



Design Benefits

Freedom to
Choose. Power to
Integrate.

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On behalf of
Fieldbus Foundation™ Marketing Committee

Design Benefits

Applying Foundation Fieldbus in a project offers several benefits over using other technologies.

This presentation will explore some of these benefits in design

- due to the concept of the technology
- associated to the bus structure
- by being digital
- due to available verification tools
- due to already-proven intrinsic safety
- due to eliminated Marshalling

Benefits by Concept

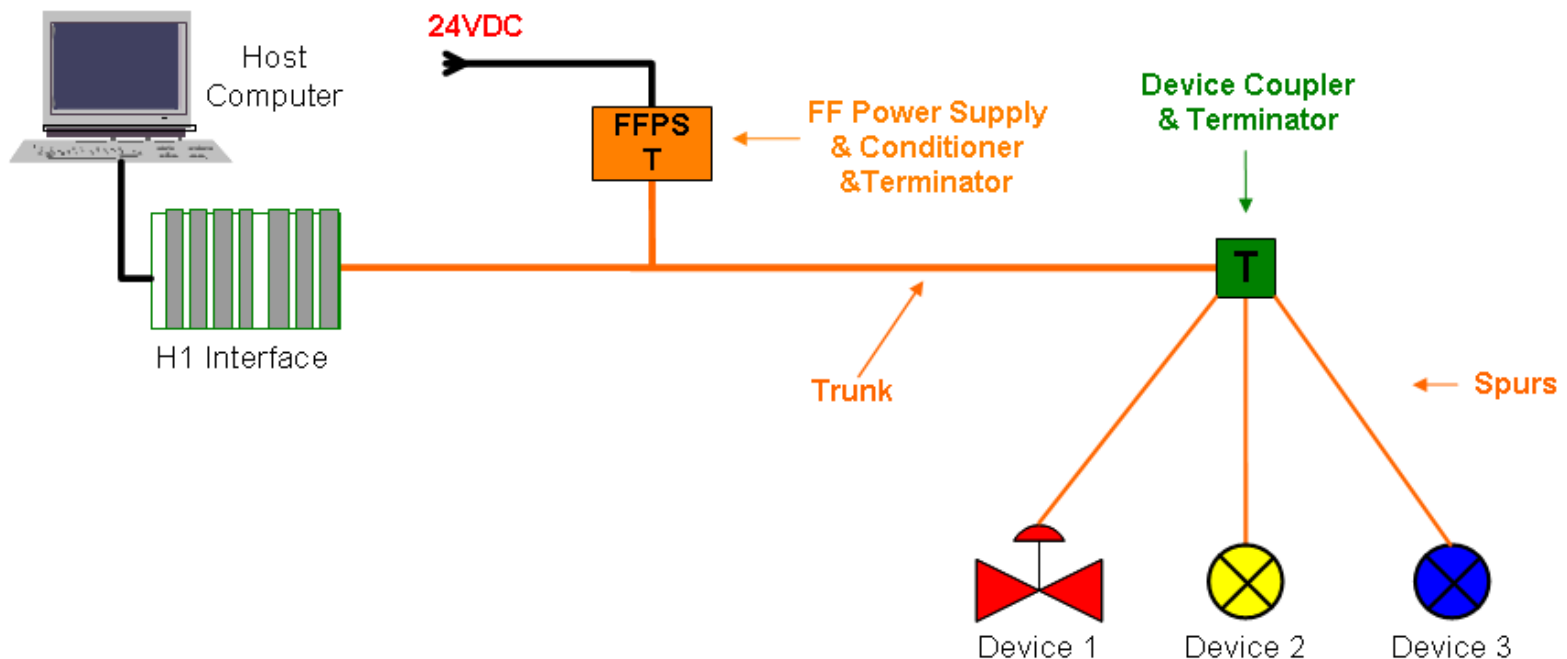
Foundation Fieldbus is a new concept

- connecting many instruments on the same segment
- allowing various hazardous area methods on the same segment (e.g. Ex d and Ex i using fieldbus barriers)
- providing intelligent field instruments regardless their function, whether temperature, ON/OFF valves, flow, pressure, etc.
- using standardized device configuration methods DD and EDDL

