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MEETING

Meeting Date	19/10/2010	**Ref**	TEC-EDP/DJ/2010/MoM/03
Meeting Place	ESTEC	**Chairman**	David Jameux
Minute's Date	25/02/2011	**Participants**	Alain Girard (Thales Alenia Space, France) Alan Senior (SEA, UK) Alain Girard (Thales Alenia Space, France) Alain Girard (Thales Alenia Space, France) Alan Senior (SEA, UK) Alain Girard (Thales Alenia Space, France) Alan Senior (SEA, UK) Antonis Tavoularis (TELETEL S.A., Greece) Barry Cook (4Links Limited, England) Karl Engström (RUAG Space AB, Sweden) Marko Isomaki (Aeroflex Gaisler, Sweden) Munetaka Ueno (Institute of Space and Astronautical ,Japan) Peter Mendham (SciSys, UK) Paul Walker (4Links Limited, England) Steve Parkes (University of Dundee ,Scotland, UK) Tatiana Solokhina (ELVEES RnD Center, Russian Federation) Takahiro Yamada (JAXA/ISAS, Japan) Stephane Davy (Syderal, Switzerland) Hiroki Hihara (NEC, Japan) Minoru Nakamura (Mitsubishi Electric, Japan) Masaharu Nomachi (Osaka University, Japan) Viacheslav Grishin (Submicron,

Russia)
Vladimir Filatov (Roscosmos, Russia)
Ed Kujpers (NLR, The Netherlands)
Guy Mantelet (Atmel, France)
Aitor Viana Sanchez (ESA/ESTEC, The Netherlands)
David Jameux (ESA/ESTEC/ESTEC, The Netherlands)
Felice Torelli (ESA/ESTEC, The Netherlands)
Javier Galindo (ESA/ESTEC, The Netherlands)
Nickolaos Panagiotopoulos (ESA/ESTEC, The Netherlands)
Stavros Tzilis (ESA/ESTEC, The Netherlands)
Martin Suess (ESA/ESTEC, The Netherlands)
Philippe Armbruster (ESA/ESTEC, The Netherlands)
Wahida Gasti (ESA/ESTEC, The Netherlands)
Kostas Marinis (ESA/ESTEC, The Netherlands)
Albert Ferrer Florit (ESA/ESTEC, The Netherlands)
Giorgio Magistrati (ESA/ESTEC, The Netherlands)
Paul Rastetter (Astrium GmbH, Germany)

Subject	SpW WG meeting #15 - Session 3: SpaceWire evolutions and standard revision	**Copy**	

Conclusion

The 15th SpaceWire Working Group meeting took place at ESTEC from the 18th to the 20th of October. The attendance was high with more than 35 participants including 24 external ones coming from Europe, Japan (4) and Russia (5). The USA were not represented this time. The main domains of interest are related to SpW new protocols (proposal for CCSDS time distribution over SpW), SpW networks for Command and Control and High Throughput data transfers, SpW Evolutions and Standard Revision, and PnP. Proceedings available at: http://spacewire.esa.int/WG/SpaceWire/ (UserID: SpWlink, Password: SpW4space).

Session 3 of the meeting, dedicated to the revision of the SpaceWire standard, was very successful. The SpW Working Group discussions, both technical and programmatic, were very fruitful and addressed main areas of concern regarding the current standard ECSS-E-ST-50-12C. This allowed a large number of dispositions to be decided on-line regarding the revision of the standard. These dispositions will serve as a basis for the official Change Request to ECSS for the revision of the SpaceWire standard. Some points which where discussed controversial could not be concluded. This was partly due to the fact that some initiators where not present to answer the questions raised. These points were kept open and will be handled in the following meetings. Some other issues were kept open for later discussion simply because the related Change Request did not provide enough technical information to make a decision.

Below are listed the action items resulting from the meeting.

Description	Action	Due Date
D. Jameux to compile the outcomes of the Working Group discussions on each point addressed in session 3.2	AI-SpW-WG#2010-10-19.1	End of 2010
SpW Working Group to review the slides of Session 3.2 and prepare inputs/reactions to the points on which the discussions were not conclusive, either because there was no consensus with the Working Group or because the matter needed more thinking/hands-on validation than online discussion could allow.	AI-SpW-WG#2010-10-19.2	End of 2010

As recalled in the agenda below, *Session 3: SpW Evolution and standard revision* was held on Day 2 of the SpaceWire Working Group meeting #15 as from 10:00. It lasted until 17:30. As foreseen, it was composed of an introduction by M. Süß on *SpaceWire evolutions, standard update (SpaceWire 1.1), backward compatibility, and SpaceWire 2.0* (Session 3.1) and *Session 3.1: SpW evolutions*, a presentation by D. Jameux of aggregated change requests to the ECSS-E-ST-50-12C standard from the Working Group and related technical discussions.

SpW Working Group Meeting #15 http://spacewire.esa.int/WG/SpaceWire/SpW-WG-Mtg15-Proceedings

Fifteenth SpaceWire Working Group meeting
18th PM, 19th (all day) and 20th (AM) of October 2010

The fifteenth SpaceWire Working Group meeting has been held on Monday the 18th (PM), Tuesday the 19th and Wednesday the 20th (AM) of October 2010 at Estec, followed by a SpW WG Steering Committee meeting on Wednesday the 20th (PM).

Scope - the meeting covered the following topics:

- SpW networks used for C&C (SpW-D) (Convenors Ph. Armbruster, ESA/ESTEC & S. Parkes, UoD)
- SpW Evolutions and Standard Revision (Convenors D. Jameux, ESA/ESTEC & M. Suess, ESA/ESTEC)
- SpaceWire-PnP (Convenors G. Rakow, NASA/GSFC, C. Taylor, ESA/ESTEC & P.Mendham, SciSys)
- SpW Deployment and Handbook (Convenor, B. Cook, 4Links)
- SpW Test, Verification and 'Certification' (Convenor Y. Sheynin, UoStPg)
- SpW Products ESA brochure (ESA)
- SpaceWire International Conferences: SpWIC 2010 – (St Petersburg RU) and SpWIC 2011 (San Antonio TX,US)

Proceedings (D)

Day 1: Monday 18th October (PM)

Welcome and Introduction (Philippe Armbruster, ESA/ESTEC)

Session 1: SpW New Protocols (Convenor Martin Suess, ESA/ESTEC)

Proposal for CCSDS time distribution over SpW (M. Isomaki, S Habinc, Aeroflex-Gaisler)

Session 2: SpW –D (Convenors Ph. Armbruster, ESA/ESTEC and S. Parkes, UoD)

SpW-D An Introduction and Discussion (S.Parkes / UoD)

Presentation on SpW-D requirements and their assessment (A. Tavoularis, Teletel)

Presentation on results of the Jaxa analysis for the SpW-D draft specification (T.Yamada, JAXA)

Presentation on SpW-D Preliminary Protocol Implementation – Parameter Identification and Trade-Off Analysis (Albert Ferrer Florit, UoD-ESA/ESTEC)

Day 2: Tuesday 19th October (all day)

Wrap-up Session 2 – Conclusions and Dispositions

Session 3: SpW Evolution and standard revision (Convenor D.Jameux, ESA/ESTEC)

Introduction: SpW evolutions, standard update (SpaceWire 1.1), backward compatibility, SpaceWire 2.0 (M.Suess, ESA/ESTEC)

SpW evolutions: presentation of aggregated change requests from the Working Group and related technical discussions, possibly to agree on technical choices (D.Jameux, ESA/ESTEC)

Session 4: SpaceWire related activities

Presentation on [illegible] (A.Girard, TAS France)

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SpW Working Group Meeting #15 http://spacewire.esa.int/WG/SpaceWire/SpW-WG-Mtg15-Proceedings

Day 3: Wednesday 20th October (AM)

Session 5: SpaceWire PnP (Convenor Ch. Taylor, ESA/ESTEC & P.Mendham, SciSys)

Introduction to SpW PnP (P.Mendham, SciSys)
Presentation on SpW PnP (Ch. Taylor, ESA/ESTEC)
ESA Comments on PnP Protocol (M. Suess, ESA/ESTEC)
Feedback presentation on PnP Protocol (H.Hihara/NTS Space)
Implementing SpaceWire PnP in the Aeroflex Gaisler Router IP core (M.Isomaki, Aeroflex Gaisler)

Session 6: Other topics

SpW Test, Verification and 'Certification' (Convenor Y. Sheynin, UoStPg)
SpW Products ESA brochure (M.Brestanska, ESA/ESTEC)
SpaceWire International Conferences: SpWIC 2010 – (St Petersburg RU) and SpWIC 2011 (San Antonio TX,US)

Day 3: Wednesday 20th October (PM)

Minutes of the SpW Steering Committee Meeting (M.Suess, ESA/ESTEC)

Next meeting will be held in ESA/ESTEC on the following days: 21 March 2011 (pm), 22-23 March 2011

Support Documents

Support Document: CCSDS Unsegmented Code Transfer Protocol

Support document SpaceWire-PnP Protocol Definition Issue 2.1

Support Document: ANALYSIS AND ASSESSMENT OF THE SPACEWIRE-D DRAFT B SPECIFICATION

Support document: SpaceWire-D Deterministic Control and Data Delivery Over SpW Networks Protocol Draft B

Support Document: Results of Analysis for the SpW-D Draft Specification

Support document: SpaceWire-D Preliminary Protocol Implementation and Analysis (draft)

Attendance list:

List of participants

Contact Person: Maria Brestanska Tel : +31 71 565 8559 Email : spacewire.secretary@esa.int

ESA - ESTEC - Electrical Engineering Department - Data Systems Division – M.Brestanska – 08/11/2010 PM

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In the first presentation (Session 3.1). the frame and the objectives for the following technical discussion of the Change Requests was set:
The Change Requests have been raised mainly by members of the SpaceWire Working Group and many have been already discussed during WG meetings over the past years.
Some of these Change Requests address ambiguities and errors which have been detected in the standard like:

1. Ambiguous formulations
2. Mix of normative clauses and descriptive text
3. Clear errors in e.g. figures

A second class of Change Requests propose a number of new features to be introduced in the SpaceWire standard like:

- Configuration port 0 in nodes
- Signalling codes to carry interrupts across the network
- Half-duplex and/or simplex links
- Link level virtual channels

The revision shall improve the standard but still allow current devices to claim compliance in order to conserve the investments made in devices and systems based on the current standard.

- New requirements may be introduced if they are compliant with the current standard.
- New requirements may be introduced as optional requirements as long as a compatibility mode with current systems is maintained.

The objective of the discussion is to agree one of the following dispositions for all Change Requests:

- Implementation of the Change Request in the revised standard ECSS-E-ST-50-12D
- Cover the Change Request by a chapter in the SpaceWire Handbook

- Reconsider the Change Request for standardisation as part of SpaceWire-2 (next major revision of the SpaceWire standard comprising also SpaceFibre)
- Issue raised in the Change Request not to be considered for standardisation (i.e. no modification o the current standard wording)

To reflect the different levels of agreement during the discussion in the SpaceWire WG one of the following classifications will be applied to the discussed Change Requests:

- Consolidated disposition by SpW WG
- Preliminary disposition (pending further definition and verification)
- No disposition could be agreed upon

If no disposition could be reached, the issue will be raised and discussed further in the following WG meeting.

During the presentation a few clarification questions were raised but, as foreseen, neither any discussion took place nor any decision from the Working Group was made.

On the contrary, Session 3.2 included quite some technical discussion, as foreseen, as well as a number of decisions by the Working Group in the form of dispositions to some of the Change Requests proposed by Working Group members and compiled by ESA. The detail of the discussions and decisions is reported further, following the structure (TOC) of the presentation.

Table Of Content

1 GENERAL

1.1 Structure of the document

Input Change Requests (see Annex 1 below)

Change Requests number 0 and 1

Issue 1

SpW users (mainly the Working Group) have detected a number of ambiguities in the ECSS-E-ST-50-12C Standard. These ambiguities come from
- unclear concepts (e.g. SpW nodes)
- non-systematic writing rules (clauses and comments are sometimes mixed)

Advantage of the current situation:
A standard document has been published in 2003 and allowed for many devices to be developed with fairly good interoperability

Disadvantage of the current situation:
Ambiguities have lead to different implementations and difficult interoperability of unit/device vendors.

Issue 2

SpW users (mainly the Working Group) have proposed a number of new features to be introduced in SpaceWire. The main features are:
- configuration port 0 in nodes
- signalling codes to carry interrupts across the network
- half-duplex and/or simplex links

Advantage of the proposed new features:
New features validated as useful by the SpW WG

Disadvantage of the proposed new features:
Risk of limiting interoperability

Proposed changes to the SpaceWire specification

A new revision of ECSS SpaceWire standard:
• Revised scope (removals and additions) and technical choices
• Written according to new ECSS writing rules
• Requirement based: each clause shall be a requirement
• Clear distinction between requirements ("normative") and text ("informative")

Benefits of the proposed changes to the SpaceWire specification:
• Better readability
• Ambiguities removed leading to better interoperability
• New features validated as useful by the SpW WG

Impact of the proposed changes to the SpaceWire specification:
• New features introduce the risk of limiting interoperability

Discussion by the SpaceWire Working Group

Many members of the Working Group first understood that the discussion at that stage was not only on the principle of revising the standard but also on the content of the revision, without having seen any input about this content. So they were first reluctant to agree. Once the issue was clarified, the Working Group agreed that the standard should be revised both to remove ambiguities and to introduce new features.
The Working Group agreed however that the revision of the standard should be performed in two steps:
• First the current standard should be rewritten in line with the new ECSS drafting rules while removing errors and ambiguities at the same time.
• In a second step the additional features should be included in the revised document.
Moreover, the Working Group agreed that ECSS public review of the revised standard should take place only after breadboarding of disambiguated features and new features.
The Working Group requested a clear definition of "backward compatibility" and "interoperability".

Following request for clarification, the Working group acknowledged that the disambiguation of the current standard and the addition of new feature do not target higher performance.

Disposition of the SpW Working Group

Disposition:

The standard ECSS-E-ST-50-12C should be revised into ECSS-E-ST-50-12D, both to remove ambiguities and to introduce new features, provided that they are backward compatible. The revision of the standard will be performed in two steps:

• First the current standard will be rewritten in line with the new ECSS drafting rules while removing errors and ambiguities at the same time.

• In a second step the additional features will be included in the revised document.

Classification of disposition:

Consolidated

1.2 Alignment with OSI model and general computer networks terminology

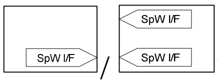
Input Change Requests (see Annex 1 below)

Change Requests number 2, 3, 4, 11, 94 and 99

1.2.1 Clarify definition of "nodes"

Issue

Many SpaceWire users have identified some ambiguity in the definition of node. Considering the generic example of SpaceWire network shown in Figure 1, the recurring questions are the following ones:

- Is a SpaceWire node ?
- Or is it ?

