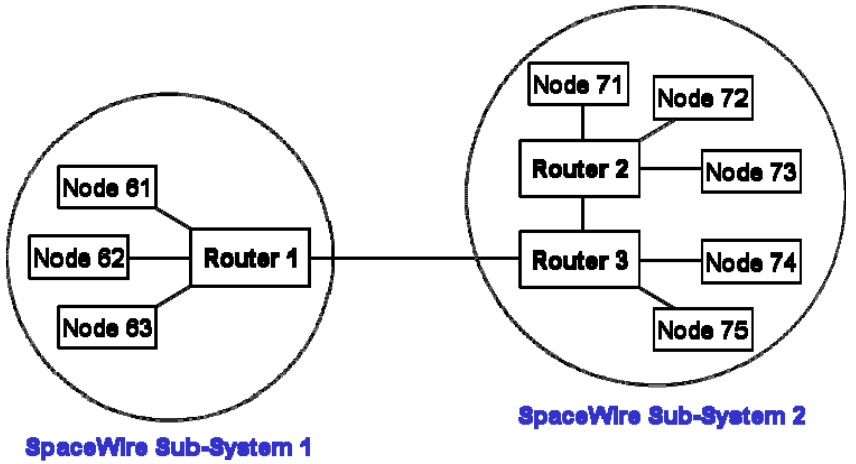
TOPNET Second Generation

R. Vitulli

ESTEC TEC-EDP

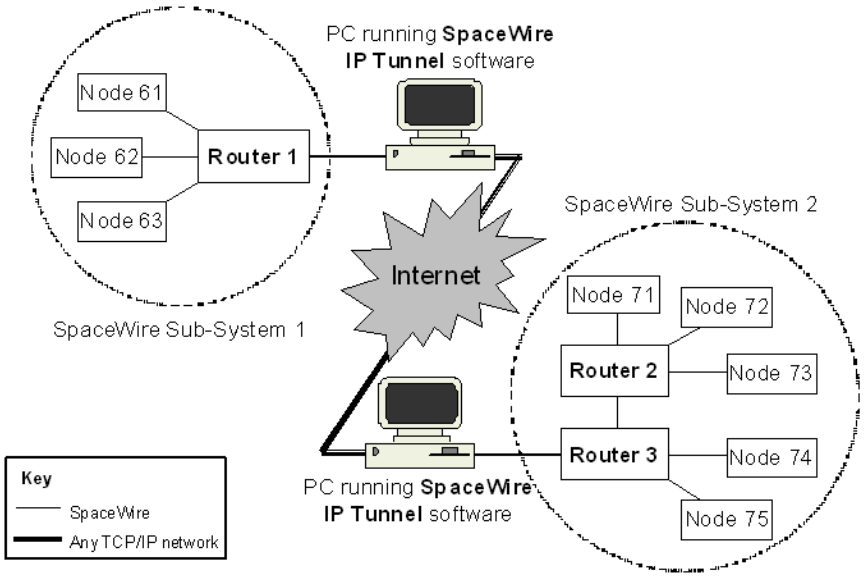
Introduction

- Problem of two SpaceWire subsystems geographically distributed
- Remote subsystems will be connected only when development is completed
- Integration and Testing performed late in development process
  - Problems expensive to correct

