Date: 15may18		

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V3 added figure showing and example of a multi-link Fieldbus.
V2 submission. With additional clause 7.x.1a Fieldbus interconnection.

Hello Ludwig, Janos,
This is submitted as comments on the preCD 60802.
It includes two major topics that should be placeholders in the draft document and listed as key topics for group discussion.

Partitioning of applications into a hierarchy of fieldbuses.
Why this is essential, and how the same functions are supported by TSN networks.

Media Redundancy.
Why linear bus or simple star structures are the most common topology.
When the additional cost of redundancy is justified, why there is no strong case for any of the main options, dual linear bus, dual star, or ring topology.

Best wishes,
Graeme. Wood.

GW1	p20	3.5.2		t	Add an additional informative note to show the different use of cycle times for Sampled Data control and Event triggered actions.	Note: Control applications use fixed interval data sampling and require buffer cycle times at least half the shortest time constant for the functions under control. Event triggered applications require either time synchronised cycle times at least equal to the shortest required response time or unsynchronised cycle times at least half the shortest required response time.	
GW2	P32	6.2	5)	t	suggest inclusion shown in yellow after bridge	5) The network can be expanded dynamically at any time by attaching an additional TSN bridge to an available unused port - without effect on established streams in the network.	
GW3	P32	6.2	7)	t	unclear concept 'supporting non deterministic traffic in a deterministic manner'	Say - to segregate or partition TSN streams to prevent interference and also to reserve a base level of support for non TSN traffic .	

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GW4		7.4		t	See comment gw2		
GW5	P49	7.5		t	Need to explain [and clarify with an example] how network management will configure a hierarchical network to achieve the basic process application hierarchy.	Please add a new clause and figures for the examples below.	

7.x Network partitioning and configuration

7.x.1 Partitioning of Fieldbus networks.

Fieldbus networks are partitioned for many reasons, such as the following;

- History. An existing brownfield network is integrated in a larger network and retains its existing local fieldbus with device addressing and performance.
- Geography. A local Fieldbus may be installed in a concentrated geographical region or device for convenient cabling and access.
- Separation of responsibility. Machines and process units from different suppliers have a dedicated local Fieldbus to allow isolation for performance testing and diagnostics.
- Application relationship. Devices that are closely related for an application should be on the same link to simplify link scheduling and minimise the need for messages to cross from one link to another.
- Traffic load. Functions needing a large bandwidth may be supported by different links to balance the bandwidth load across multiple links.
- Fault / maintenance partitioning. Devices are allocated to different fieldbus links to minimise loss of plant units or machines when one fieldbus fails or is offline for maintenance.

When these separate fieldbuses are mapped into a TSN cloud, the partitioning and separation between sub networks shall be retained and available to network management for verification.

== here add figures or examples ==

Figure xx1 Process industry Fieldbus network

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  Show the hierarchy.
  Level 1.  Site Fieldbus 'Site link', connected by bridges or gateways to
    Level 2.   Production areas each having a local Fieldbus 'Area link' and bridges/gateways to
       Level 3.  Process units each having a local Fieldbus 'Reactor link', 'Furnace link', 'Boiler link', etc.

== Figure xx2 Factory Automation Network.
  Show the heirarchy  Production line - Production cell - Machine unit
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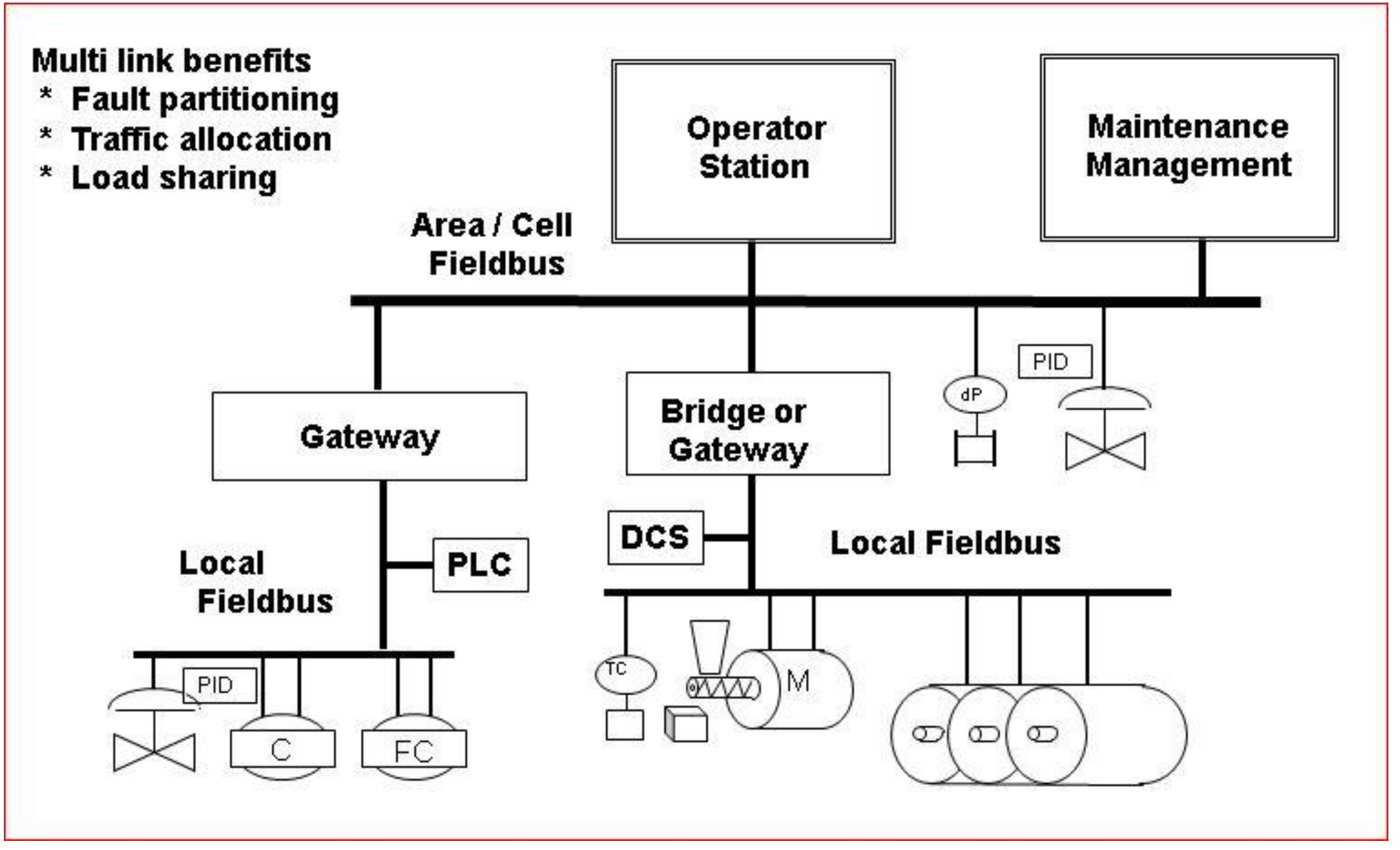

