

# FastSat

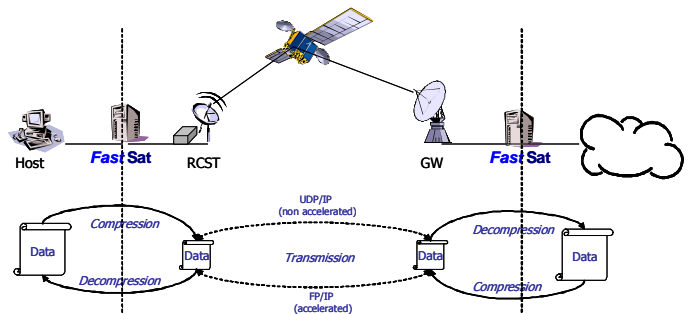
## Purpose

**FastSat** is a network acceleration product targeted to satellite link but that can benefit to any link with similar characteristics.

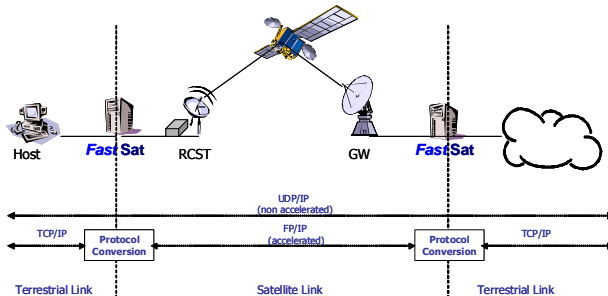
The ultimate goal of **FastSat** is to optimise the use of the available bandwidth, to maximize the number of users that can be supported on the satellite link and to reduce the delays experienced by these users.

## Overview

At the foundation of **FastSat** is the **Performance Enhancing Proxy (PEP)**. The purpose of the PEP is to dramatically improve the end-to-end TCP performance when traversing networks with long Latency, large Bandwidth Delay Product (BDP), high Bit Error Rate (BER), asymmetric Bandwidth Links or variable Bandwidth, which are exactly the conditions typical of multimedia satellite access network illustrated below.



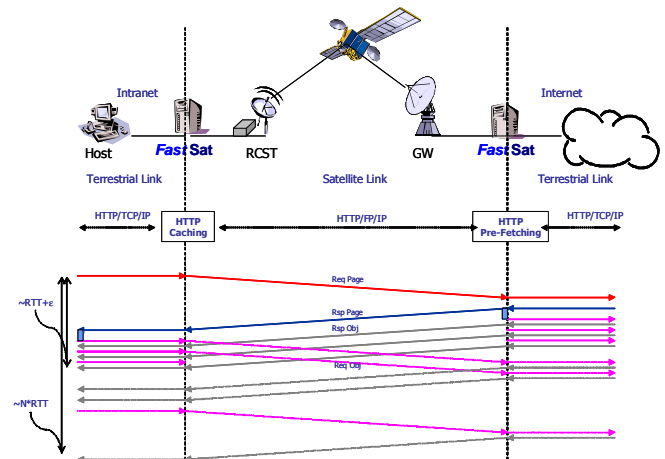
To further optimise the available bandwidth usage and accelerate the data transfer, sophisticated **Adaptive Data Compression** is provided on the satellite link to deliver the best compression ratio while not wasting processing power.



The PEP functions at the transport layer and is transport-layer transparent. It is distributed on both sides and is symmetric. It uses a split TCP connection approach. A new satellite link specific Flight Protocol (FP) is used for the middle connection instead of the standard TCP protocol.

Expected increases in performance are in the order of up to 8 times for HTTP traffic and up to 280 times for FTP traffic