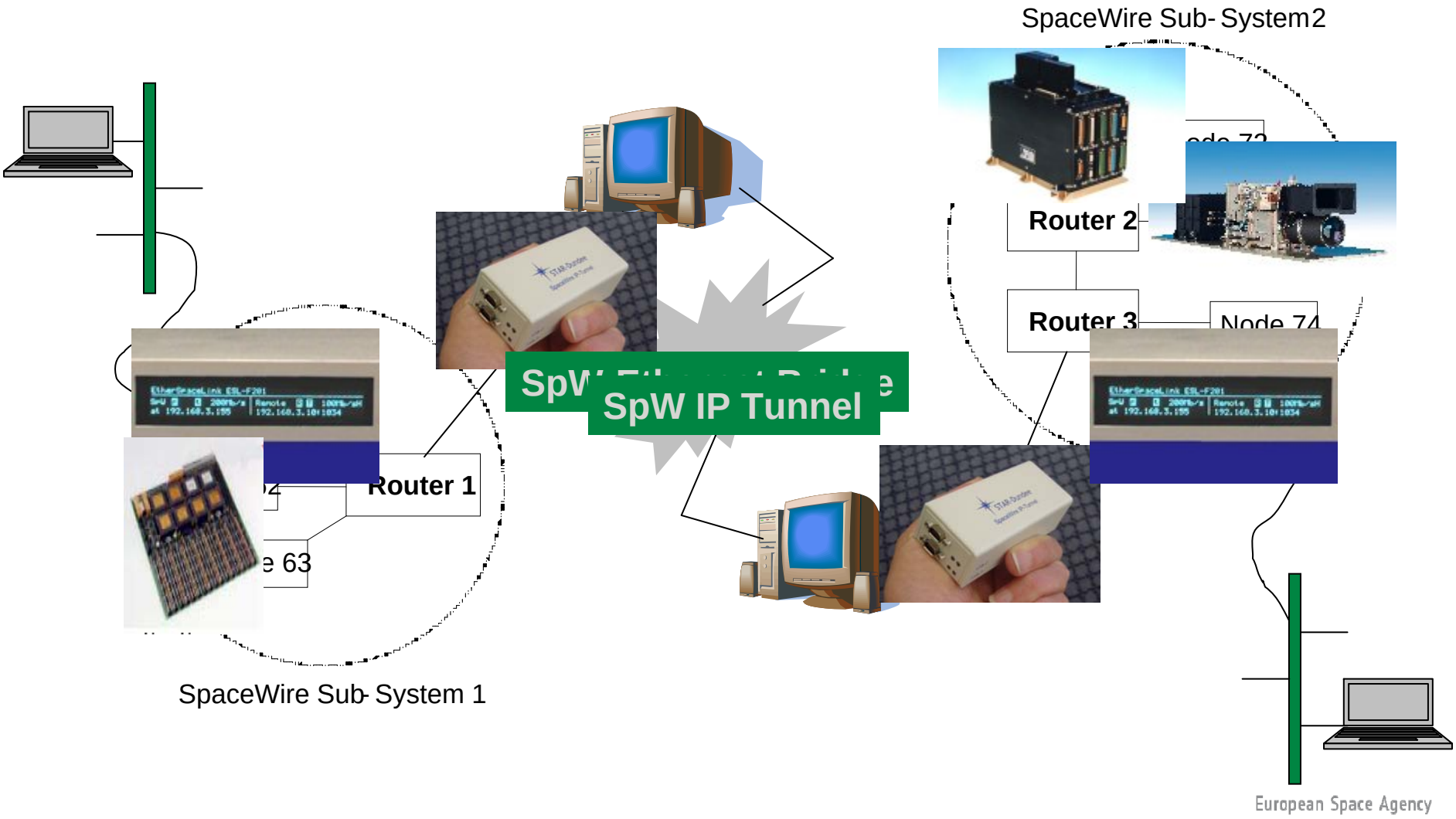


Introduction

- The **IP Tunnel** transparently replaces a SpaceWire link
- Traffic entering the Tunnel will exit in the same order
  - A time-code will be between the same two data characters
- Link start and disconnect are also represented
- Only difference is in bandwidth and latency
  - Limitations of Internet
- Protocol Analysis software also provided
  - Monitor the Tunnelled traffic