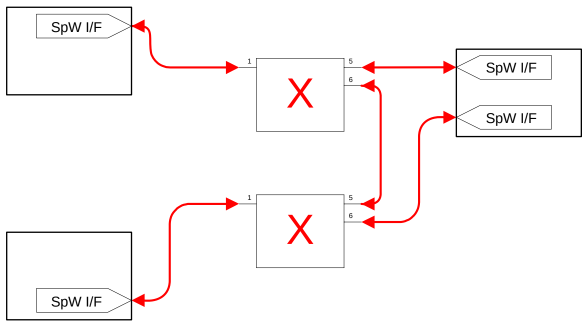
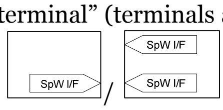
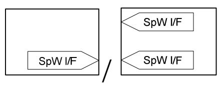


Figure 1 - Generic example of SpaceWire network

In the telecom/computer networks terminology,  is a "terminal" (terminals and routers/switches are "nodes" of the network, as opposed to "links" of the network) while  is not defined since it is not part of the protocol stack.

Note that however higher level protocols such as SpW-PnP might need the definition of .

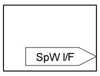
Proposed changes to the SpaceWire specification

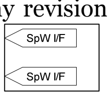
Clarify the definition of nodes

• How to clarify it is still an open point

Discussion by the SpaceWire Working Group

The Working Group agreed on some confusion related to the definition of the nodes. Indeed, some requirements in ECSS-E-ST-50-12C refer to the term "node" as some electronic module or unit (comprising one or several SpW interfaces)[1] while other requirements refer to the term "node" as a set of SpW interfaces without any host[2].

The Working Group almost reached an agreement on the fact that the definition itself of "node" in ECSS-E-ST-50-12C is not precise and consistent enough.
A few Working Group members proposed that the definition remain because it is clear enough.
Others proposed that a "node" is associated to a single configuration port. But then, the routers are nodes or contain a node[3].
Most members claimed that the terms "port", "link", interface", "router", "node", "end-point", etc. must be clarified before any revision of the standard can take place. It was pointed out that the 1553 standard does not define 

/ 

but only 

, and that it is called "Remote Terminal". A few members defined "nodes" as network end-points, i.e. 

. It was suggested to try and align to "the outside world", i.e. the telecom & computer networks community, to define the terms of the SpaceWire standard, in order to attract more than repel experts and users from this larger community. But it was opposed to this that the definitions in the telecom & computer networks community are not uniform and consistent. Other members suggested that, if the definitions need any update, the changes are the minimum required for clarification, even if the terms are defined fairly differently than in "the outside world".

Disposition of the SpW Working Group

Disposition:
The terms "port", "link", interface", "router", "node", "end-point", etc. w.r.t. SpaceWire must be clarified as part of the revision of the standard.

Classification of disposition:
Consolidated disposition by SpW WG

1.2.2 Adding routing capability to nodes

Issue

In the ECSS-E-ST-50-12C Standard, "routers" (switches) can switch packets while "nodes" (terminals) cannot.

Advantage of the current situation:

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[1] In definition clause 3.2.46 the node is defined as "source or destination of a packet, which can be a processor, memory unit, sensor, EGSE or some other unit connected to a SpaceWire network". This implies that nodes do not interface hosts but include them.
This definition is confirmed by the following excerpts of the standard:
Clause 8.12.2a "Each node or router shall contain one six-bit time counter." Implies that the node includes the host, where the counter will be.
This definition also confirmed by the many clauses that put some behavioural requirement on "nodes" in terms of packet level synchronisation ().
However, this definition is infirmed by the following excerpts of the standard:
The definition of "destination" (3.2.18) as "node or unit that a packet is being sent to" implies that a node is not a unit.

[2] In clause 10.3 (normative), the SpaceWire node is specified differently:

a. A SpaceWire node shall comprise one or more SpaceWire link interfaces (encoder-decoders) and an interface to the host system.
NOTE A SpaceWire node represents an interface between a SpaceWire network and an application system using the network services.
b. A SpaceWire node shall accept a stream of packets from the host system for transmission or provide a stream of packets to the host system after reception from the SpaceWire link, or do both.

This implies that nodes do not include hosts but interface them. This definition is confirmed by the following excerpts of the standard:
Clause 7.7d "Only one node in a SpaceWire network should have an active TICK_IN signal." implies that a node is a SpW link interface only. If it included the host, then having only one host asserting a TICK_IN signal could still result in several Time-Codes being sent simultaneously if this host has several SpW link interfaces. This is confirmed by clause 8.12.2b "A single link interface shall manage the distribution of time.".
[3] In definition clause 3.2.46 the node is defined as "source or destination of a packet,[…]" A configuration port 0 in a router is surely the destination of packets, namely configuration packets.

• Complies with OSI model and general computer networks terminology, and is therefore intuitive to most users

Disadvantage of the current situation:
• Does not unify routers and nodes (unifying routers and nodes may solve the problem of the definition of "nodes")

Proposed changes to the SpaceWire specification – Option 1
Add routing capability to nodes

Benefits of the proposed changes to the SpaceWire specification:
• Unifies routers and nodes
• Makes SpW-SMCS and other devices compliant to new standard

Impact of the proposed changes to the SpaceWire specification:
• Does not comply with OSI model and general computer networks terminology
• Does mix protocol layers

Proposed changes to the SpaceWire specification – Option 2
None

Benefits of the proposed changes to the SpaceWire specification:
• Complies with OSI model and general computer networks terminology
• Does not mix protocol layers

Impact of the proposed changes to the SpaceWire specification:
• Does not make SpW-SMCS and other devices compliant to new standard

Discussion by the SpaceWire Working Group
The Working Group agreed that this issue is in fact part of the (re)definition of "nodes" as well as terms "port", "link", interface", "router", "end-point", etc.

Disposition of the SpW Working Group
Disposition:
Decide to provide routing capability to nodes or not in the frame of the (re)definition of the terms "port", "link", interface", "router", "node", "end-point", etc.

Classification of disposition:
Consolidated disposition by SpW WG

1.2.3 Protocol description formalism

Issue
The ECSS-E-ST-50-12C Standard
–describes protocol "levels" that are not aligned with OSI,
–mixes the description of syntax, synchronisation, semantics, Service Access Points.

Advantage of the current situation:
• Facilitates first understanding of the major features of SpaceWire

Disadvantage of the current situation:
• Increases the risk of ambiguities when it comes to detailed understanding and implementation

Proposed changes to the SpaceWire specification – Option 1
Keep as is

Benefits of the proposed changes to the SpaceWire specification:
• Facilitates first understanding of the major features of SpaceWire

Impact of the proposed changes to the SpaceWire specification:
• Keeps the risks of ambiguities when it comes to detailed understanding and implementation

Proposed changes to the SpaceWire specification – Option 2
Align protocol description to OSI model and explicitly describe syntax, synchronisation, semantics, and Service Access Points.

Benefits of the proposed changes to the SpaceWire specification:
• Complies with OSI model and general computer networks terminology
• Reduces the risks of ambiguities when it comes to detailed understanding and implementation

Impact of the proposed changes to the SpaceWire specification:
• Major re-writing/reorganisation of the document (which will be necessary anyway to comply to ECSS new writing rules)

Discussion by the SpaceWire Working Group

The Working Group confirmed that there was some (minor) mixing/overlap between layers in the current standard. They also expressed their wish to keep the overall layering as it is but to have the Service Access points clearly defined.

Disposition of the SpW Working Group

Disposition:
Keep the overall layering as it is but remove any kind of (minor) mixing/overlap between layers in the current standard and clearly define Service Access Points

Classification of disposition:
Consolidated disposition by SpW WG

1.3 Streamlining references to other standards

Input Change Requests (see Annex 1 below)

Change Requests number 5, 6 and 22

Issue 1

The ECSS-E-ST-50-12C Standard refers in a few places (informative) to ECL and PECL although these technologies are not used on board any more.

Advantage of the current situation:
• None identified

Disadvantage of the current situation:
• ECL and PECL are not used for on-board data systems nor for ground applications. These references are misleading.

Issue 2

The ECSS-E-ST-50-12C Standard refers in a few places (informative) to 1355-1995 as the source of LVDS specification although section 1 providing the normative reference and section 4.3.2 related to SpW LVDS are referring to ANSI/TIA/EIA-644 and not IEEE Standard 1355-1995.

Advantage of the current situation:
• Tribute to 1355

Disadvantage of the current situation:
• Confusing
The reference to the LVDS specification should be unique and unambiguous.

Issue 3

The ECSS-E-ST-50-12C Standard refers to section 5.3.5 of IEEE Standard 1355-1995 for the specification of the Data-Strobe encoding.

Advantage of the current situation:
• Avoids referring explicitly to the STM patents

Disadvantage of the current situation:
• Confusing
• The reference to DS encoding specification should be unique and unambiguous.

Issue 4

The ECSS-E-ST-50-12C Standard specifies that SpaceWire connectors shall be a nine contact micro-miniature D-type with solder contacts, as ESCC3401/071 or crimp contacts.

Advantage of the current situation:
• ESCC3401/071: ensure high quality soldering

Disadvantage of the current situation:
ESA project are using ESCC No. 3401/029 02B9SFR113E Microminiature MDM Flying leads as there is no qualified nine contact micro-miniature D-type with solder contacts based on ESCC3401/071.
Moreover, ESA preferred part list does not include a nine contact micro-miniature D-type with solder contacts based on ESCC3401/071.

Proposed changes to the SpaceWire specification

Remove references to ECL and PECL; remove references to 1355-1995 except in the introduction/history section; add references to the STM patents for DS encoding

Benefits of the proposed changes to the SpaceWire specification:
• Increase readability
• Remove ambiguities of references

The ECSS-E-ST-50-12C Standard should specify that SpaceWire connectors shall be a nine contact microminiature D-type with solder contacts, as ESCC3401/071 or ESCC No. 3401/029 or crimp contacts; ESCC reference should be added for crimp contacts.

Benefits of the proposed changes to the SpaceWire specification:
• Complies with ESA preferred part list
• Provides specification for crimp contacts

Note: This issue might disappear if the new standard does not specify manufacturing processes anymore (see section 3.2).

Discussion by the SpaceWire Working Group

The Working Group agreed that the LVDS specification should refer to the ANSI/TIA/EIA-644 standard only. Someone pointed out that the standard should in fact refer to the revision A of the ANSI/TIA/EIA-644 standard, namely ANSI/TIA/EIA-644-A, issued in the 1990's.
The Working Group agreed to remove references to ECL, PECL and 1355-1995, especially in the normative parts of the standard.
For the DS encoding, it was clarified that the STM patents cannot serve as specification because patents do not comprehensively describe techniques, but only the innovative concept supporting them. The Working Group agreed to keep the description of the DS encoding as part of the SpaceWire standard, unless it is shown that a better description can be found elsewhere.
The Working Group did not express any opinion on the issue of the connector and the soldering and crimping standards.

Disposition of the SpW Working Group

Disposition:
Remove references to ECL, PECL and 1355-1995, especially in the normative parts of the standard.
Keep the description of the DS encoding as part of the SpaceWire standard, unless it is shown that a better description can be found elsewhere.

Classification of disposition:
Consolidated disposition by SpW WG

Note: The issue of the connector and the soldering and crimping standards is still open. This issue might disappear if the new standard does not specify manufacturing processes anymore (see section 3.2).

2 EDITORIAL COMMENTS

Input Change Requests (see Annex 1 below)

Change Requests number 8, 9, 42, 43, 50, 57, 59, 68, 72, 73, 74, 75, 76, 77, 78 and 79

Issue

A number of the editorial change requests deal with issues that might be revisited (e.g. Time-Codes and their handling) so there is no point addressing them at this stage.
Most of the editorial change requests are not controversial so they do not require technical any debate.

Proposed changes to the SpaceWire specification

Postpone processing of these change requests until major technical issues have been agreed

Benefits of the proposed changes to the SpaceWire specification:
• More efficient standard update process

Discussion by the SpaceWire Working Group

The Working Group agreed to postpone processing of editorial comments until major technical issues have been agreed.

Disposition of the SpW Working Group

Disposition:
Postpone processing of editorial comments until major technical issues have been agreed

Classification of disposition:
Consolidated disposition by SpW WG

3 PHYSICAL LAYER DESCRIPTION REDUCED SPECIFICATION OF TO ELECTRICAL SIGNALS

3.1 New shielding and grounding schemes

Input Change Requests (see Annex 1 below)

Change Requests number 23, 24, 25, 26, 27, 28, 30 and 31

Issue

The ECSS-E-ST-50-12C Standard specifies that inner shields connected to transmit end only.
Advantage of the current situation:
Simple and symmetric scheme

Disadvantage of the current situation:
Provides electrostatic screen, but inefficient at higher frequencies (>1MHz); SpaceWire operates at much higher frequencies up to 100MHz data rate, fast signal edges (~1ns R/F times).
Does not allow SpW cable extension (e.g. board-to-box + box-to-box + box-to-board)

Proposed changes to the SpaceWire specification

Change connection of inner shields:
• Low impedance bond at both ends to connector back shell / chassis
• Leave pin 3 unconnected.
• A drain wire could potentially be used (TBC)
With view towards a change of cable specification because not all applications need double shielded SpaceWire cable. Selection of cable depends on:
• Mission EMI/EMC requirements
• Space Craft grounding scheme.

Benefits of the proposed changes to the SpaceWire specification:
• Improve the EMC protection in the 100MHz range
• Allow SpW cable extension (e.g. board-to-box + box-to-box + box to board)

Note: These are preliminary recommendations. More consolidated proposal will follow the outcome of currently running ESA R&D activities including breadboarding.

Discussion by the SpaceWire Working Group

The Working Group agreed that the grounding scheme needs to be changed and can be changed while ensuring backward compatibility. They did not agree on changes to be applied. Someone recommended not using the drain wire because it adds capacitive inductance.

Disposition of the SpW Working Group

Disposition:
Redesign the grounding scheme in the frame of the global reflection on the SpaceWire cable assembly (section 3.2) and taking into account the results of the ESA study "Low-mass SpaceWire cable" currently ongoing.

Classification of disposition:
Consolidated disposition by SpW WG

3.2 Physical channel (cable assembly)

Input Change Requests (see Annex 1 below)

Change Requests number 39 and 40

The discussion on physical channel addresses two aspects: the cable and the connector.

3.2.1 Cables

Input Change Requests (see Annex 1 below)

Change Requests number 12, 13, 14, 33, 15, 16, 17, 18, 19 and 20

Issue

The ECSS-E-ST-50-12C Standard gives detailed specification on the construction of the SpaceWire cable

Advantage of the current situation:
–Specification can be delivered directly to a manufacturer to produce a compliant cable.
–The specified cable was tested for high data rate (400 Mbps), high EMC and high radiation environment and can therefore suit most ground and space needs in this respect.

Disadvantage of the current situation:
The cable may be heavier and more rigid than necessary for shorter cable lengths or for lower radiation environment or for lower data rates. It might be too fragile for other applications (e.g. launchers).

Proposed changes to the SpaceWire specification – Option 1

Specify electrical parameters verifiable by measurement rather than detailed cable construction

Benefits of the proposed changes to the SpaceWire specification:
Allows for improvement of SpaceWire cable mechanical properties while keeping the electrical parameters standardised
– E.g. lower mass cables
– E.g. more flexible cables or more robust cables
– E.g. more affordable cables
The resulting cables are expected to cope with high data rate (400 Mbps), high EMC and high radiation environment and will therefore suit most ground and space needs in this respect.