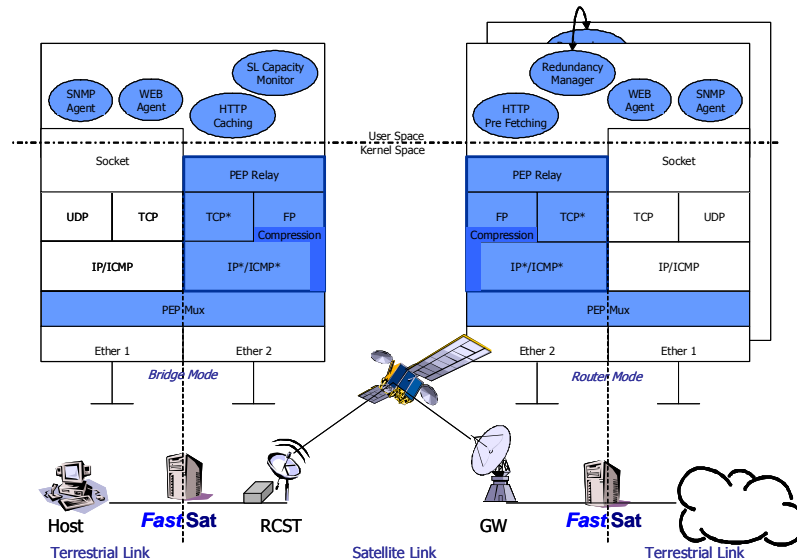
Accurate **Space Link Capacity Matching** is provided on both sides to match the spacelink capacity. To cope with the Bandwidth on Demand mechanism, the rate control parameters can be constantly and automatically adjusted according to the bandwidth variations of the return link.



Similarly **Web Page Acceleration** is being introduced to mitigate the transmission delay experienced by the end-users when downloading complex Web pages. Requested pages are parsed at the Hub side, embedded objects required for page rendering are pre-fetched and cached on the Terminal side thereby anticipating on the subsequent browser requests and eliminating numerous round trip times.

## Architecture

The PEP architecture is depicted in the figure below. It consists of two separate protocol stacks and several management applications.



Both the Gateway PEP and the Terminal PEP have basically the same architecture (symmetric). They have two separate interfaces: one to the satellite network, and one to the terrestrial network. Except for management purposes, the PEP is invisible at IP level.

The native Internet protocol stack is used for all the local traffic starting or ending in the PEP. This traffic is generated by the network management applications, the Redundancy Manager application, and the Space Link Capacity Monitor application.

The PEP protocol stack is used for all (non-local) transit traffic starting and ending in remote systems and traversing the satellite network. It is also used for the non-local RCST management traffic.

Separate protocol stacks are used mainly for portability reasons.

## Modes

The PEP software operates in one of two modes: Router or Bridge.

In the Router mode, the PEP software forwards IP traffic between two interfaces belonging to two separate (sub)networks. The Gateway PEP is normally configured in Router mode.

In the Bridge mode, the PEP software forwards IP traffic between two interfaces belonging to the same (sub)network. The Terminal PEP is normally configured in Bridge mode.

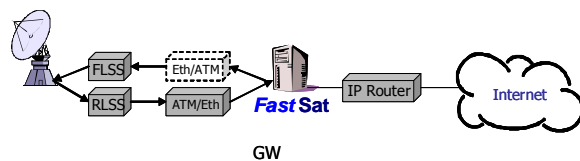
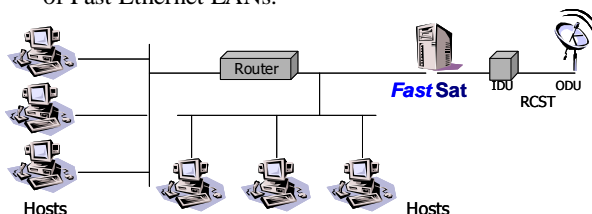
## External Interfaces

### Terminal

The Terminal **FastSat** device is inserted in the chain of DVB-RCS equipment as illustrated below.

The Terminal **FastSat** has one traffic interface to the Hosts and an optional Router, and one traffic interface to the RCST.

Both the terrestrial and the satellite networks consist of Fast Ethernet LANs.



### Gateway

The Gateway **FastSat** device is inserted in the chain of DVB-RCS equipment as illustrated above.

Each **FastSat** of a redundant Gateway **FastSat** has one traffic interface to the IP Router and one traffic interface to the FLSS and the RLSS.

The interface to the FLSS can be provided through an optional Ethernet/ATM converter implemented by the IP Router. The interface to the RLSS is provided through an Ethernet/ATM converter implemented by the IP Router.

Both the terrestrial and the satellite networks consist of Fast Ethernet LANs.

## Components

The **FastSat** software is divided into the following main components:

- Ethernet

This standard Fast Ethernet layer has been modified to interface the PEP Mux layer instead of the IP layer.

- ARP

This standard ARP layer has been modified to provide Proxy ARP functionality on both interfaces of the Terminal PEP in order to implement the required bridge mode.