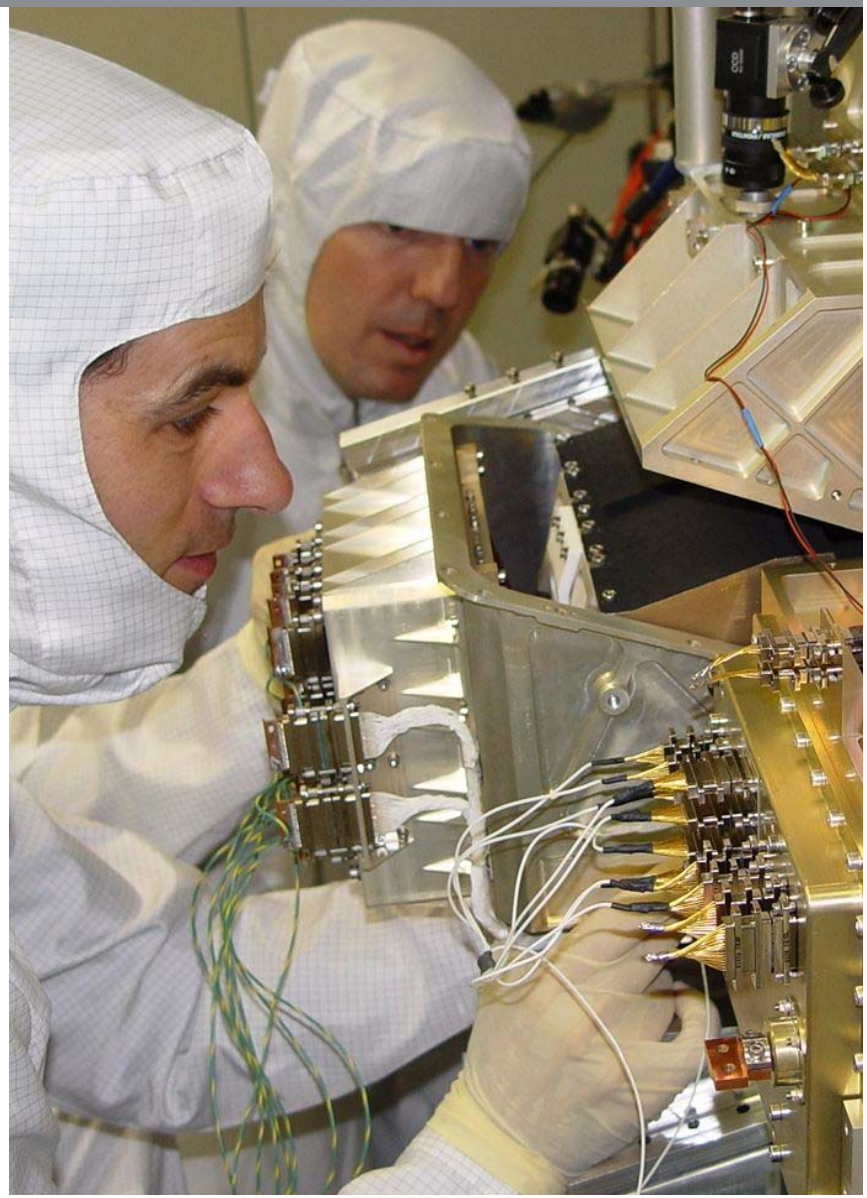


TOPNET implementation



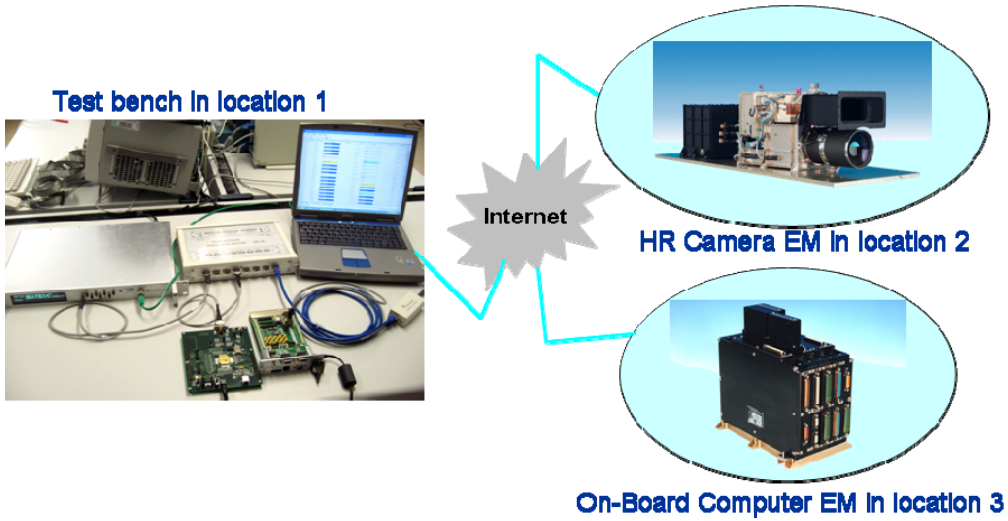
Virtual Satellite Integration

- **Virtual Satellite Integration**
  - Remote sub-systems connected using the Internet
  - Reduces geographical limitations and travel
  - Problems can be identified in interface specifications and implementations
  - Integration can be performed earlier in the development process



