Title:

Internet Protocols and Satellite Networking: Results of ESA Projects

Authors and Authors Affiliations:

Frank Zeppenfeldt E-mail: Frank.Zeppenfeldt@esa.int
Roberto Donadio E-mail: Roberto.Donadio@esa.int

European Space & Technology Centre
Keplerlaan 1
Postbus 299
NL-2200 AG Noordwijk
The Netherlands
Phone: +31 71 565.4376
Fax: +31 71 565.6040

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Subject Area:

This paper intends to provide an overview of Research & Development Projects sponsored by the European Space Agency, it would fit best in the subject area "**Integration**" or "**Technologies for Advanced Networking**".

The full paper will go in sufficient detail to attract a "network oriented" audience, but plans also to dedicate a short section to funding possibilities within different program lines of the ESA Telecommunications Department, which may be interesting to the European academic network research community.

Abstract:

Introduction

This paper presents an overview of the results of R&D projects sponsored by the European Space Agency (ESA) in the area of IP over satellite communications. ESA has a number of program lines that fund research related to networking, terminals and on-board processing technologies and satellite communications in general; the results of these programs and issues still to be addressed discussed in detail. The emphasis has been on scenarios based on the DVB technology that is seen as key factor to the development of the satellite multimedia market and its integration with advanced terrestrial networks.

Multicast and Security

Satellite networks support multicast natively, however there are a number of issues that require specific R&D effort to integrate satellite networks seamlessly with the terrestrial world.

a. The integration of commonly used intra- and interdomain multicast routing protocols and IGMP/MLDv2 handling on a satellite network is not trivial, in particular for on-board processed satellites. Advances and open issues will be presented.

b. The secure multicast distribution needs extensions to the IPSec key management protocols as currently addressed in the IETF MSEC WG. ESA supports the implementation of a second (European) implementation of GSAKMP 'light' providing support of group key management and the first results will be presented.

c. The reliable distribution of content requires reliable multicast protocols that take into account the specific satellite environment. ESA has developed with Industry reliable multicast protocols but an open standard is still lacking: activities will be initiated in this area.

QoS in satellite networks

Current satellite networks that transport IP do not provide yet support QoS. However, ISP's start to offer QoS in their SLA's on terrestrial networks. A number of ESA initiated studies address the use of QoS in satellite networks as it is expected that support of QoS in satellite networks will be essential for interoperability.

An IP/DVB Gateway has been implemented that supports the DiffServ model, and moreover demonstrates the communication between Bandwidth Brokers of the satellite link provider and multiple ISP's using this satellite link. The provisioning is implemented using COPS-PR with a customised Policy Information Base. The trading between Bandwidth Brokers uses the IOTP (Internet Open Trading Protocol, RFC 2801) and queuing is implemented using the latest Linux queuing disciplines (qdisc).

As a second activity in this area, the mapping of IntServ/DiffServ architectures is investigated: current satellite networks use Medium Access mechanisms that are standardised in ETSI standards for DVB-RCS and no standards exist for mapping IP Classes of Service onto satellite MAC layers. Problems identified are somewhat similar to those addressed by research on IP QoS over 3G networks, and will be simulated and prototyped in existing satellite terminals.

Emerging satellite network architectures for "*routers in the sky*"

ESA is supporting several multimedia programs in which experimental switching payloads are being developed. Whereas initially, payloads were developed and operated on commercial telecommunication satellites and functioned as IP or MPEG multiplexers (e.g. SkyPlex), nowadays the first satellite that employs full on-board switching is scheduled to be launched in 2004. In network terminology, this will result in a "***router/switch in the sky***" in which the satellite decides to which spot beam IP datagrams or MPEG Transport Packets need to be routed. More research is required on the integration of these emerging satellite architectures with existing network paradigms (e.g. MPLS, router servers, single-source/any-source multicast models).

IPv6 in satellite networks

The EU is sponsoring several related projects under its R&D programme. Currently however, the existing IST IPv6 projects do not address in sufficient detail the satellite component.

For interoperability it is essential that satellite components can support new protocols around IPv6. The current equipment on the market is not adequate to provide this support and more important, the satellite-specific use of IPv6 is currently not addressed.

Satellite-specific problems are expected in a number of areas:

- Network Management issues such as AAA and SNMP/MIB's are currently not addressed in the satellite world for IPv6.
- For the Transport Layer, issues such as the impact of compulsory IPSec, the PEPs (Performance Enhancing Proxies) compatibility with IPv6 need to be investigated
- For the Network Layer, the lack of experience with protocols for large-flat IPv6 topologies (i.e. satellite networks) is an issue. In addition, the Stateless and stateful auto configuration features and specific issues with uni-directional links that are not overcome by UDLR mechanisms are not sufficiently studied. Furthermore, the impact of IPv6 multicast management on large-flat networks, particular issues such as routing, addressing schemes and NAT obsolescence in DVB-RCS architectures in transparent and regenerative mode are not understood yet.

The results of an initial assessment of IPv6 in satellite network will be presented, in combination with a pilot that will be run in conjunction with one of the IST IPv6 projects, to provide an additional experimental satellite component.