Impact of the proposed changes to the SpaceWire specification:
• The quality of each cable will still have to be tested for space missions (specification is not enough).
• Mechanical improvements will be limited by high quality electrical requirements.
• May lab cables and some flight cable will deviate form the standard.

Note:
The ECSS standard on 1553 bus only addresses higher layers of the protocol, relying on MIL-1553B standard for the lower layers, but the MIL-1553B standard does specify properties of the electrical signals, not cables.
The ECSS standard on CAN does also specify properties of the electrical signals, not cables.
The ECSS standard on Discrete Interfaces does also specify properties of the electrical signals, not cables.
For ground applications, various qualities of USB or HDMI cables are available to suit the needs of various users. Ethernet can be carried on low-cost cables like Unshielded Twisted Pair (UTP) or higher-cost ones like Shielded Twisted Pair (STP or STP-A), Screened unshielded twisted pair (S/UTP) also known as Foiled Twisted Pair (FTP), Screened Shielded Twisted Pair (S/STP or S/FTP), etc. depending on the quality required (e.g. Gbit Ethernet).

Proposed changes to the SpaceWire specification – Option 2

Not to specify any cable

Benefits of the proposed changes to the SpaceWire specification:

Allows for different SpaceWire cables fulfilling different requirements
– E.g. wide-range-of-mass cables (on-board, lab)
– E.g. wide-range-of-flexibility cables (different on-board configurations, lab)
– E.g. wide-range-of-price cables (on-board, lab)
Allows for improvement of SpaceWire cable mechanical properties for the same electrical parameters (identical as option 1)

Impact of the proposed changes to the SpaceWire specification:
• The quality of each cable will still have to be tested for space missions (specification is not enough).
• Mechanical improvements will be limited by high quality electrical requirements.
• May lab cables and some flight cable will deviate form the standard.

Provide the specification of several cables in the SpW Handbook or as an annex

Benefits of the proposed addition to the SpaceWire handbook:
• Allows users to quickly procure cables for non-specified SpaceWire links
• Reduces cable screening process at mission level

3.2.2 Connectors

Input Change Requests (see Annex 1 below)
Change Request number 21

Issue
The ECSS-E-ST-50-12C Standard gives detailed specification on the SpaceWire connector.

Advantage of the current situation:
Mechanical and pin allocation enforced compatibility allows for interoperability.
Electrical properties of the chosen connector allow for up to 400 Mbps data rate.

Disadvantage of the current situation:
The connector may be heavier and more bulky than necessary for some missions; it may be too fragile for others.
Multi-purpose high-pin-count connectors are not allowed, although they are widely used on board spacecraft.

Proposed changes to the SpaceWire specification – Option 1
Specify only the type, pin allocation and some TBD electrical properties of the connector. One or two additional connector types could be selected and included in the standard to serve special needs which can not be well covered by the current connector.

Benefits of the proposed changes to the SpaceWire specification:
• Keeps forced interoperability at mating level (with some flexibility/risk if one or two additional connector types would be added)
• Allows for improvement of SpaceWire connector(s) mechanical properties (other than shape and pin allocation) for the same electrical parameters

Limitations of the proposed changes to the SpaceWire specification:
• Potential for mechanical improvement is very limited so the connector(s) may still be heavier and more bulky than necessary for some missions; it may still be too fragile for others. This limitation would be partilally leviated by introducing one or two additional connector types)
• Multi-purpose high-pin-count connectors are still not allowed, although they are widely used on board spacecraft.
• Many space missions will deviate from the standard.

Note:
The ECSS standard on 1553 bus only addresses higher layers of the protocol, relying on MIL-1553B standard for the lower layers but the MIL-1553B standard does specify properties of the electrical signals, not connectors.
The ECSS standard on CAN does also specify properties of the electrical signals, not connectors.
The ECSS standard on Discrete Interfaces does also specify properties of the electrical signals, not connectors.
For ground applications, various forms and qualities of USB or HDMI cables are available to suit the needs of various users.

Proposed changes to the SpaceWire specification – Option 2
Not to specify any connector

Benefits of the proposed changes to the SpaceWire specification:
• Allows for different SpaceWire connectors adapted to different cables and fulfilling different requirements
– E.g. wide-range-of-mass connectors (on-board, lab)
– E.g. wide-range-of-flexibility connectors (different onboard configurations or stress levels, Multi-purpose high-pin-count, lab)
– E.g. wide-range-of-price connectors (on-board, lab)
• Allows for improvement of SpaceWire connector mechanical properties for the same electrical parameters
• Allows for improvement of SpaceWire connector electrical properties for the same shape and pin allocation

Provide the specification of several connectors (these shall obviously include the current SpW connector) and provide guidelines (e.g. impedance matched to allow for higher signalling rate) in the SpW Handbook or as an annex

Benefits of the proposed addition to the SpaceWire handbook:
• Allows users to quickly procure cables assemblies for non-specified SpaceWire links
• Allows skipping connector screening process at mission level
• One example would be a Twinax assembly
• In addition miniaturised connectors such as nano-D may be considered as suitable alterative connector -> serve e.g. rover missions such as Exomars.

3.2.3 Physical channel (cable assembly) disposition

Proposed changes to the SpaceWire specification – ESA preferred option

Specify only the type and pin allocation of the connector; and electrical properties of the cable assembly. Consider one or two additional complementary connector types for inclusion in the standard.

Benefits of the proposed changes to the SpaceWire specification:
• Keeps forced interoperability at mating level (with some flexibility/risk if one or two additional connector types would be added)
• The resulting cable assemblies are expected to cope with high data rate (400 Mbps), high EMC and high radiation environment and will therefore suit most ground and space needs in this respect.
• Allows for improvement of SpaceWire cable assembly mechanical properties (other than shape and pin allocation) for the same electrical parameters

Impact of the proposed changes to the SpaceWire specification:
• Potential for mechanical improvement is very limited so the cable assembly may still be heavier and more bulky than necessary for some missions; it may still be too fragile for others.
• Multi-purpose high-pin-count connectors are still not allowed although they are widely used on board spacecraft.
• The quality of each cable assembly will still have to be tested for space missions (specification is not enough).
• Many space missions will deviate from the standard.

Discussion by the SpaceWire Working Group

A few members confirmed that many missions already deviate from the cable assembly specification of SpaceWire and challenged the need for such a specification. However, there was no support of the majority of the Working Group for removing the cable assembly specification from the SpaceWire standard.

Disposition of the SpW Working Group

Disposition:
Follow ESA-preferred option.

Classification of disposition:
Consolidated disposition by SpW WG

3.3 Backplanes

Input Change Requests (see Annex 1 below)

Change Request number 32

Issue

The ECSS-E-ST-50-12C Standard provides very little requirements on PCB and backplane tracks. It does not specify inter-PCB connectors.

Advantage of the current situation:

• Freedom of implementation allows adapting to specific mechanical constraints.

Disadvantage of the current situation:
• Lack of specification has lead to performance issues.
• Different implementations will also result in difficult interoperability of unit/device vendors.

Proposed changes to the SpaceWire specification – Option 1

Specify the type and pin allocation of PCB connectors; and electrical properties of the PCB-to-PCB backplane connection.

Benefits of the proposed changes to the SpaceWire specification:
• Keeps forced interoperability at mating level
• The resulting PCB-to-PCB backplane connection are expected to cope with high data rate (400 Mbps), high EMC and high radiation environment and will therefore suit most ground and space needs in this respect.
• Allows for improvement of SpaceWire PCB-to-PCB "cable" assembly mechanical properties (other than shape and pin allocation) for the same electrical parameters

Limitations of the proposed changes to the SpaceWire specification:
• Potential for mechanical improvement is very limited so the backplane connection may still be heavier and more bulky than necessary for some missions; it still may be too fragile for others.
• The quality of each PCB-to-PCB backplane connection will still have to be tested for space missions (specification is not enough).
• Many space missions will deviate from the standard.

Proposed changes to the SpaceWire specification – Option 2

Remove any requirement regarding backplanes but document backplane-related hints and advice in the SpaceWire Handbook

Benefits of the proposed changes to the SpaceWire specification:
• Allows for improvement of SpaceWire backplane mechanical properties for the same electrical parameters
• Allows for different SpaceWire backplane technologies adapted to different units and fulfilling different requirements
– E.g. FLEX (flexible board) for PCB-to-PCB SpW links
– E.g. use of multi-layer boards

Proposed changes to the SpaceWire specification – ESA preferred option

Specify the type and pin allocation of PCB connectors; and electrical properties of the PCB-to-PCB backplane connection

Benefits of the proposed changes to the SpaceWire specification:
• Keeps forced interoperability at mating level
• The resulting PCB-to-PCB backplane connection are expected to cope with high data rate (400 Mbps), high EMC and high radiation environment and will therefore suit most ground and space needs in this respect.
• Allows for improvement of SpaceWire PCB-to-PCB "cable" assembly mechanical properties (other than shape and pin allocation) for the same electrical parameters
Limitations of the proposed changes to the SpaceWire specification:
• Potential for mechanical improvement is very limited so the cable assembly may still be heavier and more bulky than necessary for some missions; it still may be too fragile for others.
• The quality of each PCB-to-PCB backplane connection will still have to be tested for space missions (specification is not enough).
• Many space missions will deviate from the standard.

Note:.ESA is initiating a study to investigate and select a suitable backplane connector type. The availability of the study results shall not delay the update of the standard.

Discussion by the SpaceWire Working Group

It was agreed that it would be good to specify a backplane connector in the standard but more information on the proposed connector is needed to make a final disposition.
A few members confirmed that standardising the inter-PCB physical channel would be useful. This was not confirmed by the whole Working Group.
Overall, there was no strong motivation amongst the whole Working Group in favour of changing the current physical channel specification for backplanes in the SpaceWire standard.

Disposition of the SpW Working Group

Disposition:

Follow the ESA-preferred option.

Classification of disposition:
Preliminary disposition - pending a detailed proposal of the backplane connector

4 CHARACTER LEVEL (PHYSICAL LAYER) - DATA RATE

4.1 Minimum data rate

Input Change Requests (see Annex 1 below)

Change Requests number 36

Issue

The ECSS-E-ST-50-12C Standard specifies the minimum data rate as 2Mbps (physical limitation being 1.18Mbps).

Advantage of the current situation:
• Allows for low power communication
• Allows for low EMC creation.

Disadvantage of the current situation:
• Implementations experience difficulties to comply, especially when switching from 10Mbps to 2Mbps (limiting min to 4Mbps would help).

Proposed changes to the SpaceWire specification

Keep 2Mbps (links do not have to switch directly from 10Mbps to 2Mbps)

Benefits of keeping the current SpaceWire specification:
• Backward compatibility
• Allows for low power communication
• Allows for low EMC creation

Note: ESA position could be reconsidered if a majority of the WG supports the change.

4.2 Starting data rate

Input Change Requests (see Annex 1 below)

Change Requests number 41

Issue

The ECSS-E-ST-50-12C Standard specifies the starting data rate as (10+/-1) Mbps

Advantage of the current situation:
• Provides all systems with a common, slow, initial data signalling rate so that system operation can be validated before switching to higher and possibly widely different data signalling rates

Disadvantage of the current situation:
• Prevents implementing low data-rate-only interfaces (<10 Mbps) e.g. slow-clocked very-low-power interfaces
• When the link is running at regular rate of hundreds of Mb/s, restarting the link starting at 10 Mb/s after every detected error and then moving to the regular for this link rate causes unreasonable delays and gaps in information flow.

Proposed changes to the SpaceWire specification – Option 1

Keep 10Mbps

Benefits of the proposed changes to the SpaceWire specification:
• Backward compatibility
• Provides all systems with a common, slow, initial data signalling rate so that system operation can be validated before switching to higher and possibly widely different data signalling rates

Proposed changes to the SpaceWire specification – Option 2

Do not specify any starting data rate (smart vendors will most likely offer some step-by-step downwards connection attempting scheme; to be added in the SpW Handbook)

Benefits of the proposed changes to the SpaceWire specification:

• Smart systems will implement a common, slow, initial data signalling rate
• Allows implementing low data-rate-only interfaces (<10 Mbps) e.g. slow-clocked very-low-power interfaces
• Allows restating a link at maximum data rate in order to minimise delays, gaps in information flow

Proposed changes to the SpaceWire specification – ESA preferred option

Keep 10Mbps

Benefits of the proposed changes to the SpaceWire specification:

• Backward compatibility
• Provides all systems with a common, slow, initial data signalling rate so that system operation can be validated before switching to higher and possibly widely different data signalling rates

Note: ESA position could be reconsidered if a majority of the WG supports the change.

4.3 Maximum data rate

Input Change Requests (see Annex 1 below)

Change Requests number 37

Issue

The ECSS-E-ST-50-12C Standard does not specify the maximum data rate

Advantage of the current situation:

Allows for maximum data rate that implementations can achieve

Disadvantage of the current situation:

None

Proposed changes to the SpaceWire specification

Keep it as it is, removing the clause “a. The maximum data signalling rate shall be defined.” because it does not bring any benefit

Benefits of the proposed changes to the SpaceWire specification:

Allows for maximum data rate that implementations can achieve

4.4 Negotiating data rate

Input Change Requests (see Annex 1 below)

Change Requests number 38

Issue

The ECSS-E-ST-50-12C Standard does not any mechanism for data rate negotiation.

Advantage of the current situation:

Keeps the protocol simple

Disadvantage of the current situation:

Does not provide any mechanism for data rate negotiation

Proposed changes to the SpaceWire specification

Keep it as it is, describing in the Handbook that data rate negotiation can be done at application level and may be included in SpW-PnP.

Benefits of the proposed changes to the SpaceWire specification:

• Keeps the protocol simple
• Backward compatibility

4.5 Character level (Physical layer) - Data rate disposition

Discussion by the SpaceWire Working Group

The Working Group confirmed the necessity to be able to run SpaceWire at very low data rate (2 Mbps) and recalled that

- links do not *have* to run at 2Mbps
- switching a link 10Mbps to 2Mbps can be done gradually to avoid signal synchronisation problems

A few members suggested that he starting data rate could be variable between 2Mbps and 10Mbps; others to keep the 10Mbps with a permission to deviate. But some members argued that staring at a lower rate than 10Mbps is not compatible with the current SpaceWire state machine.

Overall, there was no strong motivation amongst the whole Working Group in favour of changing the current specification for starting- and minimum data rate in the SpaceWire standard.

The Working Group agreed that there should not be any maximum data rate and that any data rate negotiation would imply unacceptable modifications to the SpaceWire state machine.

Disposition of the SpW Working Group

Disposition:

Keep the specification of data rates as it is, keeping the maximum data rate open.

Classification of disposition:

Consolidated disposition by SpW WG

5 UPDATE BEHAVIOUR OF NODES/TERMINALS

5.1 Add configuration port in nodes

Input Change Requests (see Annex 1 below)

Change Requests number 95

Issue

The ECSS-E-ST-50-12C Standard foresees a configuration port (address 0) for routers but not for nodes.

Advantage of the current situation:

Keeps the point-to-point protocol simple (possibly no header)

Disadvantage of the current situation:

Does not allow for interface configuration through the link (implemented in SMCS devices via custom protocol)

Does not allow for simple automatic discovery of nodes

Proposed changes to the SpaceWire specification

Introduce configuration port 0 for nodes

Benefits of the proposed changes to the SpaceWire specification:

• Allows for interface configuration through the link (implemented in SMCS devices via custom protocol)

• Allows for automatic discovery of nodes

Impact of the proposed changes to the SpaceWire specification:

• The leading logical address must be made mandatory (as in the PID protocol ECSS-E-ST-50-51C), at least for nodes which contain a configuration port.