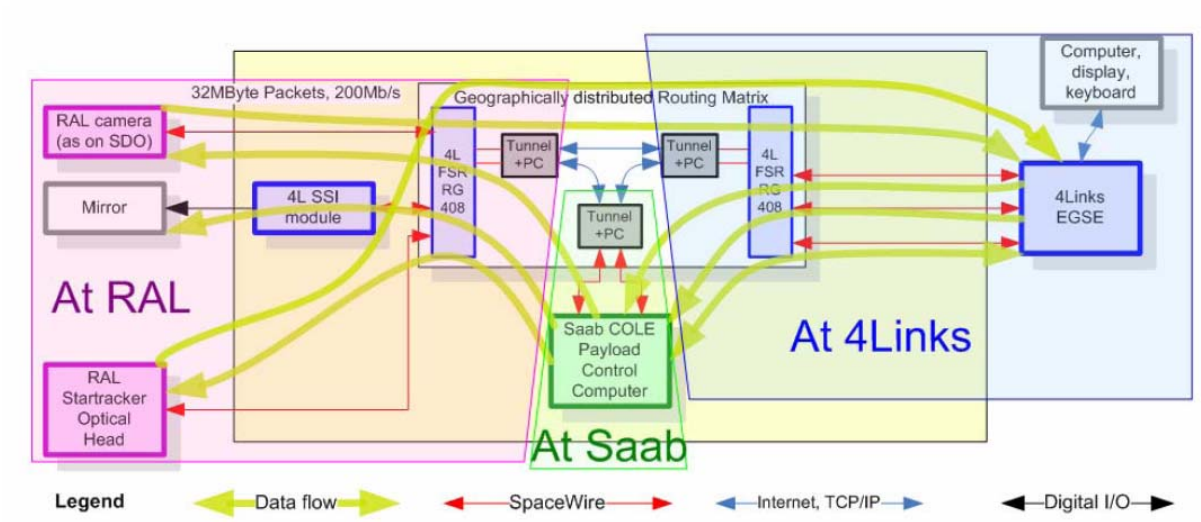
Background

- **TopNet Pilot activities: 3 parallel contracts**
- To verify the usefulness of TopNet concept in a real environment
- Primes (Large integrator) and SMEs involved
- Feedback from contractors on advantages, drawbacks and possible improvements



