC layer access procedures or Resource Management
- "missing IEEE 802.1p"
- Looks like the IP QoS on ATM CoS problem

Current study on "**Integrated resources and QoS management for DVB-RCS Networks**"

- Will use typical scenarios such as VoIP, ERP applications
- investigating needs for standardisation and further prototyping
- study integration of terrestrial practices for provisioning QoS with satellite domain

QoS and DVB-RCS



IPv6 is subject of many EC-IST projects and part of several 6FP proposals

- Not many of them address IPv6 in satellite architectures
- Invitation to Tender on

"Preparation for IPv6 in Satellite Communications"

- Should address:
  - impacts on satellite architectures
  - participation to large scale trials
  - provision of a satellite component of a terrestrial IPv6 network
  - cookbook for migration scenarios

IPv6 will impact satellite architectures concerning:

Link and Network layer

- Missing encapsulations, header compression, uni-directional links
- Routing experience missing in large flat networks

Network Management

- lots of "strange" equipment in earth station, no MIBs

Security: IPsec problems for PEP and multicast

And on Mobility, Standard bodies,…

IPv6 and other encapsulations

What is missing more for advanced protocols over satellite ?

- DVB community did not optimise carrying of IP over DVB-S.
- MPE method in DVB-S is carrying IPv4 or LLC/SNAP encapsulated data with lots of overhead
- Resulted in Invitation to Tender on "**Standardisation Support of Enhanced IETF IP Encapsulation Techniques for DVB-S**"
  - Prototype implementation of Internet Draft encapsulation for DVB-S receiver and encapsulators
  - evolution of MPE and new schemes for encapsulation
  - address resolution and MMT/INT issues
  - Hopefully at IETF in Vienna (July 2003) IP-over-DVB WG establishment !

Transport protocols

Protocol Enhancing Proxies

- required for current commercial/consumer use of TCP over satellite
- No standard available, from the space community there is SCPS (www.scps.org)
    - Rate controlled TCP
    - All tcp-sat recommendations implemented

ESA co-funded project (Xiphos and CRC) tries to:

- Integrate SCPS with DVB-S/RCS Hub and Terminals
- Use of lower layer information intelligently (as proposed in IETF TRIGTRAN WG)

IP Security

Security for satellite communications was addressed in two studies:

- Trade-off between
  - Ipsec
  - Conditional Access
  - Transport Layer security

Main problems:

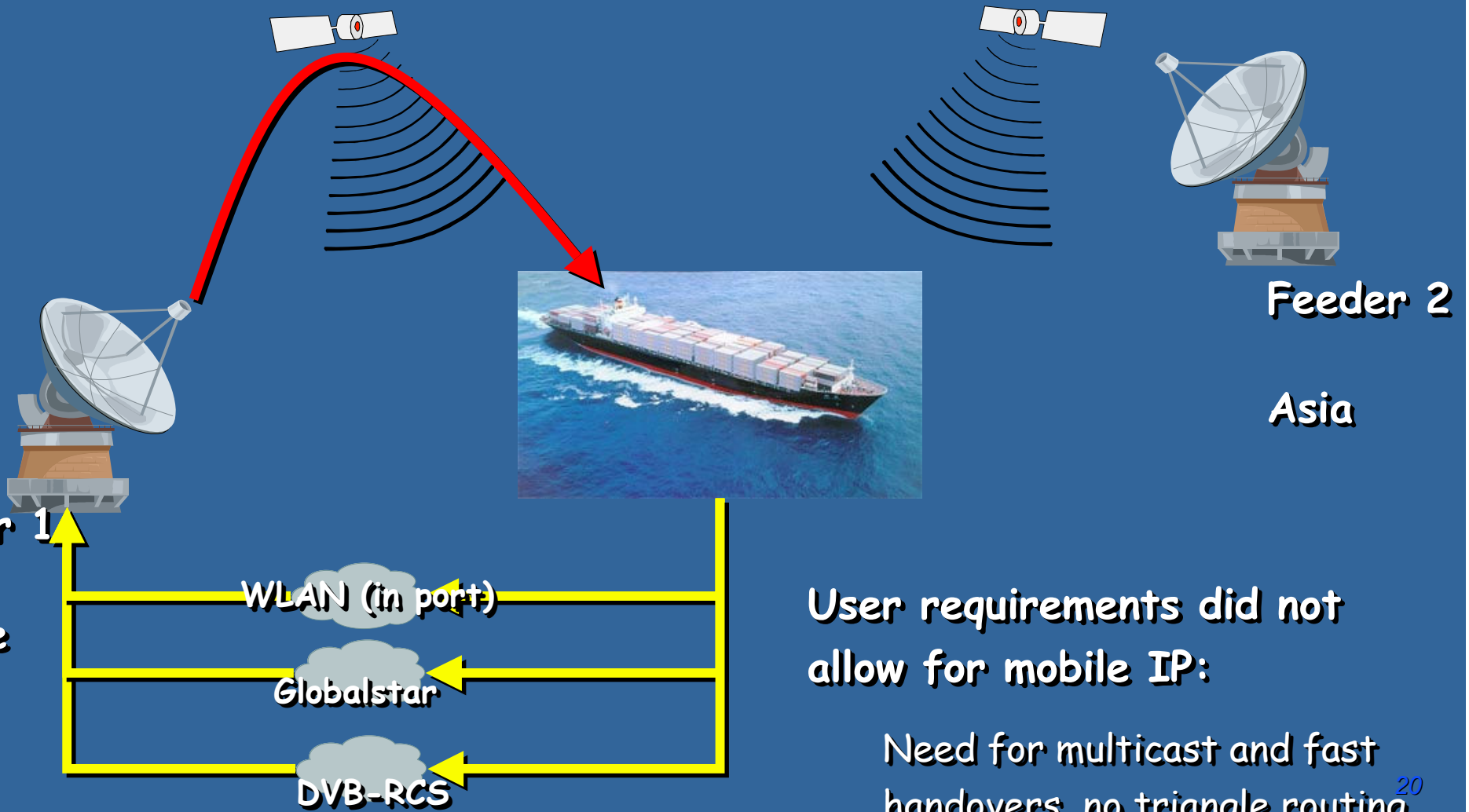
- No multicast security available yet from IETF MSEC WG (all multicast in GRE tunnels !)
- Conditional access systems are expensive and hacked
- No Support for micro-broadcasters

IP Security: multicast

Resulted in a co-funded project (Logica/Uni Surrey) implementing Secure IP multicast

- Support of second instance of Group Key Management implementation within IETF framework
- Implementation of "light" GSAKMP and LKH as key distribution method
- Workshop held to capture further requirements (1 May 2003, London)
- Interoperability tests with U.S. implementation
- Hopefully, more trials using this software over satellite
- Possibly, Internet Draft on experiences to MSEC WG

Co-funded study (Udcast) on enhanced mobility for UDLR



User requirements did not allow for mobile IP:

- Need for multicast and fast handovers, no triangle routing

IP Networking over Satellite Workshop held 13/14 May 2003 at ESTEC:

- 70 persons attended from industry, universities and research laboratories
- All presentation multi-casted over satellite with participation of remote users (using **DistLearn** tool)

Future projects

- More focus on integration of terrestrial/satellite networking
- Will look slowly into IP routing/MPLS onboard and enhanced mobility
- QoS for applications
- MIKEY/SRTP integration in security testbed
- L2 VPN (PPPoE/L2TP) scenario's

Upcoming tenders "Integrated Applications and User Terminals"

- Open since yesterday, look at **http://emits.esa.int/**
- 150k€ - 3M€ , 50% funded

http://telecom.esa.int