• Forbids logical address mapping to port 0 in routers (already in ECSS-E-ST-50-12C)

Open point:

• Should we include the whole PID into the SPW standard?

Discussion by the SpaceWire Working Group

After some technical discussion, the Working Group acknowledged that the introduction of a single port 0 for each node implies making mandatory the leading logical address, as in the PID protocol (ECSS-E-ST-50-51C).

The Working Group discussed extensively the necessity and impact of such a change. In particular, the necessity of a leading 0 to support Plug-And-Play was discussed. The discussions did not converge because it raised again the issue of the definition of "nodes" (see section 1.2.1).

The Working Group agreed that no conclusion could be reached on this point, first because it was linked to the clarification of the definition of "nodes"; and second because the main stake-holders (mainly NASA and University of St Petersburg) were not present.

Disposition of the SpW Working Group

Disposition:
Decide to assign a single configuration port to each node or not in the frame of the consolidation of the terms "port", "link", interface", "router", "node", "end-point", etc.

Classification of disposition:
Preliminary disposition – needs to be re-discussed when all stakeholders are present.

5.2 Nodes shall discard packets with unexpected destination address

Input Change Requests (see Annex 1 below)
Change Requests number 98, 100

Issue
The ECSS-E-ST-50-12C Standard does specify that nodes shall discard packets with unexpected destination address.

Advantage of the current situation:
Was considered as the best way to deal with packets containing a logical addresse that does not belong to the receiving node.

Disadvantage of the current situation:
RMAP foresees a response to an invalid Logical Address.

Proposed changes to the SpaceWire specification
Remove the requirement on nodes and replace it with a "may" to remind the user that it is a valid option

Benefits of the proposed changes to the SpaceWire specification:
• Make SpaceWire compliant with RMAP

Discussion by the SpaceWire Working Group
The Working Group first clarified that the requirement to be changed was in fact not 11.3.4 but 10.5.4.3 and that the issue is that the ECSS-E-ST-50-12C Standard DOES specify that nodes shall discard any packet with unexpected Logical Address (routers shall also reject packets with unexpected Logical Address but this is fair, since an "unexpected Logical Address" for a router means a Logical Address for which there is no entry in the local routing table).
Then, the Working Group agreed that packets with unexpected Logical Addresses should sometimes be accepted at node level, RMAP being an example.

Disposition of the SpW Working Group

Disposition:
Replace the requirement on nodes to discard packets with unexpected Logical Address with a permission to do so.

Classification of disposition:
Consolidated disposition by SpW WG

6 TIME-CODE MASTER: ONE OR MORE?

Input Change Requests (see Annex 1 below)
Change Requests number 44 and 69

Issue

The ECSS-E-ST-50-12C Standard covers the time distribution in chapters 7 and 8. In clause 7.7 d it is stated that "Only one node in a SpaceWire network should have an active TICK_IN signal." In clause 8.12.2 b it is required that "A single link interface shall manage the distribution of time."

Advantage of the current situation:
None

Disadvantage of the current situation:
It is neither suitable nor feasible to restrict the time-code source to be a single link-interface. As there shall be only one time-counter in a node or router they shall be considered the source of the time-codes not a specific link interface.
Redundancy is a desired feature in a SpaceWire network and thus it should be allowed for different link interfaces on different nodes or routers to handle the distribution of time as long as they are designed on system level not to do it at the same time.

Proposed changes to the SpaceWire specification

Replace clause 8.12.2 b with the following text:
"At any moment in time there shall be only a single node or router, the time-master, managing the distribution of time.
NOTE The node or router can use different link interfaces to transmit the time-codes. This allows for redundancy if a link is broken.
NOTE It is a allowed to switch the time mastery between different nodes or routers."
A chapter in the Handbook related to best practices for the handling of time would be very beneficial to the whole SpaceWire community.

Benefits of the proposed changes to the SpaceWire specification:
• Allows implementing clock master redundancy

Impact of the proposed changes to the SpaceWire specification:
• It does not mean that the two control flags of the Time-code can be set to another value than 00 !!

Discussion by the SpaceWire Working Group

Part of the Working Group was in line with the Proposed changes to the SpaceWire specification: in favour of clarifying the standard in the direction of keeping strong requirements on the time distribution scheme, mainly to allow only one clock master at a time on the network, with the possibility to implement a cold redundant master.
The other part was in favour of allowing even more diverse types of management of Time-codes distribution, provided that the rules of Time-code propagation are followed (the time counter increment that allows Time-code broadcast while discarding spurious Time-codes).
The Working Group could did not reach any fine agreement on this issue, mainly because they were not able to decide if the management of Time-code distribution is part of or beyond the scope of the currently defined SpaceWire levels (and would therefore be application-dependant). As a compromise between the two views, it was proposed that a number of time distribution schemes could be specified as SpaceWire higher layer protocols..

Specific issue of the two Control Flags

It was clarified during the discussion that, while being related to the use of multiple time masters in a SpaceWire network, Change request 45 was in fact more precisely dealing with a syntactic issue: Are "Time-Codes" with control flags different than 00 allowed? Are they actually Time-Codes or different codes?

Although clause 7.7h (p56) states that "The two control flags are reserved for future use and shall both be set to zero.",

- NOTE 2 of clause 7.3c (p53) states that "The Time-Code is used to distribute system time information (see clause 8.12) and control flags isochronous with the time-code distribution." and
- clause 7.3d (p53) states that "the two most significant bits (T6, T7) shall contain control flags that are distributed isochronously with the Time-Code."

Although NOTE of clause 7.7f (p56) states that "The other two bits of the time output are the two control-flag outputs and are reserved for future use.",

- NOTE of clause 7.7g (p56) states that "The other two bits of the time input are the two control-flag inputs and are reserved for future use.",
- Clause 7.7a states that "a. The time interface to the host system shall comprise two signals, TICK_IN and TICK_OUT, a six-bit time output port, a six-bit time input port, a two-bit control flag input port and a two-bit control flag output port."

This ambiguity has lead to different hardware implementations. The Working Group therefore could not agree on a common way to clarify the standard.

Disposition of the SpW Working Group on multiple time masters

Disposition:

Agreement on the "Proposed changes to the SpaceWire specification" as a baseline. Continue debating the issue for further refinement.

Classification of disposition:

No (final) disposition could be agreed upon (but agreement on a baseline)

Disposition of the SpW Working Group on the use of the Control Flags

Disposition:

Continue debating the issue.

Classification of disposition:

No disposition could be agreed upon

7 INTRODUCTION OF BACKWARD COMPATIBLE SIGNALLING CODES

7.1 Backward compatibility with Time-codes

Input Change Requests (see Annex 1 below)

Change Requests number 44 and 45

Issue

On one hand, the ECSS-E-ST-50-12C Standard specifies in 7.3 d two control flags to be carried together with Time-codes and that are qualifying the Time-Code they are carried with. On the other hand, these control-flags are specified in 7.7 h as reserved for future use and to be both be set to zero.

Advantage of reserving the 01, 10 and 11 flags:

Allows introducing in the future some new type(s) of signalling codes which have the same properties as Time-codes (broadcast, low-latency, carrying 6-bit information)

Disadvantage of reserving the 01, 10 and 11 flags:

The Time-Codes cannot carry any control information because the "two most significant bits (T6, T7), [which original purpose was to] contain control flags that are distributed isochronously with the Time-Code" (ECSS-E-ST-50-12C, 7.3d), are always 00 (ECSS-E-ST-50-12C, 7.7h).

Question to the SpaceWire Working Group

If the two control flags would be set to a different value in order to implement another type of low-latency signalling code (e.g. the scheme that was proposed and discussed within the SpW WG that uses control flags 01 to allow broadcasting 32 interrupt codes and 32 corresponding acknowledgement/clear codes with the same latency as Time-codes), would the SpW Working Group regard this as backward compatible?

ESA's position:

YES

Note that it is tricky because some devices might assume that the flags are 00 but not check it. These devices will accept any signalling code with different control flags as Time-codes.

Discussion by the SpaceWire Working Group

A few Working Group members where of the opinion that, according to ECSS-E-ST-50-12C clause 7.3.d, SpaceWire Time-codes are qualified by the control flags; and that major SpaceWire-enabled devices such as the RTC are supporting this feature. In spite of this Minority Report the majority of the Working Group supported the idea that some so far reserved control flags could be allocated to support new functions in the revised standard.

7.2 Interrups+ACK scheme

Input Change Requests (see Annex 1 below)

Change Requests number 86, 48, 51, 52, 53, 54, and 55

Issue

Some scheme was proposed and discussed within the SpW WG that uses control flags 01 to allow broadcasting 32 interrupt codes and 32 corresponding acknowledgement/clear codes with he same latency as Time-codes.

Advantage of the new feature:
- Allows broadcasting 32 interrupt codes with he same latency as Time-codes
- Keeps two options (of the four provided by the two control flags) reserved for future use

Limitations and disadvantage of the new feature:
- Allows broadcasting only 32 interrupt codes
- Corresponding ACK codes must be implemented as well, not really for acknowledgment but for clearing the Interrupt Source Registers in the routers and nodes..
- The concept of acknowledgement (high reliability, high latency) is not consistent with the one of interrupt (low reliability, low latency).
- The minimum duration between two similar interrupts is bounded by the ACK mechanism time.

Proposed changes to the SpaceWire specification – Option 1

Introduce Distributed Interrupts as documented (Distributed Interrupts in SpaceWire Networks - Dec 2006, Sheynin)

Benefits of the proposed changes to the SpaceWire specification:
• Allows broadcasting 32 interrupt codes with he same latency as Time-codes
• Keeps two options (of the four provided by the two control flags) reserved for future use

Limitations and impact of the proposed changes to the SpaceWire specification:
• Corresponding ACK codes must be implemented as well, not really for acknowledgment but for clearing the interrupts.
• The concept of acknowledgement (high reliability, high latency) is not consistent with the one of interrupt (low reliability, low latency).
• The minimum duration between two similar interrupts is bounded by the ACK mechanism time.

Proposed changes to the SpaceWire specification – Option 2

Extend the concept to multi-purpose low-latency signalling codes that could be used for the distribution of times, of interrupts, and more TBD (see details in section 7.3)

Benefits of the proposed changes to the SpaceWire specification:
• See section 7.3

Limitations and impact of the proposed changes to the SpaceWire specification:
• See section 7.3

7.3 Multi-purpose signalling scheme (allowing time codes and interrupts and more)

Input Change Requests (see Annex 1 below)

Change Requests number 46, 47, and 49

Issue

Point 1

The current Time-Code scheme does not provide the possibility to 'instantly' distribute any form of absolute time across the SpaceWire network (because the "time information value" is limited to 64 values). It provides 'instant signalling' (with some latency that can be negligible for low time-accuracy applications and bounded for high time-accuracy applications) of:
• a state (provided by one of the 64 possible "time information" values, usually value 0)
• an incremental tick (the fact that the value is incremented)
Any implementation that is trying to use the value of the Time-code to provide time information will be always limited and therefore very application specific.
• E.g. the epoch of a scheduled communication cycle will have to be 64 although the control loop might require any number of communications within a loop.

• E.g. the epoch will have to be very short (in the order of tens of microseconds) in order to allow frequent time synchronisation points, although control loops vary from 1microsecond for advanced robotics to 100ms or 125ms for spacecraft control.
• E.g. physical values such as 100ms are not easily divided by 64.

Point 2
From the point of view of the information theory, the same information can be coded on 2 bits: state and tick (e.g. the reset state is <0x> where x is either 0 or 1 depending on its previous value; and any following tick is <1x> where x is either 0 or 1 depending on its previous value; in other word, a time-code is in fact <b1, b2> where b1 is 0 in case of state reset and 1 in tick increment mode; and b2 is always flipping to indicate a new time-code)

Point 3
The 'instant signalling' of state+tick can be used to distribute time codes but also interrupts or any kind of low-latency signal

Proposed changes to the SpaceWire specification

Define the general "ESC+Data character" sequence as Signalling Codes and define Time-Codes as a sub-type of Signalling Codes.

Benefits of the proposed changes to the SpaceWire specification:
• Multi-purpose low-latency Signalling Codes can also be made backward compatible with Time-codes (like the Interrup+ACK scheme).
• They allow for the distribution of any other low latency signal.
• Each Signalling Code requires 2 bits. This leaves 6 bits that allow defining 64 Signalling codes.
• A number of them can be used as time codes
- allowing the distribution of more than one time scheme
- e.g. a 50µs time scheme as well as a 1ms time scheme and a 125ms time scheme.
• A number of them can be dedicated to interrupt distribution
- with no acknowledgement since this kind of signalling usually does not require any
- or Signalling Code <N,s,f> (where N is the 6-bit Signalling code label while s is the state bit and f is the flipping bit) can be the interrupt and Signalling Code <N+1, s,f> can be the interrupt acknowledgement if the latter is really required.

Limitations and impact of the proposed changes to the SpaceWire specification:
• The only problem of this Signalling code scheme is that it is not backward compatible with ECSS-E-ST-50-12C Time-codes. But, if we consider that, in practice, all existing implementations of SpaceWire Time-codes are using <00> as the two most significant bits ("control flags" T6 and T7), we can keep this and implement the Signalling Code concept with <01>, <10> and <11> as only possible values for T6 and T7. This leaves 2^4*3=48 possible Signalling Codes.
• The semantics of the multi-purpose low-latency signalling codes used in a system must be defined for this system. Widely used signals are likely to be standardised in the future.

7.4 Introduction of backward compatible signalling codes

Discussion by the SpaceWire Working Group

The Working Group confirmed that the Distributed Interrupts presented several times (32 Interrupt codes + 32 ACK codes) was mature enough to be introduced in the SpaceWire standard.
The Working Group also supported the extension of this scheme to more general low-latency signalling, providing that the related technical solution was mature as well. However, time did not allow discussing this alternative technical solution and this meeting was not intended for such time-consuming activity.
So the Working Group decided to postpone the decision on which scheme to adopt, until both technical solutions are thoroughly discussed and compared.

Disposition of the SpW Working Group

Disposition:
Postpone the decision on which scheme to adopt (Distributed Interrupt or general purpose Signalling Codes), until both technical solutions are thoroughly discussed and compared.

Classification of disposition:
No disposition could be agreed upon

8 INTRODUCTION OF SIMPLEX AND/OR HALF-DUPLEX

Input Change Requests (see Annex 1 below)

Change Requests number 61 and 62

Issue

The ECSS-E-ST-50-12C Standard specifies only full-duplex communication in links.

Advantage of the current situation:
• Simple and symmetric scheme
• Simple flow control mechanism using the return "link"

Disadvantage of the current situation:
• For many high speed payload data applications only a simplex connection from the instrument to the memory (data dump) is required. In these cases the back channel provided by SpaceWire is often seen as unnecessary complexity and cable mass.
• For most of high speed payload data applications only a half-duplex connection between the instrument and the memory (high data rate / non real-time data dump from instrument; low data rate / real-time command & control from the payload controller & mass memory unit) is required. In these cases the two channels provided by SpaceWire are often seen as unnecessary complexity and cable mass.

