TOPNET Second Generation

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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
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

Internet

Router 2

Node 73

Node 72

Node 74

SpaceWire Sub-System 2

Router 3

Node 74

SpW IP Tunnel

SpaceWire Sub-System 1

SpW-Ethernet Bridge
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
• **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
• EADS ASTRIUM
  - Toulouse
  - Friedrichshafen
  - 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
**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!