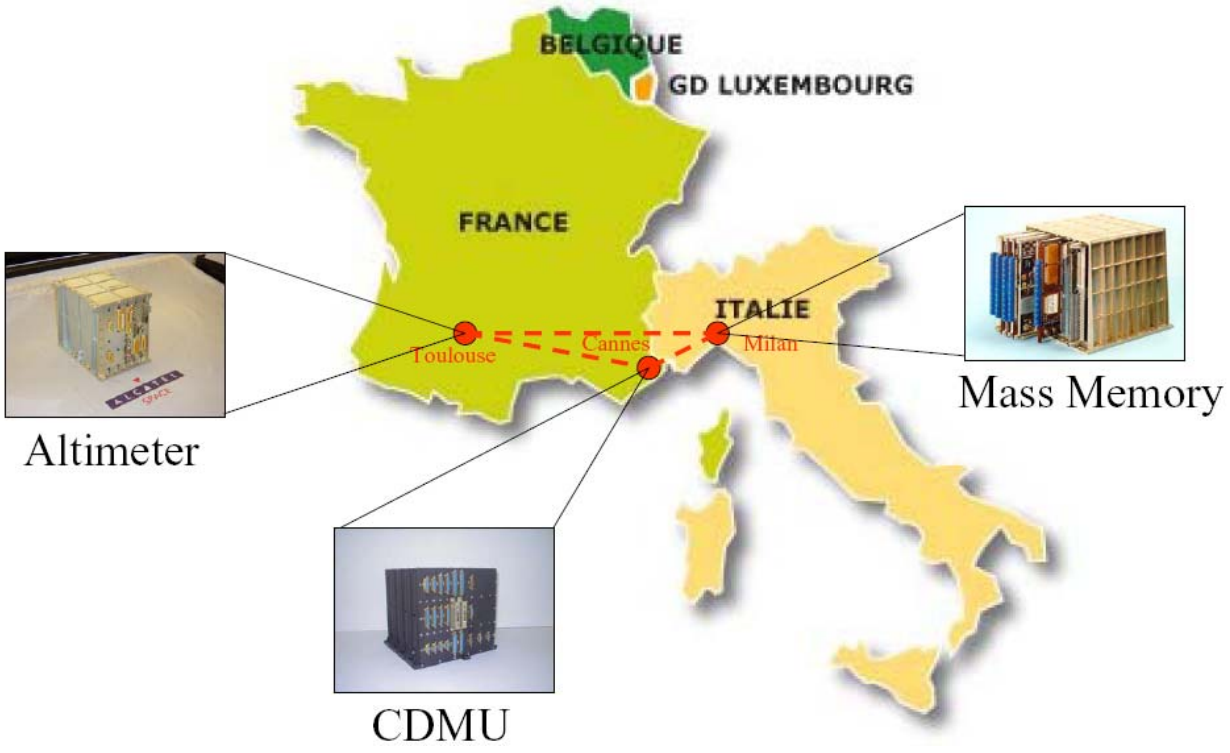
Background

- 4Links
  - RAL
  - RUAG (ex SAAB Space)



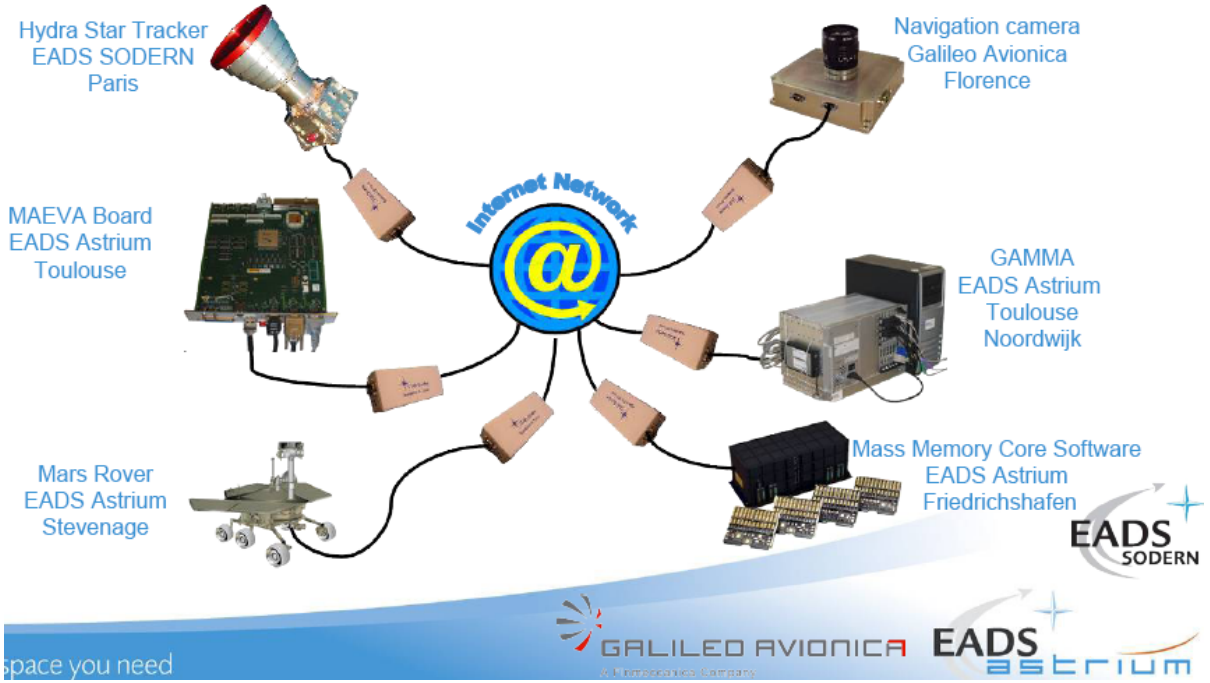
Background

- THALES Alenia Space
  - Cannes
  - Toulouse
  - Milan



Background

- EADS ASTRIUM
  - Toulouse
  - Friedrichschafen
  - Stevenage
  - Galileo Avionica (Florence)
  - EADS Sodern (Paris)