Proposed changes to the SpaceWire specification

It has been proposed to modify the SpaceWire codec and the state machine to support simplex operation. Also the possibility of a half-duplex SpaceWire implementation has been suggested.
It remains to be investigated what consequences these changes will have for the backwards compatibility of SpaceWire and if they should be included in the update of the standard.

Benefits of the proposed changes to the SpaceWire specification:
• Mass and complexity reduction for end-of-the-line devices (simplex)
• Mass and complexity reduction for end-of-the-line devices while keeping commandability (half-duplex)

Note: Another option is to standardise half-duplex and/or simplex as part of a different "SpaceWire inspired" ECSS standard.

Discussion by the SpaceWire Working Group

The Working Group acknowledged the need for simplex and/or half-duplex SpaceWire links.
On one hand the Working Group acknowledged that simplex and half-duplex have been not only presented in their main principles but also already breadboarded, leading to high confidence in the feasibility.
On the other hand, they felt the need for more detailed explanations on the mechanisms behind the technical solutions already breadboarded and the need for more analysis of the impact on the current SpaceWire standard (e.g. on the state machine).
Therefore the Working Group recommended that simplex and half-duplex are not introduced in the update of the SpaceWire standard unless more detailed explanations on the technical solution and on the impact on the current SpaceWire standard are provided very soon.

Disposition of the SpW Working Group

Disposition:
Not to introduce simplex and half-duplex in the update of the SpaceWire standard unless more detailed explanations on the technical solution and on the impact on the current SpaceWire standard are provided very soon.

Classification of disposition:
Preliminary disposition - pending further definition and breadboarding

9 MISCELLANEOUS

9.1 Misleading references to Virtual Channels

Input Change Requests (see Annex 1 below)

Change Requests number 87, 88, and 97

Issue

The ECSS-E-ST-50-12C Standard makes several informative references to the possibility to implement Virtual Channels with SpaceWire.

Advantage of the current situation:
Interesting hints

Disadvantage of the current situation:
This has created a lot of confusion and misunderstandings.

Proposed changes to the SpaceWire specification

Remove all references to Virtual Channels

Benefits of the proposed changes to the SpaceWire specification:
• Remove confusion

Impact of the proposed changes to the SpaceWire specification:
• None

Discussion by the SpaceWire Working Group

The Working Group acknowledged the confusion related to mentioning “Virtual Channels” in ECSS-E-ST-50-12C and recommended to remove all references.

Disposition of the SpW Working Group

Disposition:
Remove all references to Virtual Channels

Classification of disposition:
Consolidated disposition by SpW WG

9.2 High resolution time-synchronisation option

Input Change Requests (see Annex 1 below)

Change Request number 60

Issue

It has been proposed to implement some high resolution time broadcasting based on the use of two types of Time-codes (regular Time-codes + “delta” Time-codes).

Advantage of the new feature:
Increases the resolution of time broadcasting

Disadvantage of the new feature:
Makes use of the two reserved control flags.

Proposed changes to the SpaceWire specification

• Do not adopt
• Keep it as input to SpaceWire 2.0

Benefits of keeping the current SpaceWire specification:
• Backward compatibility

Impact of keeping the current SpaceWire specification:
• High resolution time synchronisation still missing

Discussion by the SpaceWire Working Group

The Working Group acknowledged the need for higher resolution time broadcasting but agreed that other methods are available that allow the same increase in resolution while not making use of the reserved control flags of Time-codes.

Disposition of the SpW Working Group

Disposition:
Not to adopt but to keep the proposal as input to SpaceWire 2.0

Classification of disposition:
Consolidated disposition by SpW WG

9.3 Introduce broadcast/multicast

Input Change Requests (see Annex 1 below)

Change Request number 93

Issue

The current standard specifies in 10.2.7 the possibility of "packet distribution" as a restricted form of broadcast or multicast. This feature is currently limited to connections between routers and nodes only to avoid the risk of network blockage. The change request proposes to allow this type of packet distribution also between routers but to limit it certain topologies and routing table settings. However, it is not supported with any technical proposal so far.

Advantage of the new feature:
Many applications

Disadvantage of the new feature:
- In the case of transient permanent blockage of a connection to one node the complete network could become blocked.
- The extension of multi-cat capability to the whole network probably implies non backward-compatible modifications of the Character Level

Proposed changes to the SpaceWire specification

• Do not adopt
• Keep it as input to SpaceWire 2.0

Benefits of keeping the current SpaceWire specification:
• Backward compatibility

Discussion by the SpaceWire Working Group

The "packet distribution" feature is poorly defined in the current standard (the synchronised flow control over several links is not explained).
Besides, the Working Group did not really understand the need for broadcast or multicast of packets and could not base their opinion on any technical solution presented and discussed within the Working Group.

Disposition of the SpW Working Group

Disposition:
Not to adopt but to keep the proposal as input to SpaceWire 2.0

Classification of disposition:
Consolidated disposition by SpW WG

9.4 Requirement on Regional Addressing

Input Change Requests (see Annex 1 below)

Change Request number 92

Issue

The ECSS-E-ST-50-12C Standard specifies in 10.2.3.i that "Regional addressing shall be used for larger networks with each cluster limited to a maximum of 224 logical addresses".

Advantage of the current situation:
Using regional addressing for large networks is a good hint.

Disadvantage of the current situation:
"Larger" cannot be a requirement.

Proposed changes to the SpaceWire specification

Remove clause 10.2.3i

Benefits of the proposed changes to the SpaceWire specification:

• Improves readability

Impact of the proposed changes to the SpaceWire specification:

• None

Discussion by the SpaceWire Working Group

The Working Group agreed to remove clause 10.2.3i.

Disposition of the SpW Working Group

Disposition:

Remove clause 10.2.3i

Classification of disposition:

Consolidated disposition by SpW WG

9.5 Update state machine

Input Change Requests (see Annex 1 below)

Change Requests number 65, 66, and 67

Issue

A shortcoming has been identified in the ECSS-E-ST-50-12C Standard state diagram (Figure 8-2 in section 8.5.1).

Proposed changes to the SpaceWire specification

Add requirement "always to send FCT before going to the RUN state"

Benefits of the proposed changes to the SpaceWire specification:

• Improves SpaceWire state diagram

Impact of the proposed changes to the SpaceWire specification:

• Changes the core behaviour of SpaceWire; this has a potential impact on all SpW interfaces already implemented, i.e. on all devices deployed at world level.

Discussion by the SpaceWire Working Group

Although this modification was discussed already in the SpW Working Group and was raising mostly support so far, the Working Group was reluctant to change the SpW state machine in which so much thinking was put a few years ago.

Disposition of the SpW Working Group

Disposition:

Continue debating the issue

Classification of disposition:

No disposition could be agreed upon

9.6 After reset the time-counter shall be set to zero

Input Change Requests (see Annex 1 below)

Change Requests number 80, 81, 82, and 83

Issue

The ECSS-E-ST-50-12C Standard specifies in 8.12.2 m that “After reset the time-counter shall be set to zero”.

Advantage of the current situation:

Avoids using obsolete Time-code values

Disadvantage of the current situation:
It is not advisable to reset the time-counter when one of multiple links in e.g. a router enters error-reset. Then the whole time distribution will be disturbed just because one link had a disturbance.

Proposed changes to the SpaceWire specification
Remove clause 8.12.2 m

Benefits of the proposed changes to the SpaceWire specification:
• Improves Time-code management

Discussion by the SpaceWire Working Group
The Working Group agreed that the intention was not to reset time counters if a single SpW interface is reset but only if a whole device (node or router) is reset. However, they experienced some difficulty in formalising this intention into a SpaceWire requirement and it was not clear form the discussions whether the management of time counters is part of or beyond the scope of the currently defined SpaceWire levels (and would therefore be application-dependant).

Disposition of the SpW Working Group
Disposition:
Find a way to express that the intention is not to reset time counters if a single SpW interface is reset but only if a whole device (node or router) is reset

Classification of disposition:
Consolidated disposition by SpW WG

9.7 Switching arbitration algorithm

Input Change Requests (see Annex 1 below)
Change Requests number 89.

Issue (inconsistency)
The last paragraph of section 10.1.2.9.6 specifies that "In the event of several packets competing for a set of links, subclause 10.2.5 specifies the means of arbitration when an output port becomes available, giving access to the newly freed output port to the packet with the highest priority destination address".
However section 10.2.5 specifies that "SpaceWire routing switches shall provide a means of arbitrating between input ports requesting the same output port." Therefore no specific arbitration algorithm is specified.

Proposed changes to the SpaceWire specification
Make clear that arbitration policy (at router ports) is not specified in clause 10.2.5

Benefits of the proposed changes to the SpaceWire specification:
• Improves readability

Discussion by the SpaceWire Working Group
The Working Group acknowledged that the issue is inconsistent in ECSS-E-ST-50-12C and recommended that the text should be modified in 10.1.2.9.6 to take into account that the means of arbitration (at router ports) is in fact not specified in 10.2.5.

Disposition of the SpW Working Group
Disposition:
Clarify that arbitration policy (at router ports) is not specified

Classification of disposition:
Consolidated disposition by SpW WG

9.8 Router timeout

Input Change Requests (see Annex 1 below)
Change Requests number 90 and 91

Issue

The ECSS-E-ST-50-12C Standard does not specifies that routers shall spill "still" packets after some timeout but this feature is included in the SpW-10X.

Advantage of the current situation:
• Avoids specifying a feature which is outside of the protocol stack (spilling "blocked" packets could be done in other ways, at application level)
• Timeouts are highly non-linear and their use is limited because non-deterministic.

Disadvantage of the current situation:
• Prevents autonomous spilling of "blocked" packets by the router

Proposed changes to the SpaceWire specification

Open point

Discussion by the SpaceWire Working Group

In spite of the unknown consequences of the use of timeouts at system level (high non-linearity), the Working Group agreed that the requirement for a selectable timeout in each router should be added to the SpaceWire standard because the risk of deploying timeout-less devices on the market is too high. However, the Working Group did not specify what the available values should be for the timeout, except that "infinity" (i.e. no timeout) should be allowed.

Disposition of the SpW Working Group

Disposition:
Introduce a requirement into the SpaceWire standard for a selectable timeout in each router. The possible values for these programmable time outs still have to be discussed and agreed.
Classification of disposition:
Preliminary disposition (pending further definition and verification)

9.9 State of the link interface during the spilling of a packet

Input Change Requests (see Annex 1 below)

Change Request number 96

Issue

Assume a large packet is being spilled on a SpW port. What state should the link halt in? Section 10.5.2 states that if an error is detected by either the source or destination node that the packet will be "spilled" if the pack being spilled is quite large it could take some time to rid the link of the error packet. f. Then goes on to state "the link shall not restart after an error until some N-Chars are read..." it does not state the state the SpW link should be in while/after the packet is spilled.
Should the link be in the ErrorWait state? Ready state and not send data until some N-Chars are received? (per section 8.5 figure 8-2).

Advantage of the current situation:
Change Request not understood

Disadvantage of the current situation:
Change Request not understood

Proposed changes to the SpaceWire specification

N/A

Discussion by the SpaceWire Working Group

The Working Group could not really understand the issue and the originator of the Change Request was not present to provide further explanations.

Disposition of the SpW Working Group

Disposition:
Adjourn the discussion until the issue is clarified

Classification of disposition:
No disposition could be agreed upon

9.10 Over specification of host interface

Input Change Requests (see Annex 1 below)

Change Requests number 58. 70 and 71

Issue

The ECSS-E-ST-50-12C Standard specifies in 7.6 the host interface for data characters as well as EEP and EOP. There are also some ambiguities in the definition of the time interface.

Advantage of the current situation:
The intention was to facilitate interoperability at IP level.

Disadvantage of the current situation:
It seems unnecessary to have a lot of requirements for a specific implementation. It is better to write the requirement in general terms. Otherwise it should be specified that everyone MUST use 8-bit width.

Section 8.12.2 is not clear about where a time counter is located but indicates that one should be located in each link interface. This seems not to be what was actually intended from the beginning since other descriptive parts (8.4.2) of the standard indicate that when TICK_IN is asserted then the time-code presented on a time-code input should be transmitted. This also seems to be in line with existing codec implementations such as the UoD codec. The most reasonable thing to do is to entirely skip the talk of TICK_IN and similar signals in this section and only talk about what the clause title says that is: time distribution. It is specified how the time-counter is updated and to where the new time-count shall be sent. It should not specify how the time-code is transmitted. Clause 7 specifies a signal interface for time-codes.
If one is present then a time-code should be transmitted as indicated there. Other implementations perhaps have the time distributer integrated in the link interface and does not need an external interface. Thus it is unnecessary to refer to specific signals here.

Proposed changes to the SpaceWire specification

- Streamline host interface (7.6)
- Parameters and their format should be specified, not their implementation/encoding
- Streamline Time distribution mechanism and time interface

Benefits of the proposed changes to the SpaceWire specification:
- Avoids specifying features which are outside of the protocol stack
- These “internal” interfaces for most users are in fact external interfaces for IP core vendors; over specification therefore matters.

Discussion by the SpaceWire Working Group

A few members supported the idea that the currents standard specifies too much of some interfaces but the Working Group were overall not technically ready to express a documented opinion on the issue.

Disposition of the SpW Working Group

Disposition:
Continue debating the issue

Classification of disposition:
No disposition could be agreed upon

9.11 Credit count error protection

Input Change Requests (see Annex 1 below)

Change Requests number 63 and 64

Issue

The ECSS-E-ST-50-12C Standard specifies in 8.3 the link flow control through the exchange of FCTs.

Advantage of the current situation:
Provides simple low-level low-overhead flow control at link level

Disadvantage of the current situation:
Some people experience the state in which FCT transmission vanishes when some error occurs.

Proposed changes to the SpaceWire specification

None

Benefits of keeping the current SpaceWire specification:

• Backward compatibility at Exchange Level

Discussion by the SpaceWire Working Group

The Working Group acknowledged that credit count can be lost, especially after a high number of disconnect/reconnect, probably because transient effects at reconnection lead to FCTs not being received.

However, the Working Group agreed that this situation results of a specific ground use of SpaceWire and is therefore not critical. Given the fact that increasing the robustness of the credit count system within the defined levels of SpaceWire (namely at Character Level) would require substantial modifications to the SpW state machine while the problem can be solved "at application level" through some higher layer SpaceWire protocol, the Working Group decided not to take any action on this matter.

Disposition of the SpW Working Group

Disposition:

Document the issue and possible workarounds into the SpaceWire Handbook.

Classification of disposition:

Consolidated disposition by SpW WG

10 INPUTS TO THE SPW HANDBOOK

The issues identified as to be included into the SpaceWire Handbook were mainly the LVDS EMC susceptibility and recommended practice with LVDS.

Unfortunately, time did not permit that the Working Group could discuss these points. They will therefore be addressed in the following steps of the standard update process.

Annex 1 : Change Requests collected from the SpaceWire Community

Below are listed the complete set of comments and change requests wrt the ECSS-E-ST-50-12C Standard originating from the SpW Working Group and SpaceWire community.