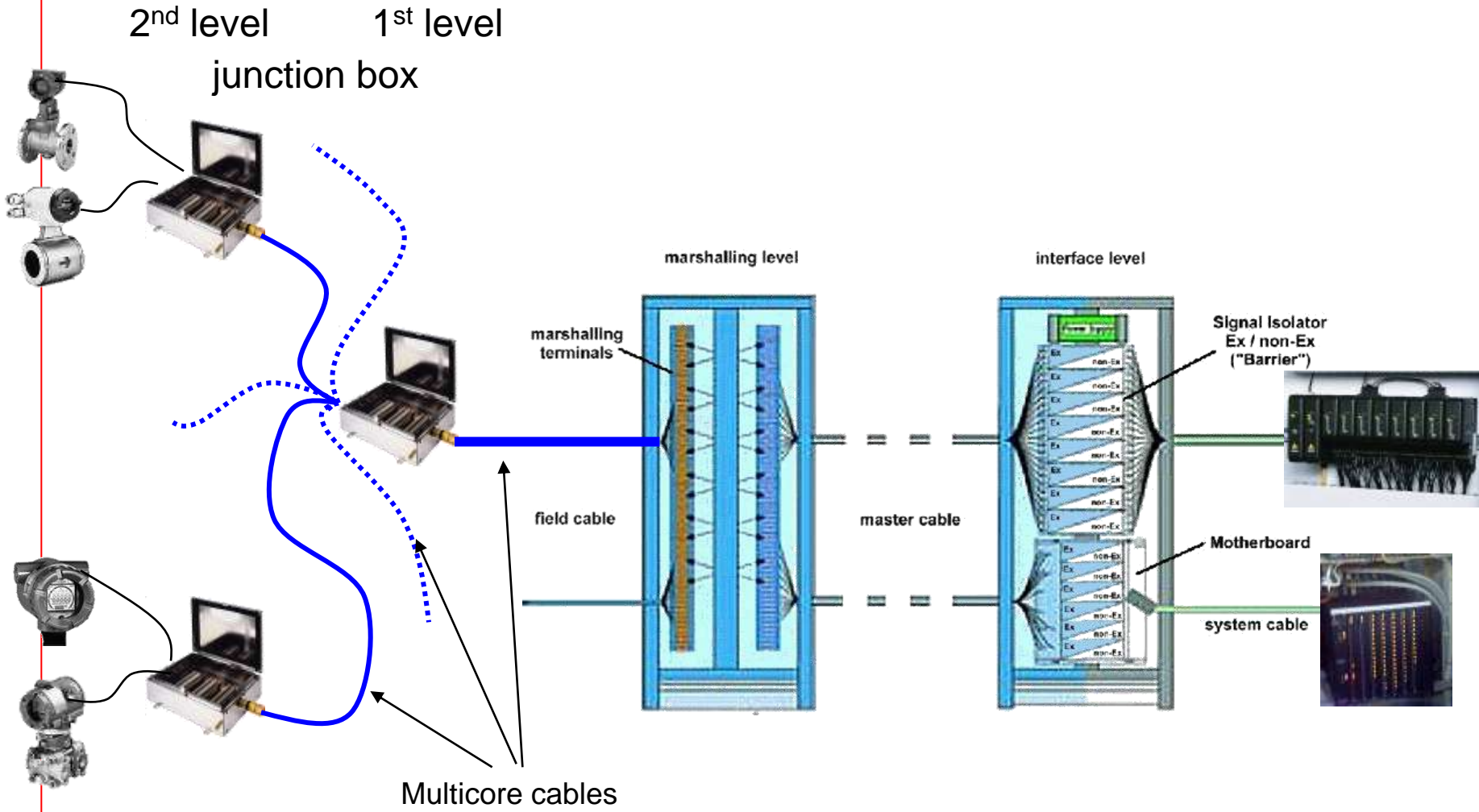
(We heard about these in earlier presentations)

Benefits in wiring and infrastructure

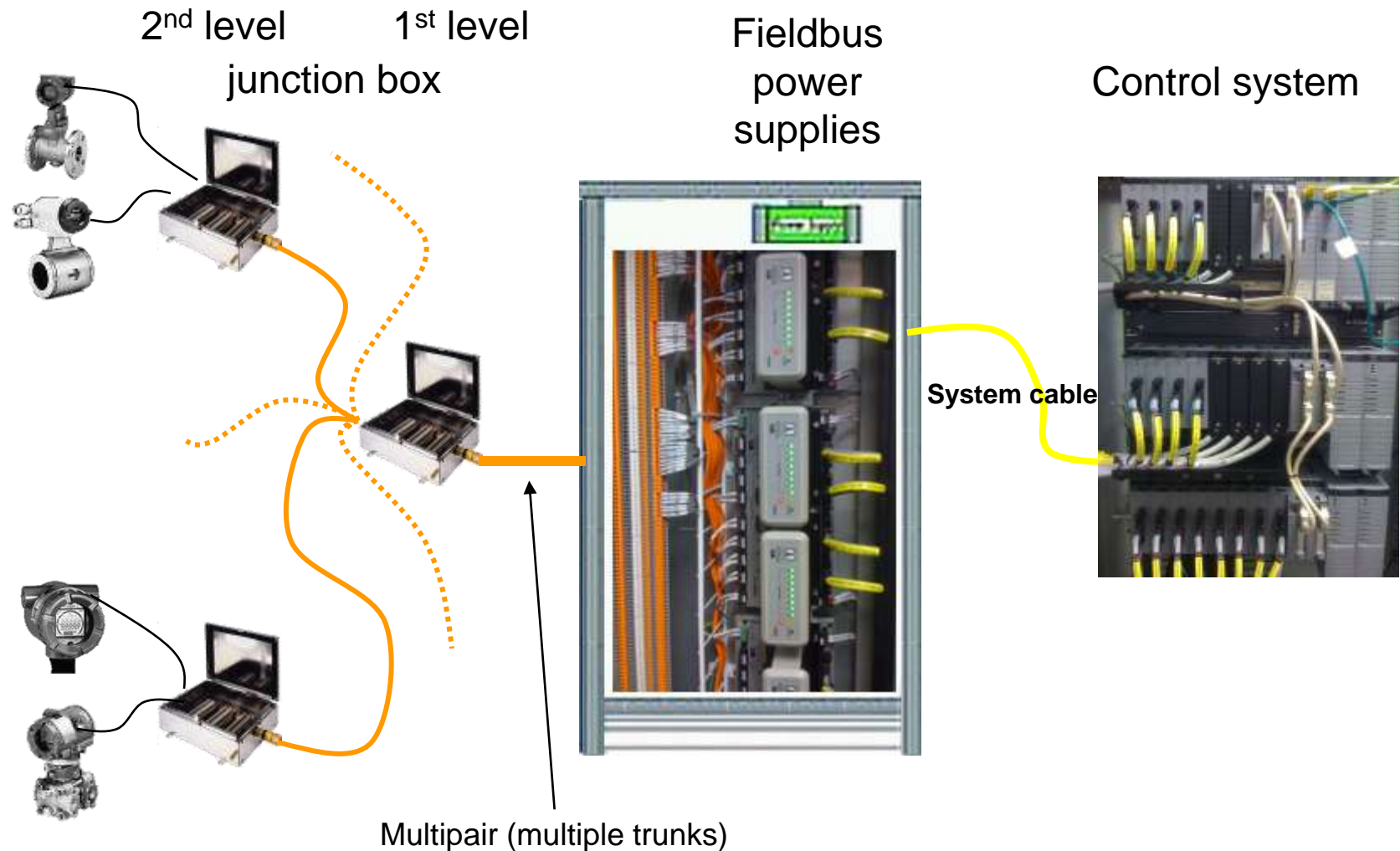
Foundation Fieldbus uses a common FF power supply (or FF IS power supply) compared to multiple isolators and individual wiring



