

# TOPNET EVOLUTION

**Session:** SpaceWire test and verification

## Short Paper

Raffaele Vitulli

*European Space Agency - Keplerlaan 1, 2201AZ Noordwijk (The Netherlands)*

*E-mail: [Raffaele.Vitulli@esa.int](mailto:Raffaele.Vitulli@esa.int),*

### ABSTRACT

The concept of virtual spacecraft integration (a.k.a. “TopNET”) provides a means by which integration and testing of spacecraft components can be performed without the need to bring each of the components to one physical location. The SpaceWire standard aims to improve reusability, promote compatibility and reduce system integration costs. Virtual spacecraft integration has the potential to reduce system integration costs still further, by reducing travel and by identifying problems at an earlier stage of spacecraft development than is currently the case.

Virtual integration is achieved through the use of a network such as the Internet. A section of the spacecraft’s onboard bus is replaced with a virtual connection over the network, allowing components to communicate with one another, despite potentially being great distances apart.

To determine the benefits and limitations of virtual spacecraft integration, ESA conducted a pilot study involving spacecraft and equipment manufacturers in different countries across Europe. They conducted experiments using the SpaceWire Internet Tunnel device to remotely integrate components and reported back on their findings. Their results were very positive.

Despite the identified benefits, there are potentially some limitations of virtual spacecraft integration. Use of a network connection such as the Internet introduces limits in bandwidth and latency. Neither are guaranteed in Internet communication, and both bandwidth and latency can vary greatly during a connection’s lifetime. This limitation makes possible only “asynchronous” operations, at the moment.

Starting from the valuable feedback received by the pilot study, it seems necessary to improve the TopNET concept, in order to overcome the above-mentioned limitations. In the paper, the outcome of the pilot study will be shortly summarized, and a strategy to enhance “synchronous” operation will be presented. Moreover, a further objective is to extend the TopNET concept, having in mind the CCSDS SOIS architecture. This means the introduction of additional Data Link Layers besides SpaceWire and the use of Quality of Service metrics.