A.1 GENERAL

A.1.1 Structure of the document

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
0 [Süß]	Whole document	all	**Revisit the whole document** so that clauses contain only requirements and Notes do not contain any requirement **Remove ambiguities** raised by the SpW users (mainly the Working Group) **Introduce new backward compatible features** raised by the SpW users (mainly the Working Group)	Re-write the standard according to the new ECSS writing rules Ambiguities have lead to different implementations and difficult interoperability of unit/device vendors. These new features are considered necessary for the deployment of SpaceWire networks by the SpaceWire community.	
1 [Parkes ECSS-E-ST-50-12C changes.ppt slide 2]	Whole document	all	**Separate informative and normative material**		

A.1.2 Alignment with OSI model and general computer networks terminology

A.1.2.1 Clarify definition of “nodes”

A.1.2.2 Add routing capability to nodes

A.1.2.3 Protocol description formalism

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
2 [Jameux RC 1]	Whole document	all	**Replace all references to routing and routers with switching and switches.**	SpW does not involve routing (OSI layer 3) but only switching (OSI layer 2).	
3 [Süß SpaceWire Nodes - June 2010]	3.2.46	19	**Change definition of node:** according to attached file "SpaceWire Nodes - ISC, Jun 2010, Süss.pdf"	Aligning the definition of nodes to the one of routers to clarify this definition, support PnP, and allow routing in nodes.	
4 [Seynin - SpaceWire Standard Evolution.Sheynin.ppt slide 11]	3.2.46	19	**Clarify definition of node**	Many SpW nodes implementations have more than one link (for fault-tolerance, for throughput improvement, etc.). It isn't covered in the standard, how the links and the node should operate (same/different LA, common/separate time-code register(s), etc.)	
11 [Ferrer - spw new version albert comments.ppt slide 14]	4.6	31	**Clarify Wormhole routing/switching:**	In literature the term Wormhole switching is widely used as a synonymous of wormhole routing. A reference to this other term could be included.	

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
94 [Süß - SpaceWire Standard Evolution - Nov. 2008]	10.3	100	**Add routing capability to nodes.**	Whether or not to include the optional routing function described under option C as part of the definition of the SpaceWire node has been controversially discussed during previous SpaceWire working group meetings. For example the draft SpaceWire-PnP Protocol Definition [3] states that nodes are expected to have no routing function: “packets arriving at any port on a node will be consumed by the node.” On the other hand there exist already some devices like the SMCS332SpW (AT7911E) which include such a routing function between the SpaceWire ports of the node. Similar, the Golden Gate ASIC developed by BAE [5], which can be used to connect up to four SpaceWire interfaces through a PCI bus to the host processor, also contains a routing function between the SpaceWire ports. There have been also a number of computer boards developed which make use of the SpW-10X router (AT7910E) to interface to the SpaceWire network. The SpW-10X provides two external ports that are effectively FIFO interfaces to inject and retrieve SpaceWire packets into and form the network. These examples make clear that nodes with integrated routing function are a concept which is actually widely used. During a discussion it was proposed that these cases could be regarded as a node being attached to a router. Conceptually this could establish again the clear distinction between the routing and the network access point function in the Space Wire network. But as this connection is part of a SpaceWire network there should be one or several SpaceWire links between the router and this	

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
99 [Jameux RC 2]	Whol e docu ment	all	**Improve description of each protocol "level" according to telecommunication and computer networks standards**	The ECSS-E-ST-50-12C Standard mixes for each protocol "level" the description of syntax, synchronisation, semantics; and it does not describe the Service Access Points. Advantage: Facilitates first understanding of the major features of SpaceWire Disadvantage: Increases the risk of ambiguities when it comes to details	

A.1.3 Streamlining references to other standards

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
5 [Gasti RC 1.1]	3.2.55	19	**Remove section**	The PECL technology is no more used in the manufacturing of LVDS receivers and transceivers.	
6 [Gasti RC 1.3]	4.1	24	**Remove "SpaceWire takes… those differences"** All reference and misleading clarifications to IEEE Standard 1355-1995 shall put in annex.	Section 1 providing the normative reference and section 4.3.2 related to SpW LVDS are referring to ANSI/TIA/EIA-644 and not IEEE Standard 1355-1995.	
22 [Gasti RC 1.2]	5.3.1a	38	**Replace with:** The SpaceWire connectors shall be a nine contact micro-miniature D-type with solder contacts, as ESCC3401/071 or ESCC No. 3401/029 or crimp contacts ESCC reference shall be added for crimp contacts	ESA project are using ESCC No. 3401/029 02B9SFR113E Microminiature MDM Flying leads as there is no qualified nine contact micro-miniature D-type with solder contacts based on ESCC3401/071. Moreover, ESA preferred part list does not include a nine contact micro-miniature D-type with solder contacts based on ESCC3401/071.	

A.2 PHYSICAL LAYER DESCRIPTION REDUCED SPECIFICATION OF TO ELECTRICAL SIGNALS

A.2.1 Physical channel (cable assembly)

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
39 [Parkes ECSS-E-ST-50-12C changes.ppt slide 18]	6.6.4	46	**Change:** Define skew and jitter in terms of acceptable eye pattern at receiver		
40 DS - 23 sept. 10 15:36 in ECSS-E-ST-50-12C for SpW Evolutions internal review_JI_DSannoted.pdf	6.6.4.1	47		EMC/EMI: The skew generates a comb of nearly constant emission lines from the frequency bit rate up to about 1GHz and then very aggressive in term of EMI. This is particularly a problem when LVDS signals cover a long distance inside a unit. Low frequency bit rates are even more aggressive because of the increase of the frequency overlap with low-level signals.	
13 [Parkes ECSS-E-ST-50-12C changes.ppt slides 3-11]	5.2	33	**Change cable and cable assembly:** Remove inner shields - May be a cross-talk issue Connect inner shields together and to outer shield - Will reduce stiffness, size and weight - Will not degrade electrical performance Include drain wire Connect to pin 3 at both ends - Prevents “bulk-head” problem - Simplifies and improves grounding arrangement	Connect to ground at one end only Provides a ground reference for differential pair 100 Mbit/s signals 1 ns edges 1 GHz signals Inner shield effective for around 150 mm	

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
33 DS - 23 sept. 10 15:21 in ECSS-E-ST-50-12C for SpW Evolutions internal review_JI_DSannoted.pdf	5.5.2.1a	43		For transmitted bit rates much lower than 200Mb/sec, the LVDS frequency bandwidth can be limited using a pair of capacitive load at the transmitter output terminals. This method is particularly useful to reduce EMI on low-level signals within a unit.	

A.2.1.1 Cables

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
12 [Süß - SpaceWire Standard Evolution - Nov. 2008]	5.2	33	**Re-write paragraph:** specify not the construction but some physical and electrical parameters. These could comprise parameters like Differential Impedance, Signal Skew, Return Loss, Insertion Loss, Near-end Crosstalk (NEXT) and Far-end Crosstalk (FEXT)	The standard provides a very detailed and rigid specification on the construction of the cable. It specifies e.g. wire type and size of the conductors but also of the shield, filler, binder and jacket material. This kind of specification can be directly given to a cable manufacturer who can based on this produce a cable compliant to the standard, which is able to transmit the signal over a length of 10 m and support a data rate of 200 Mbps. The disadvantage is that this cable may be too heavy and rigid for some short connections and too lossy for distances beyond 10 m. Some different cable constructions have been proposed in the past.	

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
14 [Ilstad – comment p33 in ECSS-E-ST-50-12C for SpW Evolutions internal review_JI.pdf]	5.2	33		With regards to the SpaceWire Cable construction, a draft standardisation text for SpaceWire WG evaluation will be one of the outputs from the ongoing Low Mass SpaceWire cable activity. At present several alternative cable constructions are being evaluated in addition to alternative connectors for the cable assembly. As mentioned above in the comment, section 5.2 should rather specify electrical parameters than the cable construction itself to allow more freedom for different constructions to be applied according to user needs. The downside of this approach may be that a range of cables needs qualification which can be a costly and lengthy procedure. At present a one of the solutions that seems most appropriate is to remove the outer shield while terminating inner shields at both ends to chassis. Pin 3 is then left unconnected at both sides as the electronics inside a box is also grounded to chassis to follow good EMC rules.	
15 [Nomachi - SpaceWire-modification_request.v1 - Masaharu Nomachi.ppt slide 2]	5.2.2.1a	34	**Remove.**	Thick signal wire such as 24 AWG is required for launch vehicle application.	

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
16 [Nomachi - SpaceWire-modification_request.v1 - Masaharu Nomachi.ppt slide 2]	5.2.1b	34	**Remove.**	Thick signal wire such as 24 AWG is required for launch vehicle application.	
17 [Ilstad – comment p36 in ECSS-E-ST-50-12C for SpW Evolutions internal review_JI.pdf]	5.2.4	36	This section should be considered removed.	If electrical performance parameters, including EMC/EMI levels, are specified that cables must adhere to, then cables can be constructed in various ways depending on length, data rate and slew rate of the driver or particular environmental requirements.	
18 DS - 23 sept. 10 14:38 in ECSS-E-ST-50-12C for SpW Evolutions internal review_JI_DSannoted.pdf	5.2.4.8	37	Could be used for the shielding introduction then a. should talk about 4 individually screened twisted pairs.	Outer shield No more needed.	
19 DS - 23 sept. 10 14:39 in ECSS-E-ST-50-12C for SpW Evolutions internal review_JI_DSannoted.pdf	5.2.4.11	37	To be removed.	Unjustified	

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
20 [Parkes ECSS-E-ST-50-12C changes.ppt slides 12-14]	5.2.4.15	34	**Change:** Make cable signal skew specification much tighter E.g. Factor of 5 - 0.02 ns per m - 150 mm per ns - 3mm length difference per m of cable	Cable attenuation Include larger wire gauge cores for reduced attenuation i.e. have a least two different cables Larger, heavier long distance (20 m) E.g. 26 AWG Smaller, lighter short distance (5 m) E.g. 28 AWG or 30 AWG? Higher Speed SpaceWire 400 Mbits/s plus Principal limitation is connector impedance mismatch (and cable attenuation) Need connector with 100 ohm differential impedance up to 2 or 3 Gbps	

A.2.1.2 Connectors

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
21 [Süß - SpaceWire Standard Evolution - Nov. 2008]	5.3	38	**Insert:** [additional connector types should be included in the standard?]	A nine-pin micro-miniature D-type is specified as the SpaceWire connector. It is compact and available for space use. The differential impedance of the D-type connectors does not match the 100 Ω of the cables and the termination. Still in practice the distortion introduced by it is acceptable in most cases. Other connectors like a 4-way twinax connector [2][3][4] or circular 13 pin 38999 Series II connector [6] have been proposed and investigated.	

A.2.1.3 New shielding and grounding schemes

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
23 DS - 23 sept. 10 14:42 in ECSS-E-ST-50-12C for SpW Evolutions internal review_JI_DSannoted.pdf	5.3.4	39	Pin 3 is useless		
24 DS - 23 sept. 10 14:44 in ECSS-E-ST-50-12C for SpW Evolutions internal review_JI_DSannoted.pdf	5.3.5	40	5.3.5 Individual shield connection Each twisted pair shield shall be connected to the connector backshell over 360°. The backshell shall be a fully closed metallic enclosure. The rest of this paragraph is unjustified and should be removed.		
25 [Ilstad – comment p40 in ECSS-E-ST-50-12C for SpW Evolutions internal review_JI.pdf]	5.3.5b &c	40	Both 5.3.5 b. and c. should be adapted depending on recommendation outcomes from the Low Mass SpaceWire activity.	Point c. is in not correctly specified. If a connection via resitor and capacitor is to be used, then it should be done at the opposite end of the inner shield connection (pin3). As it is written here it can be misunderstood that the connection from pin3 to inner shield should go via resistor and capacitor - a useless thing to do.	

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
26 [Süß - SpaceWire Standard Evolution - Nov. 2008]	5.4	41	**Change:** [A connection of the inner shield on both sides with the possibility to implement a controlled capacitive decoupling on one side behind the plug could be investigated as a solution.]	The micro-miniature D-type connector has nine signal contacts. Eight are used for the 4 twisted pair cables and one is used to terminate the inner shields at end of the cable from which the signals are being driven. The inner shields are isolated from one another. This feature can be useful to prevent loops in the grounding design and the symmetrical arrangement avoids the problem of having to know which end of the cable is which during installation. A problem occurs when the cable is broken into several parts due to bulk head connectors which are often used in larger structures. This leads to the situation that the inner shields on both sides of the bulkhead are not connected to the ground of either side.	
27 [Ilstad – comment p41 in ECSS-E-ST-50-12C for SpW Evolutions internal review_JI.pdf]	5.4	41	Final recommendation pending results from Low Mass SpaceWire activity.		
28 DS - 23 sept. 10 14:53 in ECSS-E-ST-50-12C for SpW Evolutions internal review_JI_DSannoted.pdf	5.4.3	41	The whole paragraph should fit with the new implementation: - individual shielded twisted pairs - shields 360° terminated in the metallic backshell.		

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
29 DS - 23 sept. 10 14:57 in ECSS-E-ST-50-12C for SpW Evolutions internal review_JI_DSannoted.pdf	5.4.3d &e	41	d. Shields bonded via <10mΩ impedance connection e. Backshell to main body via <10mΩ impedance connection		
30 [Ilstad – comment p42 in ECSS-E-ST-50-12C for SpW Evolutions internal review_JI.pdf]	Figure 5-3	42	Inner shield grounding scheme is due for revision. Recommendations pending results from Low Mass SpaceWire activity.		
31 DS - 23 sept. 10 15:01 in ECSS-E-ST-50-12C for SpW Evolutions internal review_JI_DSannoted.pdf	Figure 5-3	42	To be redrawn	- no more ground pin - shields connected to the main body via a backshell free of aperture.	

A.2.2 Backplanes

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
32 [Süß - SpaceWire Standard Evolution - Nov. 2008]	5.5	43	**Insert:** [Add requirements on backplane connectors or backplane construction.]	SpaceWire links are often used within a unit or electronic box. The current SpaceWire standard contains some requirements on PCB and backplane tracking but no requirements on backplane connectors or backplane construction.	

A.3 CHARACTER LEVEL (PHYSICAL LAYER) - DATA RATE

A.3.1 Minimum data rate

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
36 [Parkes ECSS-E-ST-50-12C changes.ppt slide 16]	6.6.1	46	**Change:** Increase minimum data rate to 4 Mbits/s Allows time for both ends to respond to speed change Possible extension to low data rate start-up E.g. 1 Mbits/s or 2 Mbit/s Required modification to state machine time-out times		

A.3.2 Starting data rate

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
41 [Seynin - SpaceWire Standard Evolution.Seynin.ppt slide 6]	6.6.5	47	**Change:** We restart a link at its regular rate at once.	When the link is running at regular rate of hundreds of Mb/s, to restart the link starting at 10 Mb/s after every detected error and then moving to the regular for this link rate causes unreasonable delays, gaps in information flow.	