Conventional wiring

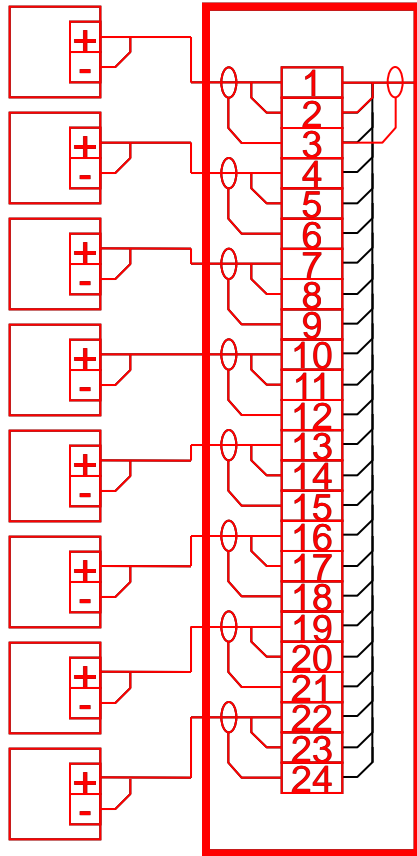


Fieldbus system wiring



Lower Cost: Fewer Connections to be Made

Devices



16
16

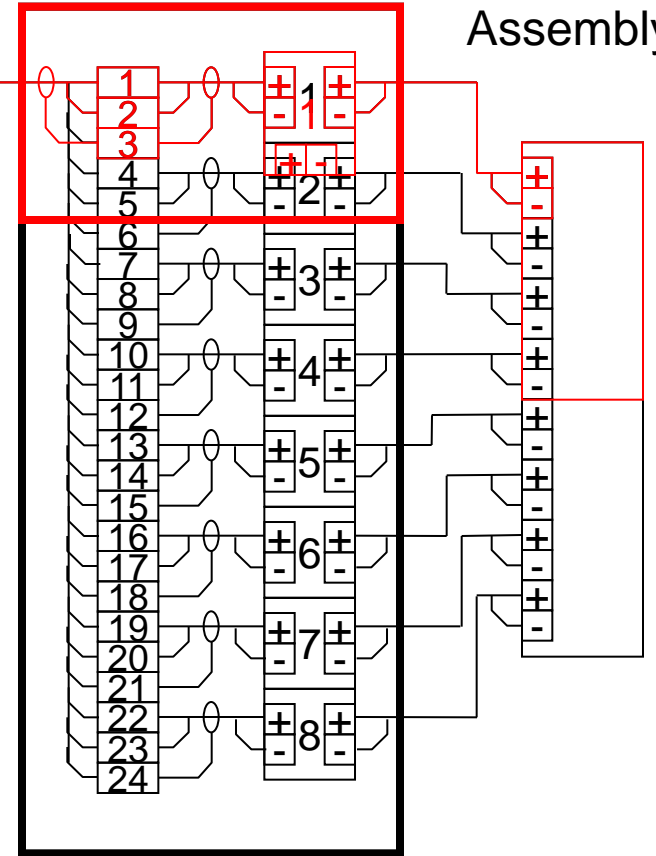
48
27

Field
Junction Box

- Hardwired
 - 160 connections
 - 8 barriers
- **Fieldbus**
 - 55 connections
 - 1 barrier

If devices have more signals, such as position feedback or auxiliary inputs, the reduction becomes even more dramatic.

Marshalling I.S. Barrier I/O



48
6

32
4

16
2

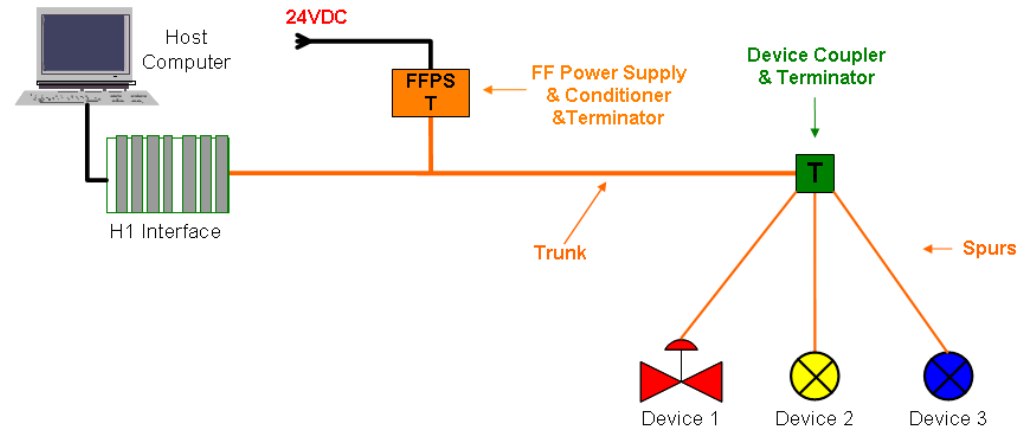
Control Cabinet

I/O
Assembly

Benefits by Concept

The benefits of this are:

- reduced cabling (wiring)
- reduced infrastructure and components involved
- eliminate the variety of isolators and converters needed for DI/DO/AI/AO/RTD/etc
- no marshalling required for grouping DI/DO/AI/AO/RTD/etc
- provide high levels of diagnostics, not just LB/SC
- Get rid of manufacturer-dependent configuration tools