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7.x.1a Fieldbus interconnection

To enforce network partition policy for an application, each fieldbus link shall operate as a closed system.

Bridging and Gateway functions shall be used to enforce the separation and limit the transfer of messages between different fieldbus links, and the outside world. These inter-link transfer functions may include firewalls and sandboxes.

Note for discussion:
The conclusion from these user and safety requirements is:

- each separate fieldbus link shall be implemented as a closed TSN domain with security against message cross over and malicious attack.
- Fieldbus networks and hierarchy applications shall be formed by bridge / gateway functions connecting edge ports on different fieldbus links to provide the required message transfer filtering, checking, and security.
- Bridge / gateway functions between fieldbus edge ports shall be outside the TSN cloud.

7.x.2 Mapping a Fieldbus network into a TSN.

Explain how the following features are supported by TSN network configuration and reservation of resources.

- each link has its own scheduler to manage its local link traffic deterministically
- messages can transfer between links deterministically on a time schedule
- verification that single failure of any bridge, any wire, or any power supply will only affect one link
- safety and integrity are maintained against eavesdropping and hostile attack.

7.x.3 Dual star fieldbus mapped into a TNS

Here give examples for applications using redundancy to ensure no loss of performance is caused by a single failure.

7.x.3.1 TSN mapping for multiple independent dual star fieldbuses

Example

7.x.3.2 TSN mapping for multiple independent ring fieldbuses

Example

GW6	P38	7.2		t	TSN system model should not give preference to ring structures for reasons explained in	Delete sentences about 'Ring topologies' here and elsewhere as explained in new	

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					new clause 8.7	8.7.	
GW7	P65	8.7		t	Existing text is not valid for most process industry examples.	delete existing text and replace by the text below.	

8.7 Media Redundancy

The most aggressive environments usually exist at the end device, for example sensors and actuators in a chemical reactor, a blast furnace, or motor drive. Consequently, best practice is to create star structures based on a junction box in a protected environment with a local cable from the junction box to each device. Junction boxes at each process unit are then connected to the plant control room by 'home run' cabling.

With this approach, the majority of cabling can avoid the aggressive environment and failure of a device or its local cable to the junction box affects only one device.

Failure of a home run cable will affect multiple devices on the attached star, however home run cables are usually well protected so the addition of redundant cables and ring management logic is not generally needed.

Most process applications use single star or linear topology. If redundancy is required to protect against single failures, this can be provided at similar cost by redundant linear cabling, or dual star topology or a ring. See IEC 62439 High Availability Automation Networks.

Note: Ring wiring or daisy chain connections directly between devices in the hostile environment of a process unit is not encouraged. Normal industry practice is to install a double connection from each device to the related junction box, so the ring is configured at the junction box to facilitate fault diagnosis and rewiring to add/remove ring devices.

GW8	p43	7.3.4		t	applying 'reduction ratio' to a cycle time implies making it smaller which is incorrect.	Replace by a better term such as 'skip factor' to indicate the multiple of basic 1ms cycles that are skipped by the application.	
GW9	P43	7.3.4	Table 8	t	Needs to cover common process time intervals.	Extend Table 8 to include common process cycle times between 10 sec and 0.1 sec. These should be listed as mandatory.	
GW10	P47	7.4		t	add a domain feature to ensure fault resilience.	i) data streams within domains may be configured to be hardware independent, such that they do not share any common point of failure such as bridges, cables, or power supplies.	