A.3.3 Maximum data rate

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
37 [Parkes ECSS-E-ST-50-12C changes.ppt slide 17]	6.6.2	46	**Change:** Define maximum data rate to be 200 Mbits/s using existing specified cables and connectors		

A.3.4 Data rate negotiation

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
38 [Seynin - SpaceWire Standard Evolution.Seynin.ppt slide 6]	6.6.3	46	**Change:** Introduce two-side procedure to agree on rates.	duplex link rate matching procedure by negotiation and/or by sequence of attempts is required.SpaceWire is a standard with smooth, continuous rates scale and lack of a two-side procedure to agree on rates looks as a flaw in the standard	

A.4 UPDATE BEHAVIOUR OF NODES/TERMINALS

A.4.1 Add configuration port in nodes

4. Number	5. Location of deficiency clause page (e.g. 3.1 14)	6. Changes	7. Justification	8. Disposition

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
95 [Süß - SpaceWire Standard Evolution - Nov. 2008]	10.3	100	**Add configuration port in nodes.**	Every SpaceWire routing switch has one internal configuration port with address zero. It can be used to configure the routing switch and to obtain status information. This is an important feature for network discovery and PnP. It showed to be a problem that this port zero is only present in routing switches and not in nodes. The update of the definition will align the SpaceWire Node addressing with the SpaceWire Routing Switch addressing. An internal configuration port with address 0 will be introduced for nodes but normal SpaceWire packets starting with a logical address (32 – 254) will be passed to the next layer as before. With the described modification, the concept of node is tied to a single configuration port which can be accessed from all SpaceWire links which belong to this node. In this port zero configuration space, among others, information about all links belonging to the node can be found. [...] The processing of a SpaceWire packet by a node following this definition is shown in Figure 1. The packet may have some leading bytes containing a path address. As specified in [2] this is followed by the logical address and the PID bytes and the payload of the packet. The node will start by analysing the first byte of the packet. A. If the leading byte is a zero the packet will be routed to the configuration port for processing. The second byte would be expected to be one valid logical address of the node or the default logical address 254. The later is especially the case if a node is to be discovered and the logical address is not yet known by the sending node. The following handling of packet will be	

A.4.2 Nodes shall discard packets with unexpected destination address

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
98 [Parkes ECSS-E-ST-50-12C changes.ppt slide 21]	10.5.4 .3	103	**Change** [Packet with unexpected destination address shall be discarded] **with** [Packet with unexpected destination address can be discarded]	Conflict with RMAP which responds to invalid addresses	
100 [Jameux RC 3]	10.5.4 .3.a	103	**Remove**	A requirement cannot be based on the criteria “a packet arrives at a node with an unexpected destination address” since “unexpected destination address” is not defined for a node.	

A.4.3 Add routing capability to nodes

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
94 [Süß - SpaceWire Standard Evolution - Nov. 2008]	10.3	100	**Add routing capability to nodes.**	Whether or not to include the optional routing function described under option C as part of the definition of the SpaceWire node has been controversially discussed during previous SpaceWire working group meetings. For example the draft SpaceWire-PnP Protocol Definition [3] states that nodes are expected to have no routing function: “packets arriving at any port on a node will be consumed by the node.” On the other hand there exist already some devices like the SMCS332SpW (AT7911E) which include such a routing function between the SpaceWire ports of the node. Similar, the Golden Gate ASIC developed by BAE [5], which can be used to connect up to four SpaceWire interfaces through a PCI bus to the host processor, also contains a routing function between the SpaceWire ports. There have been also a number of computer boards developed which make use of the SpW-10X router (AT7910E) to interface to the SpaceWire network. The SpW-10X provides two external ports that are effectively FIFO interfaces to inject and retrieve SpaceWire packets into and form the network. These examples make clear that nodes with integrated routing function are a concept which is actually widely used. During a discussion it was proposed that these cases could be regarded as a node being attached to a router. Conceptually this could establish again the clear distinction between the routing and the network access point function in the Space Wire network. But as this connection is part of a SpaceWire network there should be one or several SpaceWire links between the router and this	

A.5 TIME-CODE MASTER: ONE OR MORE?

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
44 [Süß SpaceWire Nodes - June 2010]	7.7d 8.12.2 b	56 84	**Change:** [support multi Time-Code master]	Only one node in a SpaceWire network should provide the active TICK_IN signal which triggers the broadcast of the Time-Codes. This is to avoid collisions of Time-Codes within the network. For fail safety and redundancy reasons it can be useful to have simultaneous Time-Codes from different time masters in a system. This could be implemented by using the two remaining reserved states of the control flags.	
45 [Parkes ECSS-E-ST-50-12C changes.ppt slide 19]	7.3	53	**Change:** Remove (c) note 2 and part of (d)	SpW-WG reserved time-codes NASA use multiple time-codes Both violate the existing standard	
69 [Isomaki RC1.1]	8.12.2 b	84	**Replace with the following:** At any moment in time there shall be only a single node or router, the time-master, managing the distribution of time. NOTE The node or router can use different link interfaces to transmit the time-codes. This allows for redundancy if a link is broken. NOTE It is a allowed to switch the time mastery between different nodes or routers.	It is neither suitable nor feasible to restrict the time-code source to be a single link-interface. As there shall be only one time-counter in a node or router they shall be considered the source of the time-codes not a specific link interface. Redundancy is a desired feature in a SpaceWire network and thus it should be allowed for different link interfaces on different nodes or routers to handle the distribution of time as long as they are designed on system level not to do it at the same time.	

A.6 INTRODUCTION OF BACKWARD COMPATIBLE SIGNALLING CODES

A.6.1 Backward compatibility with Time-codes

A.6.2 Interrups+ACK scheme

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
86 [Sheynin Distributed Interrupts in SpaceWire Networks - Dec 2006]	8.12.2	86	**Insert:** [attached file 8.13 Interrupts distribution (normative).pdf]	Introduction of Distributed Interrupts	
48 [Sheynin Distributed Interrupts in SpaceWire Networks - Dec 2006]	Figure 7-2	53	**Replace figure with the one attached here.**	Introduction of Distributed Interrupts	
51 [Sheynin Distributed Interrupts in SpaceWire Networks - Dec 2006]	7.3c	53	**Replace with:** The other three control codes (Time-Code, Interrupt-Code and Interrupt_Acknowledge-Code) shall be formed from ESC followed by a single data character.	Introduction of Distributed Interrupts	

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
52 [Sheynin Distributed Interrupts in SpaceWire Networks - Dec 2006]	7.3c	53	**Insert:** NOTE 3. The Interrupt-Code and Interrupt_Acknowledge-Code are used to distribute real-time interrupt signals from nodes that are sources of interrupts to nodes that can do interrupt processing procedures (see subclause 8.13). Interrupt/ Interrupt_Acknowledge-codes can eliminate system-wide sideband signals for low latency control signals distribution.	Introduction of Distributed Interrupts	
53 [Sheynin Distributed Interrupts in SpaceWire Networks - Dec 2006]	7.3d	53	**Replace with:** (C6=0, C7=0)	Introduction of Distributed Interrupts	

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
54 [Sheynin Distributed Interrupts in SpaceWire Networks - Dec 2006]	7.3e	53	**Insert:** Five bits of interrupt information shall be held in the least significant five bits of the Interrupt-Code (I0-I4) and the three most significant bits (C5=0. C6=0, C7=1) shall contain control flags that are distributed isochronously with the Interrupt- Code. NOTE The Interrupt-Code is used to distribute interrupt request information and control flags (C5=0, C6=0, C7=1) isochronous with the Interrupt-Code distribution.	Introduction of Distributed Interrupts	

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
55 [Sheynin Distributed Interrupts in SpaceWire Networks - Dec 2006]	53		**Insert:** Five bits of interrupt acknowledge information shall be held in the least significant five bits of the Interrupt_Acknowledge-Code (I0-I4) and the three most significant bits (C5=1, C6=0, C7=1) shall contain control flags that are distributed isochronously with the Interrupt_Acknowledge-Code. NOTE The Interrupt_Acknowledge-Code is used to distribute interrupt acknowledge information and control flags (C5=1, C6=0, C7=1) isochronous with the Interrupt_Acknowledge-Code distribution.	Introduction of Distributed Interrupts	

A.6.3 Multi-purpose signalling scheme (allowing time codes and interrupts and more)

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
46 [Ferrer - spw new version albert comments.ppt slide 8]	7.3	52	**Redefine Time-Codes:** Proposal to define Time-Codes as a type of ESC+Data character sequence. This special sequence can be called "escape data characters" or "signalling codes" or "escape codes".	Current definition states: "The Time-Code is used to distribute system time information and control flags isochronous with the time-code distribution." If Time-Codes are going to be used for other purposes the definition must be changed. Escape codes are very important because they can bypass the flow control mechanism. - In case of packet blocking they can still be sent They have minimum latency and jitter. They can contain minimum information They are limited - If possible, some values should be reserved for future SpW development If possible, same control code should imply same behaviour. Mandatory functions of theses codes should be very simple to implement in hardware.	

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
47 [Ferrer - spw new version albert comments.ppt slides 11, 19 and 20]	7.3	52	Restrict 64-bit Time-code scheme to <T6,T7>=<0,0> and use the other three combinations to implement Signalling codes, a number of them maybe dedicated to time distribution, others to interrupt distribution, etc.	Point 1. The current Time-Code scheme does not provide the possibility to 'instantly' distribute any form of absolute time across the SpaceWire network (because the "time information value" is limited to 64 values). It provides 'instant signalling' (with some latency that can be negligible for low time-accuracy applications and bounded for high time-accuracy applications) of: - a state (provided by one of the 64 possible "time information" values, usually value 0) - an incremental tick (the fact that the value is incremented with 1) Any implementation that is trying to use the value of the Time-code to provide time information will be always limited (e.g. the epoch of a scheduled communication cycle will have to be 64 although the control loop might require any number of communications within a loop; the epoch will have to be very short (in the order of tens of microseconds) in order to allow frequent time synchronisation points, although control loops vary from 1microsecond for advanced robotics to 100ms or 125ms for spacecraft control); and physical values such as 100ms are not easily divided by 64) and therefore very application specific. Point 2. From the point of view of the information theory, this information can be coded on 2 bits: state and tick (e.g. the reset state is <0x> where x is either 0 or 1 depending on its previous value; and any following tick is <1x> where x is either 0 or 1 depending on its previous value; in other word, a time-code is in fact <b1, b2> where b1 is 0 in case of state reset and 1 in tick increment mode; and b2 is always flipping to indicate a new time-code)	

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
49 [Ferrer - spw new version albert comments.ppt slide 11]	Figure 7-2	53	**Requirements on the introduction of side-band interrupt signalling based on control codes:** Proposed interrupt codes use Escape+data characters to broadcast a value to the network. Two problems must be solved 1. Avoid a spurious value to be broadcasted 2. Avoid infinite transmission due to loops Timeout requires configuration and a counter in the routers for each possible value . Proposal: A different control codes (or any other bit change) must be received each time to enable the value to be broadcasted. (requires 64 bits per port) Interrupts distribution could be designed so that its implementation supports other uses. (rename to signalling codes)		

A.7 INTRODUCE BROADCAST/MULTICAST

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
93 [Seynin - SpaceWire Standard Evolution.Sheynin.ppt slide 12]	10.2.7	99	**Insert** Broadcast/multicast modes in SpaceWire interconnections	In the standard it is limited to router-to-node.It can be extended for router-to-router for some interconnection topologies, (e.g. tree) and accurate routing tables writing	

A.8 INTRODUCTION OF SIMPLEX AND/OR HALF-DUPLEX

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
61 [Süß - SpaceWire Standard Evolution - Nov. 2008]	8	57	**Add simplex and/or half-duplex mode.**	For many high speed payload data applications only a simplex connection from the instrument to the memory is required. In these cases the back channel provided by SpaceWire is often seen as unnecessary complexity and cable mass. It has been proposed to modify the SpaceWire codec and the state machine to support simplex operation [11], [12]. Also the possibility of a half-duplex SpaceWire implementation has been suggested [13]. It remains to be investigated what consequences these changes will have for the backwards compatibility of SpaceWire and if they should be included in the update of the standard.	
62 [Seynin - SpaceWire Standard Evolution.Sheynin.ppt slide 11]	8	57	**Add** simplex SpaceWire	Using two new signals – tx_simplex_enabled and rx_simplex_enabled two types of the simplex mode link operation – transmitting simplex or receiving simplex. Transmitting:transmitter sends data for N*12,8 microseconds. Reconnecting:transmitter goes to Connecting State and sends only NULL symbols on the frequency 10MHz for 12,8*K microseconds.	

A.9 MISCELLANEOUS

A.9.1 Virtual channels

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
87 [Parkes ECSS-E-ST-50-12C changes.ppt slide 22]	Figure 10-3	93	**Remove "virtual channel"**	Remove all text related to virtual channels	
88 [Parkes ECSS-E-ST-50-12C changes.ppt slide 22]	10.1.2.8	93	**Remove section**	Remove all text related to virtual channels	
97 [Parkes ECSS-E-ST-50-12C changes.ppt slide 22]	10.5.4.3 NOTE 1	103	**Remove section**	Remove all text related to virtual channels	

A.9.2 High time-synchronisation resolution option

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
60 [Pinsard - CR1.1]	7.7h	56	**Insert:** i. high time-synchronisation resolution option: On the transmitter part: · When a high resolution synchronisation is needed a jitter-correction Time-Code could be sent just after the usual Time-Code that carries the six-bit time. · This jitter-correction Time-Code is built as follow: - the two control flags are set to One in order to avoid any confusion with any other use of the Time-Code - The Four lowest bits are equal to the number M of bits sent between the Tick-In signal assertion and the output on Dout of the first data-control flag bit of the Time-Code (ESC data-control flag bit) - The two left bits are reserved for future use and shall both be set to zero. On the receiver part: · A synchronisation signal shall be asserted after a number (64 minus M) of receiver bits from the arrival of the first data-control flag bit of the Time-Code (ESC data-control flag bit). See example in attached file "high time-synchronisation resolution option - example.pdf"	To improve the time synchronisation the following requirement could be added to the SpaceWire standard in section 7.7 time interface The implementation of this requirement is low resource consuming and will allow SpaceWire to be use were high accuracy synchronisation is needed (better than 10µs).	

A.9.3 Increase error detection capability at character level

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
56 [Ferrer - spw new version albert comments.ppt slides 4-6]	8.5.1	64	**Add other error types** In Figure 8.2 ("RxErr = Disconnect error OR Parity error OR Escape error (ESC followed by EOP or EEP or ESC).")	Parity bit covers SpW character. It can detect a change on a single bit But errors can be produced by - Unexpected jitter, noise or interferences - Simultaneous Data/Strobe transitions may occur - One or more bits may be added Parity error may not detect these errors. Up to now, the behaviour depends on SpW Codec implementation. The standard should push implementers to detect as many types of error as possible and to disconnect for each of them. A Bit Error Rate (BER) of 10exp(12) implies an error every 2.78 hours in a single 100Mbit/s link. (GOES-R NASA project)	

A.9.4 Requirement on Regional Addressing

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
92 [Isomaki RC5.1]	10.2.3 i	97	**Define larger or remove requirement completely.**	This is not a requirement as larger is not defined which breaks the ECSS standardization rules.	