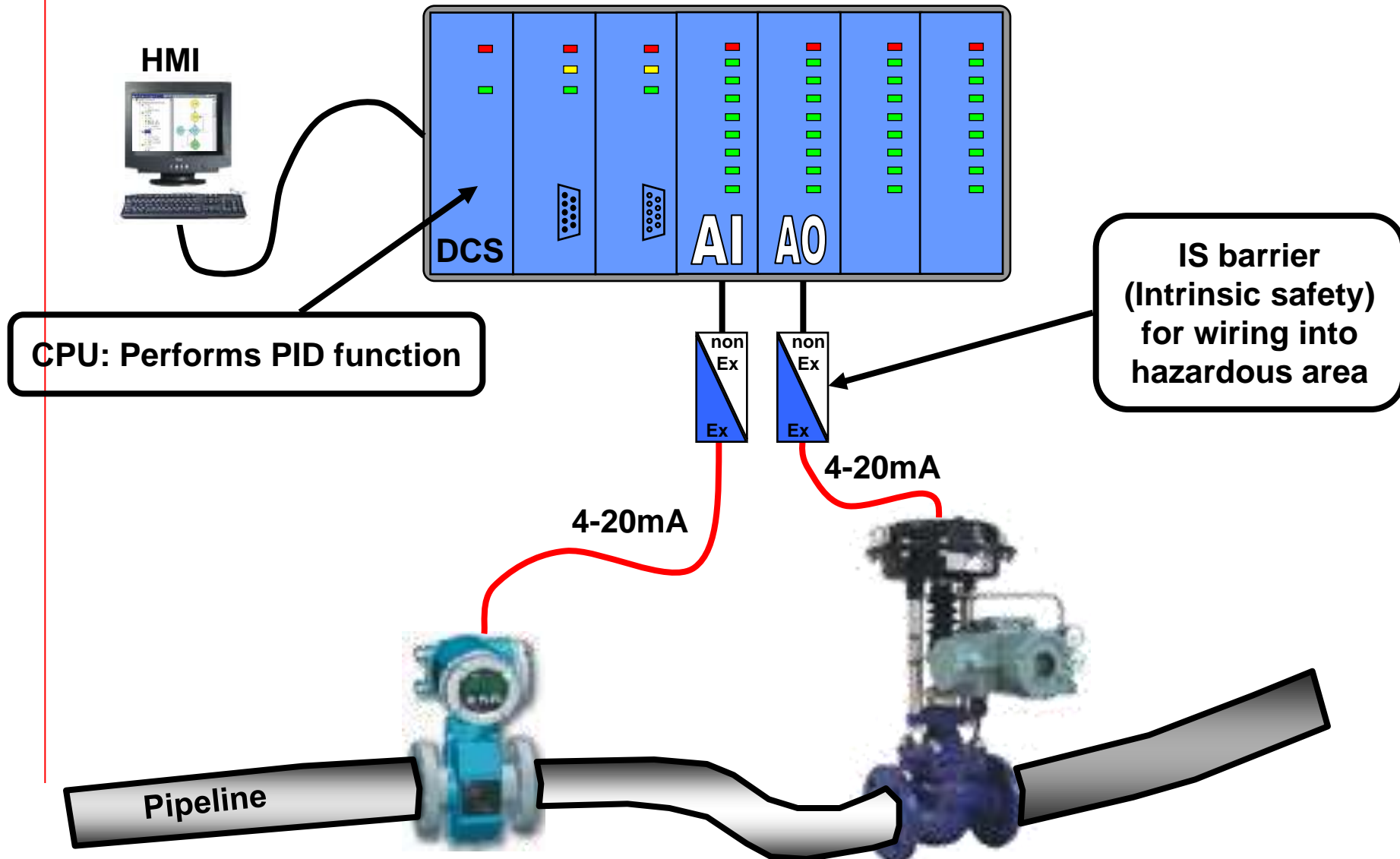
Benefits by Higher Integrity

Foundation Fieldbus combines all components of the control loop (e.g. AI, PID, AO) on the same cable pair (segment)

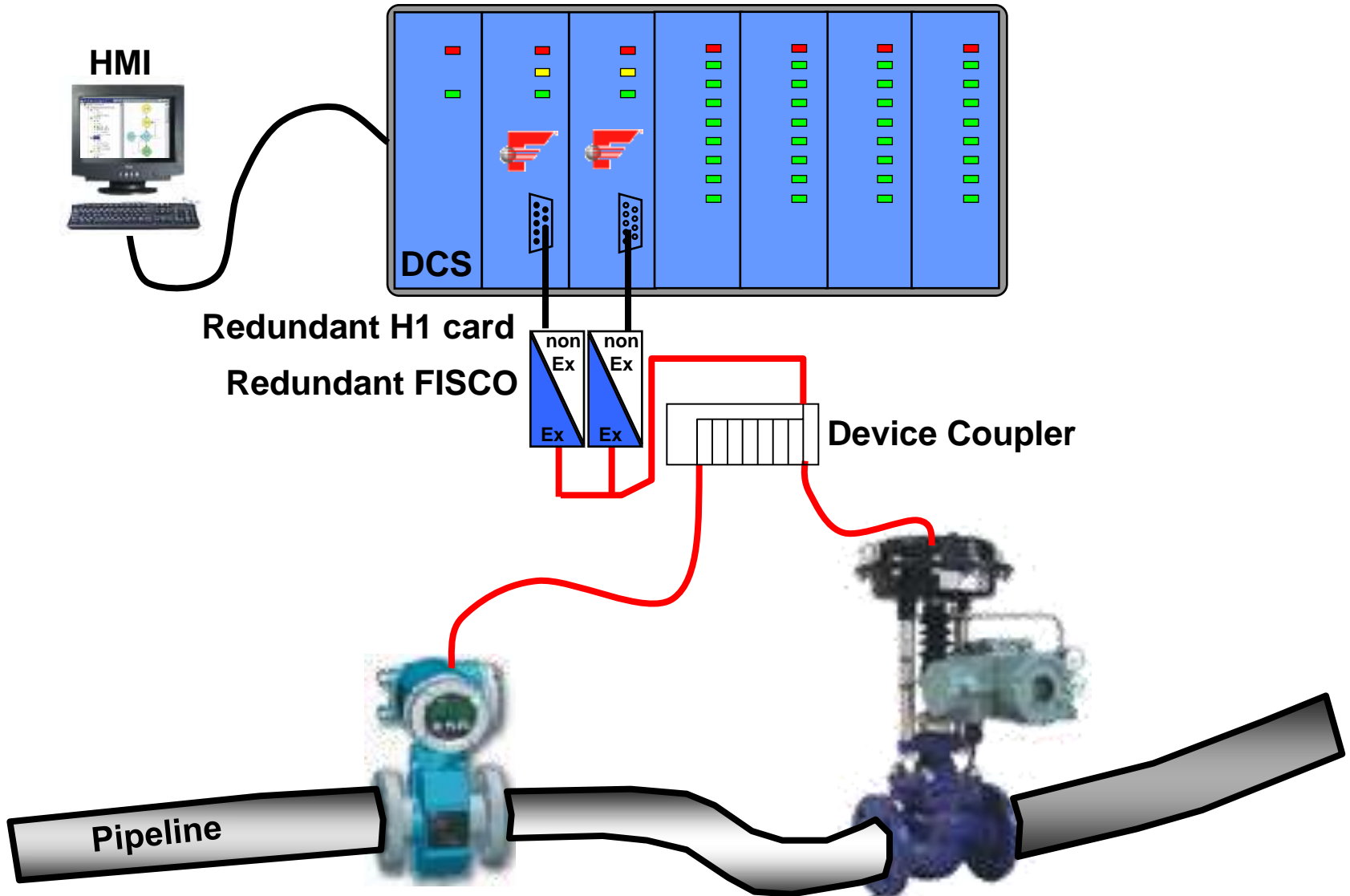
Conventional: A “loop” is often considered the arrangement of equipment between DCS and field device (I/O card, isolator, field instrument, cabling).