Feedback

- **Advantages:**
  - Earlier integration
    - Identify and correct problems earlier
    - Saves time and money as easier to correct problems identified at an earlier stage
  - Less travel
    - Can integrate sub-systems without physically bringing them together
  - Improved cooperation
    - Allows multiple organisations (or a single organisation with multiple sites) to work on the same system
  - Improved flexibility
    - Integration testing can be performed at any time
    - Sub-systems can easily be replaced by simulations

Feedback

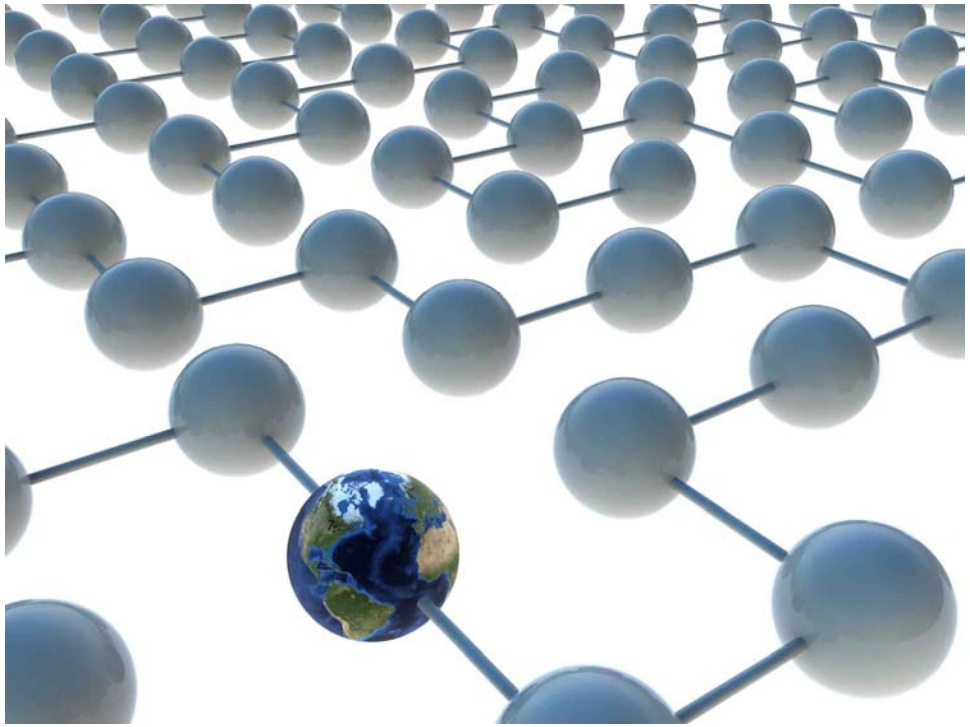
- **Drawbacks:**
  - Bandwidth and Latency Restrictions
    - Software provides mechanisms to cope with poorer and varying bandwidth and latency
    - Internet latency can affect Isochronous operation and Real Time operation
    - Risk to have a bad synchronisation of equipments using time diffusion principle (time-codes, OBT)
  - Firewall Issues
    - Software allows any TCP port to be used
      - Using an appropriate port, a firewall will see the traffic as no different to a secure web page
    - Use of a Tunnel Server avoids the client-server limitations on the end users
      - Companies may still require their own Tunnel Server if they are worried the company operating the server may view their data

Possible Improvements

- Visual Representation of Network Topology
- Edit Network Topology Visually
- Automatic updates
- Improvement for the installer
- Microsoft certified USB driver
- Windows Vista
- Management of large packets
- Improvement of the Statistics window
- Address limitation when using two links of Tunnel device
  - Links not entirely independent
  - Single shared USB “pipe”
  - One link can be blocked by the other
- Multiple language support