- PEP Mux

The purpose of this new PEP specific layer is to multiplex incoming and outgoing IP packets between the two protocol stacks (native stack and new stack). This layer also provides Space Link Capacity Matching through rate control.

- PEP IP (also called IP\*)

This is a modified version of the standard IP layer. The main modification concerns the forwarding decision which is no longer based on the IP destination address but on the interface through which the packet entered the system.

- PEP ICMP (also called ICMP\*)

This modified version of the standard ICMP layer intercepts and processes some ICMP messages.

- PEP TCP (also called TCP\*)

This modified version of the standard TCP layer implement the TCP spoofing mechanism (i.e. interception of TCP connections) that is required to implement the split TCP connection approach.

- FP

The Flight Protocol is at the core of the PEP. This is a brand new protocol that takes benefit from the point-to-point satellite link connection in order to optimise the use of the available bandwidth.

- PEP Relay

The role of this new PEP specific layer is to forward data traffic between the PEP TCP and FP layers and to propagate connection management requests.

- Space Link Capacity Monitor

On the Terminal side, the Space Link Capacity Monitor (SLCM) application is used in conjunction with the PEP Mux layer to provide accurate Space Link Capacity Matching. The role of this application is to monitor the status of the RCST output queue and to adjust rate control parameters accordingly. (on the Gateway side, these parameters can be set at installation).

- FastSat Management

**FastSat** can be managed using commands entered from its local console, from a terminal console on one of its serial lines, or from any terminal emulator console on a Telnet connection.

- SNMP Agent

**FastSat** can also be managed through SNMP. The standard MIB II is used for the native stack and an enterprise specific PEP MIB is used for the PEP stack.

- Web Agent

**FastSat** can also be managed through HTTPS using a standard Web Browser. The Web Agent provides a Graphical User Interface (GUI) that allows the browsing of the standard and PEP specific MIBs.

- Redundancy Manager

On the Gateway **FastSat**, the Redundancy Manager application is responsible for the fault detection, state transfer, and fault recovery of the redundant FastSat.

- HTTP Pre-fetching

On the Gateway **FastSat**, HTTP pre-fetching consists in intercepting requested Web pages, identifying Web objects referred to by the Web pages, downloading these objects and pushing them into the Terminal cache in anticipation of the next user requests. This eliminates the need to wait for numerous round trip delays before the user can view a requested Web page with all its included objects.

- HTTP Caching

On the Terminal **FastSat**, HTTP caching caches the Web pages together with the pre-fetched objects. Pre-fetching and caching is intentionally limited to intra-page pre-fetching of embedded Web objects that are directly needed to render the requested pages. These objects are typically images, style sheets, frames, scripts, and applets.

- IP and FP Compression

Data compression is implemented on IP or FP payloads to benefit to all traffic types. FP compression is moreover adaptive on a per connection basis.

## Performance Characteristics

### Terminal

The Terminal **FastSat** software is able to forward traffic (i.e. large packets) between its two interfaces at a sustained speed of 8 Mbps in the forward link direction and 2 Mbps in the return link direction simultaneously.

### Limitations

A maximum of 20,000 simultaneous end-to-end connections are supported by the PEP on the Gateway **FastSat**.

The maximum simultaneous end-to-end connections supported by on the Terminal side depends upon the available buffering space (it can typically be set to 1,200).

Communication (e.g. management) through the satellite link to a satellite neighbour of **FastSat** (e.g. RCST) cannot be done via the opposite **FastSat** (e.g. Gateway **FastSat**) using the TCP protocol.

Similarly, communication (e.g. management) through the satellite link to a satellite neighbour of **FastSat** cannot be done via the opposite **FastSat** (even when using SNMP over UDP) if IP compression is enabled on that **FastSat**.

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### Gateway

The Gateway **FastSat** software is able to forward traffic (i.e. large packets) between its two interfaces at a sustained speed of 40 Mbps in the forward link direction and 32 Mbps in the return link direction simultaneously.

### Key Features

- Performance Enhancing Proxy (based on RFC 3135)
  - Transport-layer transparent
  - Split TCP connection
  - New FP protocol optimized for two way DVB-RCS satellite environment
  - Router and bridge modes
- Space link capacity matching (effectively allowing the use of VBDC on the Terminal side)
- Adaptive data compression (based on RFC 3173 and 2394)
- Web page acceleration with pre-fetching on the gateway side and caching on the Terminal side.
- Manageable through both SNMP and HTTPS
- Redundancy on the Gateway side