It is usually *not* the “logical” loop (e.g. AI, PID, AO).

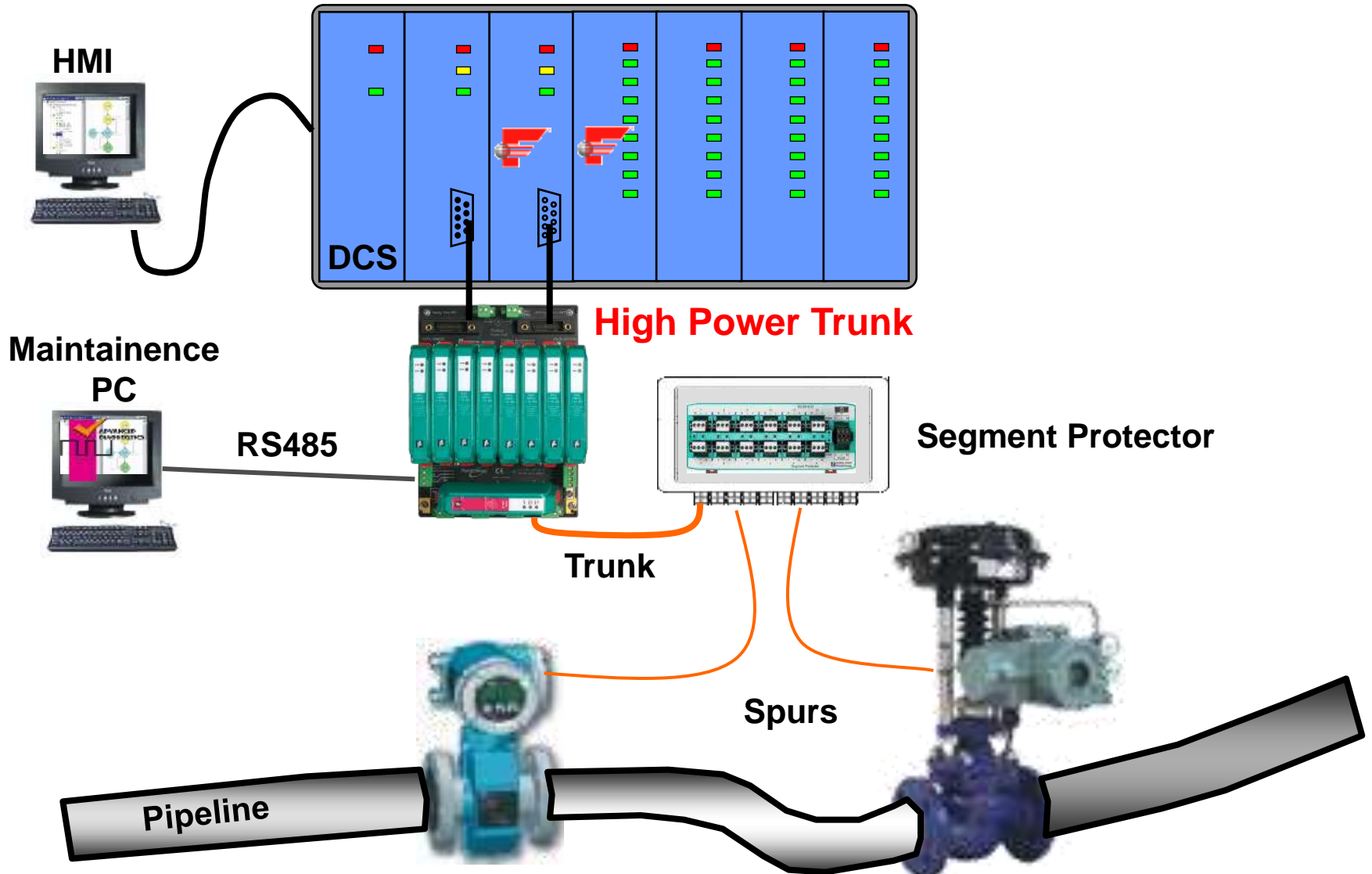
Design – Perception of single loop integrity