A.9.5 Update state machine

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
65 [Süß - SpaceWire Standard Evolution - Nov. 2008]	8.5	63	**Change state diagram.**	During the implementation of the SpaceWire codec some inconsistencies in the transitions described in the state diagram have been identified [10]. a) The transition from Started to ErrorReset is impossible when gotNULL condition is set. b) The transition from Connecting to Run shall be applied only after sending FCT to channel. These inconsistencies will have to be corrected by making some slight modifications of the standard text and state diagrams.	
66 [Seynin - SpaceWire Standard Evolution.Sheyn in.ppt slide 10]	8.5	63	**Add requirement** "always to send FCT before going to the RUN state"	An only sending node can never set a connection	
67 [Isomaki RC4.3]	8.5.2.7a NOTE		**Make the NOTE a requirement instead:** 8.5.2.7c The receiver is enabled. 8.5.2.7d The transmitter is enabled to send Time-codes, FCTs, N-Chars and NULLs.	It is not specified in a requirement anywhere in the standard that the transmitter should be enabled to transmit all four character in the run-state. This is only written in descriptive text (and in the state diagram figure which is only referenced from descriptive text).	

A.9.6 After "reset" the time-counter shall be set to zero

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
80 [Isomaki RC3.4]	8.12.2 m	85	**Replace with the following:** After reset the time-counter shall be set to zero.	It is not feasible to reset the time-counter when each individual link enters error-reset. Then the whole time distribution will be disturbed just because one link had a disturbance. It should instead only be specified that the time-counter shall be zero after reset/startup. The control flags do not need to be specified here since only the count is relevant to the time-distribution.	
81 [Parkes ECSS-E-ST-50-12C changes.ppt slide 20]	8.12.2 m	85	**Replace with the following:** After reset the time-counter shall be set to zero.	This is incorrect and stops time-codes working briefly after a link disconnect.	
82 [Hihara RC1.1]	8.12.2 .m		After reset or disconnect-reconnect (state machine in ErrroReset state) the time-counters <u>in time master nodes and end nodes, excluding routers</u>, shall be set to zero and any control-flag outputs shall be set to zero.	Since SpaceWire routers are connected to multiple nodes, its internal time-counter does not have to be initialized after reset or disconnect-reconnect occurs in one port. - The statement "After reset or disconnect- reconnect (state machine in ErrorReset state) the time- counter shall be set to zero and any control- flag outputs shall be set to zero." would not be suitable for router use. - Since a router accommodates several SpaceWire links, the internal counter, which is described as "the router's time- counter" in term k and l, should not be reset. In other words, one reset operation on a link should not have influence on other links.	

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
83 [Nomachi - SpaceWire-modification_request.v1 - Masaharu Nomachi.ppt slide 2]	8.12.2 m	85	**Change:** [This specification would be applied for time master node only.This specification would be applied for end nodes (reserved counters in receivers), excluding non-time master routers.]	The statement "After reset or disconnect- reconnect (state machine in ErrorReset state) the time- counter shall be set to zero and any control- flag outputs shall be set to zero." would not be suitable for router use. Since a router accommodates several SpaceWire link, the internal counter, which is described as "the router's time- counter" in term k and l, should not be reset. In other words, one reset operation on a link should not have influence on other links.	

A.9.7 Switching arbitration algorithm

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
89 [Ferrer - spw new version albert comments.ppt slide 11]	10.1.2 .9.6	96	**Inconsistency:** last paragraph of section 10.1.2.9.6: “In the event of several packets competing for a set of links, subclause 10.2.5 specifies the means of arbitration when an output port becomes available, giving access to the newly freed output port to the packet with the highest priority destination address” Section 10.2.5 “SpaceWire routing switches shall provide a means of arbitrating between input ports requesting the same output port." -> Does not oblige the use of a specific arbitration algorithm		

A.9.8 Router timeout

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
90 [Süß - SpaceWire Standard Evolution - Nov. 2008]	10.2	96	**Add router timeout.**	If a router stops receiving data due to an internal failure the packet is stuck and can block some paths in the network. It is difficult to detect and recover this situation from outside the routers. An effective method to recover from this failure condition is to introduce a timeout inside the routing switches which removes the stuck packet from the link after a certain period of time.	

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
91 [Parkes ECSS-E-ST-50-12C changes.ppt slide 23]	10.2	96	**Add:** [Add router time-out requirements]		

A.9.9 State of the link interface during the spilling of a packet

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
96 [Larsen RC1.1]	10.5.2	101	**Request** that the state in which the SpaceWire link interface should be in during the spilling of a packet be defined.	Assume a large packet is being spilled on a SpW port. What state should the link halt in? Section 10.5.2 states that if an error is detected by either the source or destination node that the packet will be "spilled" if the pack being spilled is quite large it could take some time to rid the link of the error packet. f. Then goes on to state "the link shall not restart after an error until some N-Chars are read..." it does not state the state the SpW link should be in while/after the packet is spilled. Should the link be in the ErrorWait state? Ready state and not send data until some N-Chars are received? (per section 8.5 figure 8-2).	

A.9.10 Over specification of host interface

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
58 [Isomaki RC6.2]	7.6	55	**The clause should specify everything** without an explicit data width or require that everyone uses 8-bits+control bit. EEP and EOP could be specified with saying that the control bit is 1 and the lsb data bit is 0 (EOP) or 1 (EEP).	It seems unnecessary to have a lot of requirements for a specific implementation. It is better to write the requirement in general terms. Otherwise it should be specified that everyone MUST use 8-bit width.	
70 [Isomaki RC1.2]	8.12.2 c	84	**Remove**	How a time-code is transmitted is clear from clause 7. This section should only specify how time is distributed that is how the time-counter is changed and how the value is propagated on a network.	
71 [Isomaki RC1.3]	8.12.2 d	84	**Replace with the following:** To distribute time the time-master shall do the following: 1. The time-counter is incremented by one. 2. The control flags are set to zero. 3. A time-code is constructed from the new time-counter value and the control flags. The resulting time-code is transmitted on all link interfaces in the time-master.	Original description was not clear about where a time counter was located but indicated that one should be located in each link interface. This seems not to be what was actually intended from the beginning since other descriptive parts (8.4.2) of the standard indicate that when tick in is asserted then the time-code presented on a time-code input should be transmitted. This also seems to be in line with existing codec implementations such as the UoD codec. In my view the most reasonable thing to do is to entirely skip the talk of TICK_IN and similar signals in this section and only talk about what the clause title says that is: time distribution. It is specified how the time-counter is updated and to where the new time-count shall be sent. It should not specify how the time-code is transmitted. Clause 7 specifies a signal interface for time-codes. If one is present then a time-code should be transmitted as indicated there. Other implementations perhaps have the time distributer integrated in the link interface and does not need an external interface. Thus it is unnecessary to refer to specific signals here.	

A.9.11 Credit count error protection

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
63 [Hihara RC1.2]	8.3e2	58	**Insert:** 3. Credit count in the transmitter and the receiver might be checked, or the flow control could be re-established within upper protocol layers.	Due to some reasons, FCT transmission sometimes vanishes(“dead lock” in other words). One major cause of FCT disappearance is considered as the discrepancies of credit counters between an initiator and a target. - Transmission error is considered in current specification, whereas some specific case, in that the credit counter in sending end becomes less than the one in receiving end due to some reason, has to be considered. - Strictly speaking, a credit counter in a receiving end, which corresponds to 8.3.c is not specified explicitly.	
64 [Nomachi - SpaceWire-modification_request.v1 - Masaharu Nomachi.ppt slide 4]	8.3e2	58	**Change:** [Is additional state transition required for continuous SpaceWire communication ?]	Many people experience the state in which FCT transmission vanishes when some error occurs.	

A.10 EDITORIAL COMMENTS

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
8 [Bonnet RC1.1]	Figure 4-1	26	**Correct figure** [voltage values are wrong]	Indeed, if the voltage across the input resistor of 100 Ohm is 350mV, then the voltage indicated on the right of the arrows are wrong. I think it is not +250mV +400mV typical but +125mV +200mV typical. There is a ratio 2 between both values.	
9 [Ilstad – comment p26 in ECSS-E-ST-50-12C for SpW Evolutions internal review_JI.pdf]	Figure 4-1	26	**Do NOT correct figure**	Actually this figure is correct and in line with EIA/TIA-644 specification. The figure indicates the minimum voltage threshold a receiver must adhere to to change state. if the differential signal is less than +/- 100mV then behaviour of the receiver is not guaranteed.	
42 [Ferrer - spw new version albert comments.ppt slide 3]	Figure 6-2	48	**Replace figure with the one attached here.**		
43 [Isomaki RC5.3]	7.2	52	**Add specification in text** that parity is sent first, then control bit and lastly data starting from the LSB	Currently it is only indicated in the figure with an arrow in what order the characters are transmitted. Only the data bit transmission order is explicitly specified in the text.	
50 [Isomaki RC5.4]	Figure 7-2	53	**An explicit requirement should refer to the figures** as the definition of the characters. Also the transmission order of the bits should be explicitly stated.	Currently the figure is only referenced from a NOTE which is not according to ECSS standardization rules.	
57 [Isomaki RC6.1]	7.4a	54	**Remove.**	It is already specified for both data characters and control characters in clauses 7.2 and 7.3 where a parity bit should be included. This clause should only specify how it is used.	
59 [Isomaki RC5.2]	7.7d	56	**Remove**	Specified in 8.12.2 since only one node or router is allowed to be time-master. It is not appropriate to have time distribution specifications in this section as it should only specify the signal interface.	

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
68 [Nomachi - SpaceWire-modification_request.v1 - Masaharu Nomachi.ppt slide 2]	8.11.2		**Change:** [The definition for duration (727-1000ns) should be clarified..]	[see also figure attached]	
72 [Isomaki RC1.4]	8.12.2 e		**Remove**	Specified in 8.3 m, n.	
73 [Isomaki RC2.1]	8.12.2 f	84	**Remove**	This clause is actually not as clear as it seems. It specifies that a time-master entity shall not try to transmit a time-code unless it has first checked that the link interface in question is in the run-state. Nowhere is a requirement written that says that a transmitter shall only transmit time-codes in the run-state. Clauses 8.3 p,q, r and s have some requirements. 8.4.2 on page 60 also have some relevant text but it is descriptive. 8.5.2.7 a states what is actually needed as a requirement but only as a NOTE which is thus descriptive. The part in the NOTE should be made an explicit requirement and this clause (8.12.2 f) should be removed.	

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
74 [Isomaki RC2.2]	8.12.2 g84		**Replace with the following:** When a Time-code is received on a node or router the following shall be done: 1. Compare the time-count value of the time-code with the local time-counter. 2. If the time-count value of the Time-code is one more modulo 64 than the current time-counter value the time-counter is updated and the updated value is transmitted on all link interfaces except the one it was received on. 3. If the time-count value of the Time-code is equal to the current time-counter value nothing is done. If the time-count value of the Time-code is neither one more modulo 64 nor equal to the time-counter value the time-counter should be updated with the received value.	Previously the information in this replacement clause was spread out into several other clauses. I specify why these clauses should be removed and replaced with this one in the removal change requests for those clauses. It should also be specified explicitly that the calculations are done modulo 64. It is also specified that the node or router should send the time-code to all the ports except the one it was received on. The node or router at the originating port should already be updated but this is not a necessary requirement since even if the time-code is transmitted on the originating port it will not be propagated. This requirement could therefore perhaps be removed to ease implementation. The downside is that an unnecessary time-code is transmitted.	
75 [Isomaki RC2.3]	8.12.2 h	84	**Remove**	It is sufficient to state that it shall be checked that the time-count is one more than the time-counter value which is done in other clauses. This clause does not add any information.	
76 [Isomaki RC2.4]	8.12.2 i	84	**Remove in favour of new 8.12.2.g**	As it is now it is not verifiable on its own since it specifies a situation when the procedure in the current 8.12.2 g does not apply.	
77 [Isomaki RC3.2]	8.12.2 j	84	**Remove in favour of new 8.12.2.g**	This clause is not individually verifiable since it violates the procedure specified in the current 8.12.2 g. The relevant information from this clause is included in the new clause 8.12.2 g.	
78 [Isomaki RC3.2]	8.12.2 k	84	**Remove in favour of new 8.12.2.g**	This clause is not individually verifiable since it violates the procedure specified in the current 8.12.2 g.	
79 [Isomaki RC3.3]	8.12.2 l	85	**Remove in favour of new 8.12.2.g**	This clause is not individually verifiable since it violates the procedure specified in the current 8.12.2 g.	

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
84 [Isomaki RC4.2]	8.12.2 n	85	**Remove in favour of new 8.12.2.g**	This clause specifies the circumstances under which a time-code or the time-counter is considered invalid. The next clause (o) specifies what shall be done if the time-code is considered invalid but it is left to the implementer to determine which of the two cases apply.	
85 [Isomaki RC4.2]	8.12.2 o	85	**Remove in favour of new 8.12.2.g**	This clause is not individually verifiable. It violates the procedure specified in the current 8.12.2 g. The actual behavior has not been changed in the proposed 8.12.2 g but it could be argued that one change should be made. The current specification results in that after a time-code is lost it would take the number of additional time-code transmissions equal to the number of hops in the network until the complete network is synchronized again. This is probably not desirable. It is not good to leave this issue open for implementations to handle individually as it is currently.	

A.11 INPUTS TO THE SPW HANDBOOK

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition

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7 DS - 23 sept. 10 13:17 in ECSS-E-ST-50-12C for SpW Evolutions internal review_JI_DSannoted.pdf	4.2.2	24		Differential characteristic impedance matched Remark: LVDS is not impedance matched in Common Mode (CM). That means the LVDS is vulnerable to CM voltage exceeding a certain threshold at receiver inputs. ex: ±0.8 Volt from DC to about 10kHz. Above 10kHz the shield becomes effective but the ability of the receiver to reject CM voltage disturbance decreases when increasing the frequency. A good immunity to external CM disturbances is usually expected above 10kHz, thanks to the shield, but not documented. That's the meaning of "good" in the last point ! rather an expectation instead of a valid/measurable requirement.	
10 DS - 23 sept. 10 13:45 in ECSS-E-ST-50-12C for SpW Evolutions internal review_JI_DSannoted.pdf	4.3.2	27		See DS's previous note. This declaration has a very limited practical extent. Probably a very good immunity for space application but not documented. It is suspected the LVDS being particularly susceptible to conducted ESD tests (bit flip) due to signal clipping at the receiver ports. Comparatively RS422 and RS232 offer a much higher immunity to offending CM voltage.	

4. Number	5. Location of deficiency clause (e.g. 3.1	page 14)	6. Changes	7. Justification	8. Disposition
33 DS - 23 sept. 10 15:21 in ECSS-E-ST-50-12C for SpW Evolutions internal review_JI_DSannoted.pdf	5.5.2.1a	43		For transmitted bit rates much lower than 200Mb/sec, the LVDS frequency bandwidth can be limited using a pair of capacitive load at the transmitter output terminals. This method is particularly useful to reduce EMI on low-level signals within a unit.	
34 [Parkes ECSS-E-ST-50-12C changes.ppt slide 15]	6.2	44	**Change:** Add clarification that the 100 k ohm input impedance is for the receiver chip only If does not include bias resistors used for prevention of noise induced switching when input is open circuit.	Recommended practice with LVDS	
35 DS - 23 sept. 10 17:59 in ECSS-E-ST-50-12C for SpW Evolutions internal review_JI_DSannoted.pdf	6.2	44	High PCB ground plane to unit chassis inductance		