Virtual Devices

- **Virtual devices** represented in software
- Connected together using virtual links
- Virtual links can also connect applications and physical devices
- Applications can communicate with physical devices and virtual devices without any changes
- Graphically build virtual network connecting applications, virtual devices and physical devices

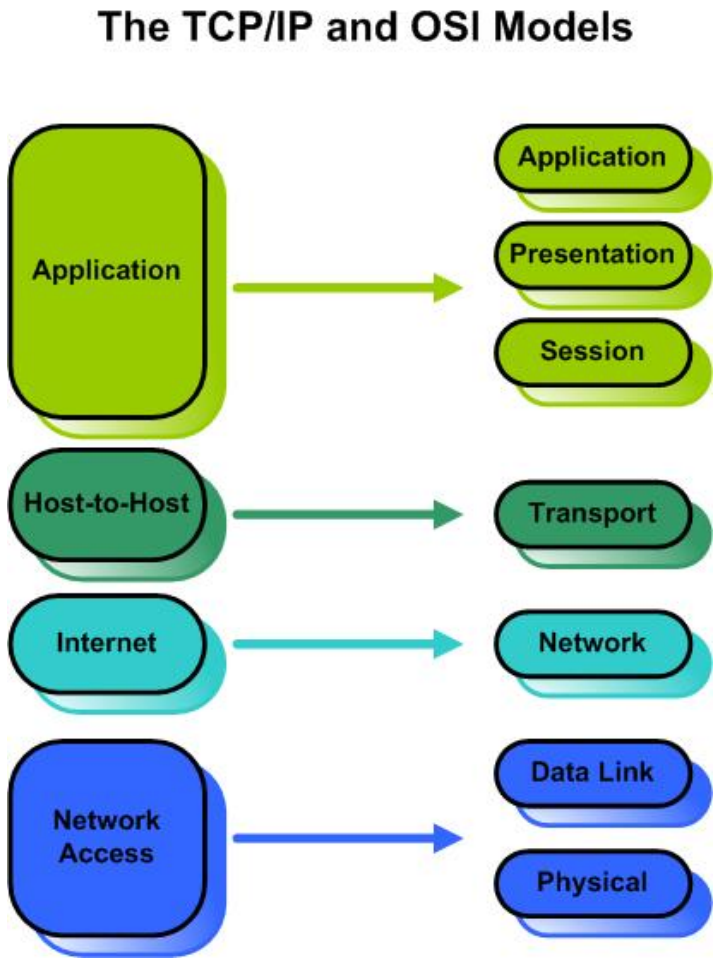


Virtual Devices

- **Virtual networks can be integrated using a SpaceWire Internet Tunnel**
- Can prototype features in a virtual device prior to implementation in a physical device
- Can make use of virtual versions of physical devices, e.g. Instruments
  - Perform testing without requiring the physical hardware
- Test out different network architectures
- Allows an higher level of Virtual Satellite Integration

Real-Time communication issues

- For the Internet tunnelling communication regular TCP/IP is used
- It is well-known that **TCP/IP implements a "best-effort"** paradigm without guaranteeing latency
- Reasons are: queuing delays sum up at each routers
- TCP is "best effort" and tries to fill the routers queues



Real-Time communication issues

- Possible solutions in order to have a guaranteed latency is to use a **customised communication protocol:**
  - TCP Westwood+ is available in Linux kernel and it is a sender-side only modification of the TCP protocol stack that optimizes the performance of TCP
    - Investigate TCP Westwood+ that is known to provide less queuing
    - Customize TCP Westwood+ considering a particular scenario
      - i.e. when the bandwidth of the tunnel is known, as it is in corporate intranet
  - Design **rate-based transport protocol at application level executed over the UDP**
    - as it is done for applications that are time-sensitive such as VoIP or Video Conferencing

Follow-on: GSTP5 activity

- **GSTP5 activity named "TOPNET 2nd generation"**
- GSTP5 is an optional programme
- The activity is in the GSTP-5 work plan, but at the moment there are not funds to implement it
- If you are interested, contact your national agency to promote this activity!