Design - Single loop integrity on FF



Design - Single loop integrity on FF



Benefits by Bus structure

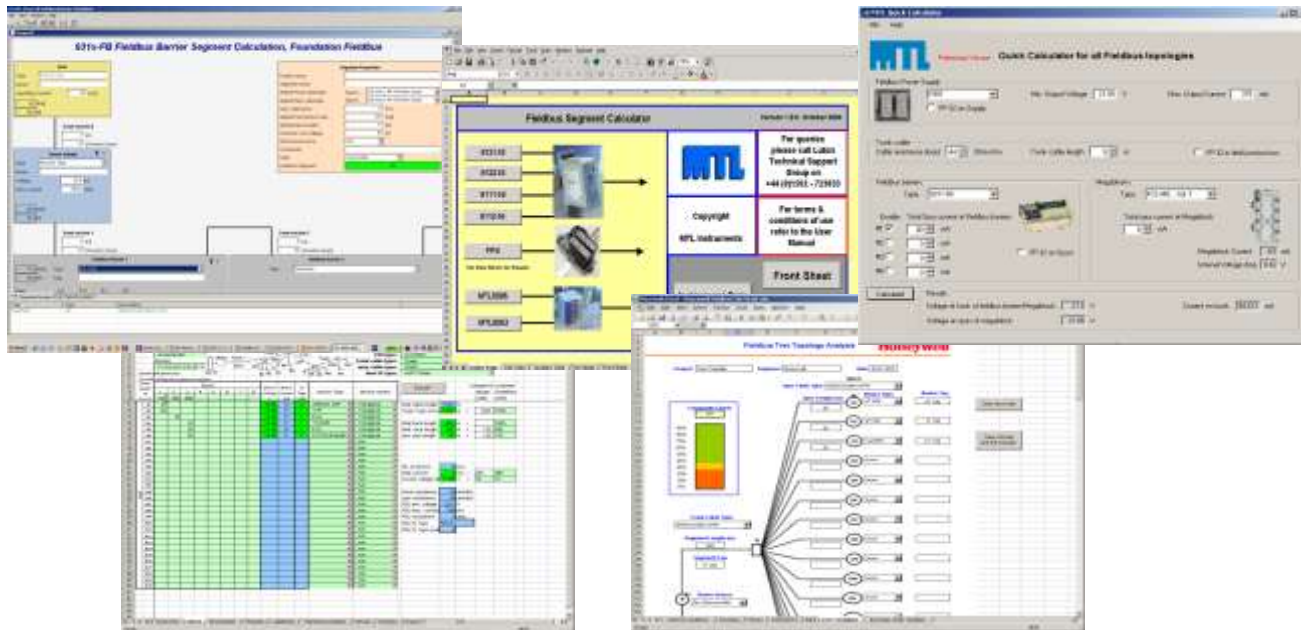
- Foundation Fieldbus enables single Loop Integrity
 - AI, PID and AO on the same cable
 - Major components are redundant
 - FF H1 card (host)
 - Redundant FF power supply
 - In conventional (particularly I.S.), more components are involved, so more prone to failure
- Fieldbus is less prone to failure

Benefits by Being Digital

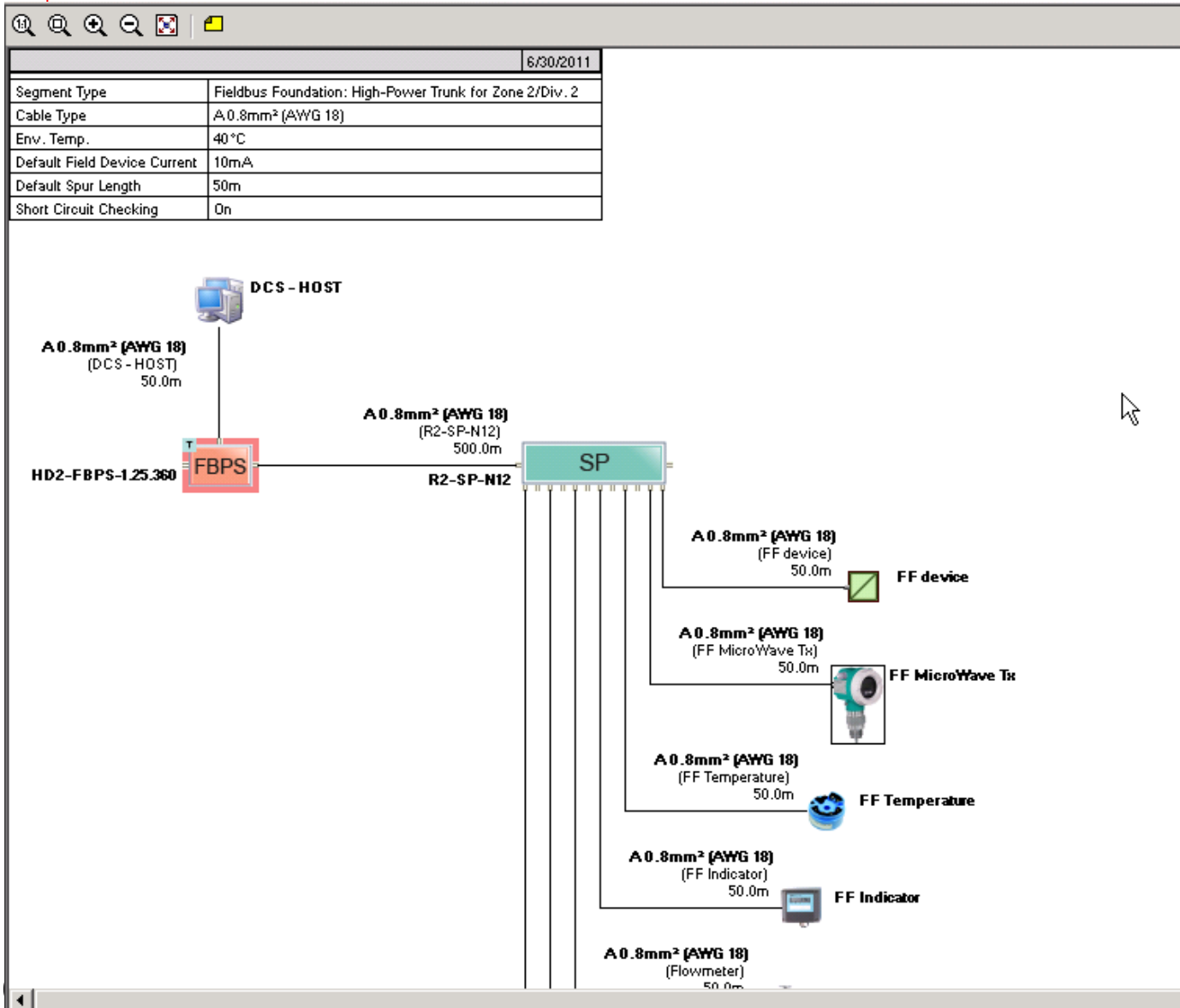
- Digital communication increases signal transmission accuracy
 - Analogue loop: A/D (sensor to device) – D/A (device to cable) – A/A (signal isolator / I.S. barrier) – A/D (DCS) – D/A (DCS) – A/A (signal isolator / I.S. barrier) – A/D (cable to device) - D/A (device to actuator)
 - Fieldbus loop: A/D (sensor to device) - D/A (device to actuator)
(Note that all transmission and DCS calculation is all-digital)
- Higher accuracy by design

Validation of Design

- Easy verification of segment power distribution using software tools
- Individual loop calculations (with individual voltage and current parameters) are not required
- Spur calculations negligible (spur voltage drop is $< 0.1V$)
- Exact lengths do not need to be known



Validation of Design



ers	
	= Fieldbus Foundation: High
	= A 0.8mm ² (AWG 18)
	= 40°C
ent	= 10mA
	= 50m
	= On

	success
rk	success
	success

	1
	1
	1
	1
	1
	1
	1
	1
	1
	1
	1
	900m

Validation of Design

Fieldbus signal:

- Ex parameters standardized
 - FISCO: 17.5V, 380mA, 5.32W (IEC 60079-27)
 - Entity: 24V, 250mA, 1.2W (FF-816)
- Input voltage at field instrument: 9V (IEC 61158-2)
- Device currents: typical 17mA (AG-181 Rev 2.1), formerly 20mA assumed.

A study suggests 15.29 mA calculated average, and 63% of registered devices having 15mA current or less.

Source: <http://forums.fieldbus.org/showpost.php?p=5181>

Validation of Design

Conventional signal:

- I.S. barrier Ex parameters (U_0 , I_0 , P_0 , C_0 , L_0) (all different)
- Cable Ex parameter (C_C , L_C)
- For each device:
 - Device Ex parameters (U_1 , I_1 , P_1 , C_1 , L_1) (all different)
 - Actual device current requirement (4-20mA: maximum 22/24mA)
 - Minimum input voltage requirement (all different)
- Actual output voltage of barrier (all different)
- Actual cable resistance (specific resistance and distance)

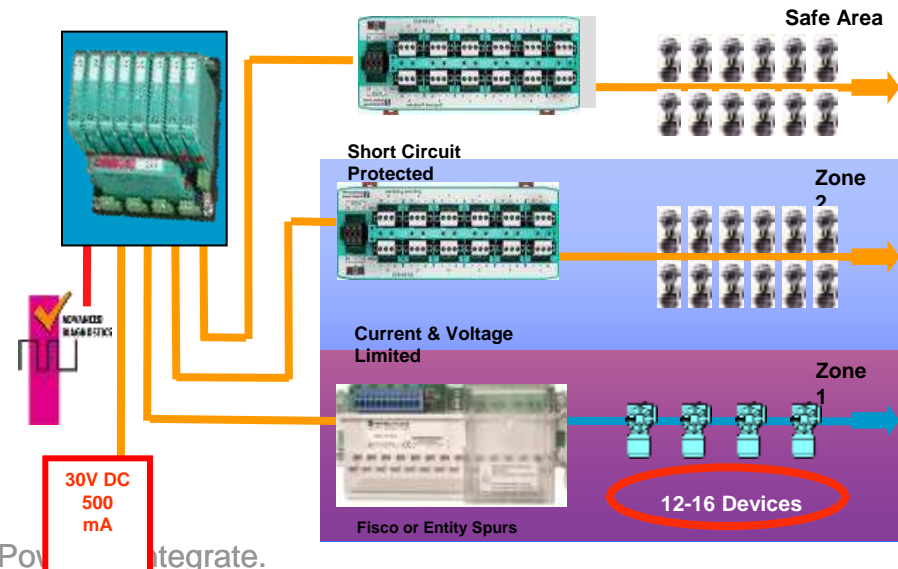
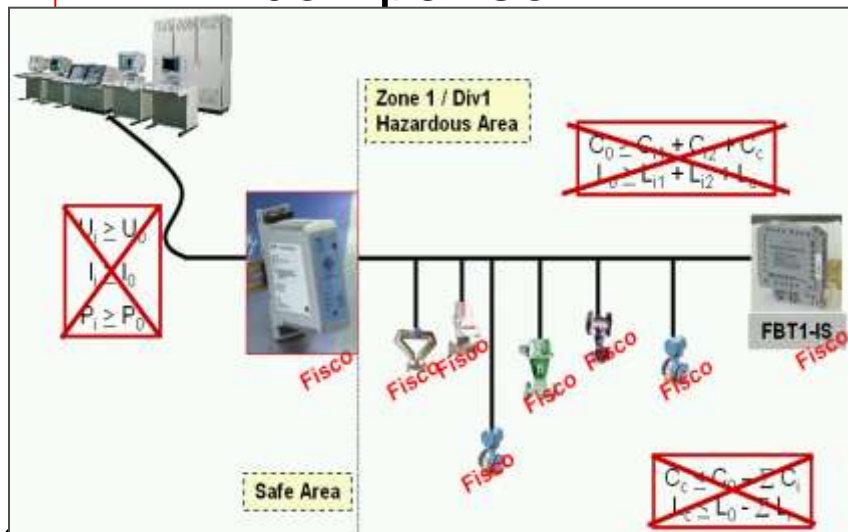
Fieldbus signal:

- FISCO or not (if not, then Ex parameters as above)
- Assumed typical device current (as per AG-181 Rev. 2.1, 17mA)
- Planned number of instruments per segment
- *Estimated maximum* trunk cable length (maybe “5 worst cases” can cover the whole plant)
- Actual output voltage of FF power supply (same for all segments)
- Actual cable resistance (specific resistance and distance)

Validation of Intrinsically Safe Design

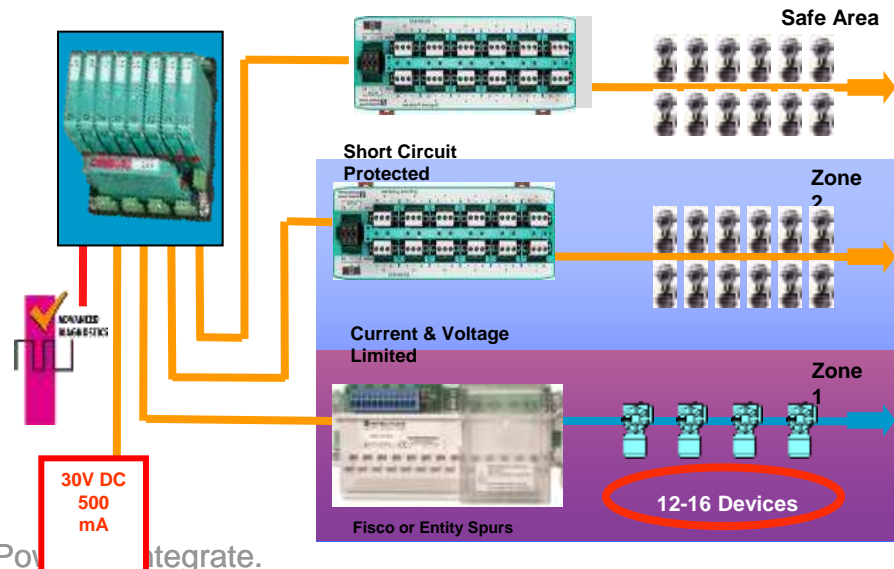
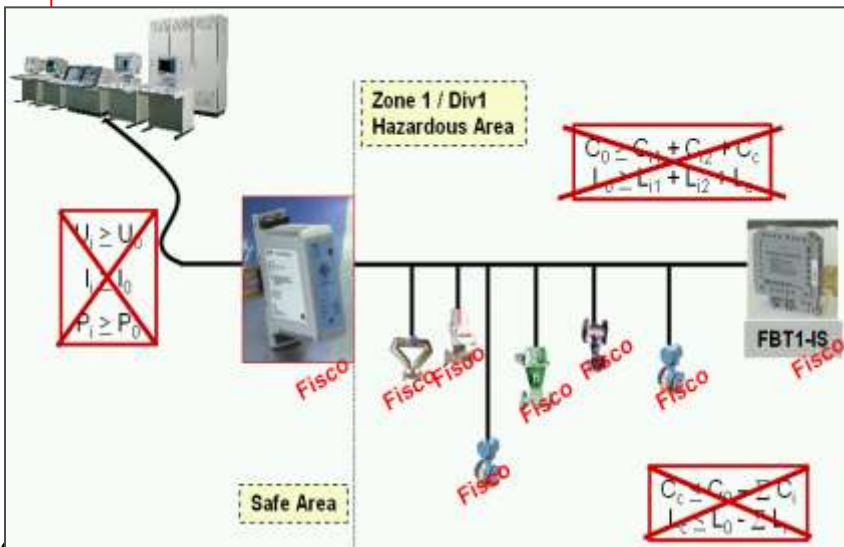
Verification of intrinsic safety

- eliminated using FISCO
 - I.S. demonstrated by following the design rules
- easy for Entity using fieldbus barrier
 - Point-to-point connection (spur)
 - Max. 120m spur length allows to calculate worst case cable parameters, reducing the verification to a simple comparison



Benefits of Validation

- Validation using readily available tools is simpler, and hence less time consuming
- Bus structure simplifies calculations:
 - Only 1 trunk with 1 trunk current vs. many signals in a multicore with different voltages and currents
- IS verification not necessary (FISCO) or simple (entity on fieldbus barrier)



Benefits by Eliminating Marshalling

Flexibility to handle changes and additions late in the project

- Fieldbus is designed with “spares” provisions (spare spurs, spare trunks)
- Signals do not need to be grouped by type (AI/AO/DI/DO/RTD/...), and can simply be connected to any segment
- Change a on/off valve to electric actuator to control valve late in the project without changing I/O cards, drawings, wiring, etc
- Adding further non-control related signals (e.g. for monitoring) does not require infrastructure
- Adding signals does not require change of cabinet drawings
- Fewer intermediate wire connections in the panel simplifies drawings

Summary

Foundation Fieldbus is technology enabling a number of benefits.

Some benefits are derived due to the concept of the technology, being **digital**, having a **bus infrastructure**, allowing **mixtures of protection methods**, and having **many devices on the same cable** allowing **different topologies**.

Other benefits indirectly derived from the network structure, like **eliminated marshalling**, **less components**, **reduced drawings**, **greater flexibility**, etc.

Summary

The main benefits in the design phase are:

- Faster and easier to design
- Greater flexibility
- Reduced validation
- Higher accuracy (digital data throughout)
- Reduced components
- Less prone to failures
- Diagnostics are included, and do not need to be designed-in



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