IPC-HERMES-9852

The global standard for "M2M" in SMT assembly

The Hermes Standard:

The new backbone for board-flow data management in Smart SMT Factories

www.the-hermes-standard.info

IPC-HERMES-9852
The global standard for "M2M" in SMT assembly

Welcome to The Hermes Standard for M 2 M communication

IPC

Our World becomes digital

The Hermes Standard for vendor independent machine-to-machine communication in SMT Assembly.

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IPC-HERMES-9852
The global standard for "M2M" in SMT assembly

Welcome to The Hermes Standard for M 2 M communication

IPC

The Hermes Standard for vendor independent machine-to-machine communication in SMT Assembly.

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IPC-HERMES-9852
The global standard for "M2M" in SMT assembly

Innovation in Communication
“Every Day Life”

All the way from manual switch boards…

… to instant global connections.

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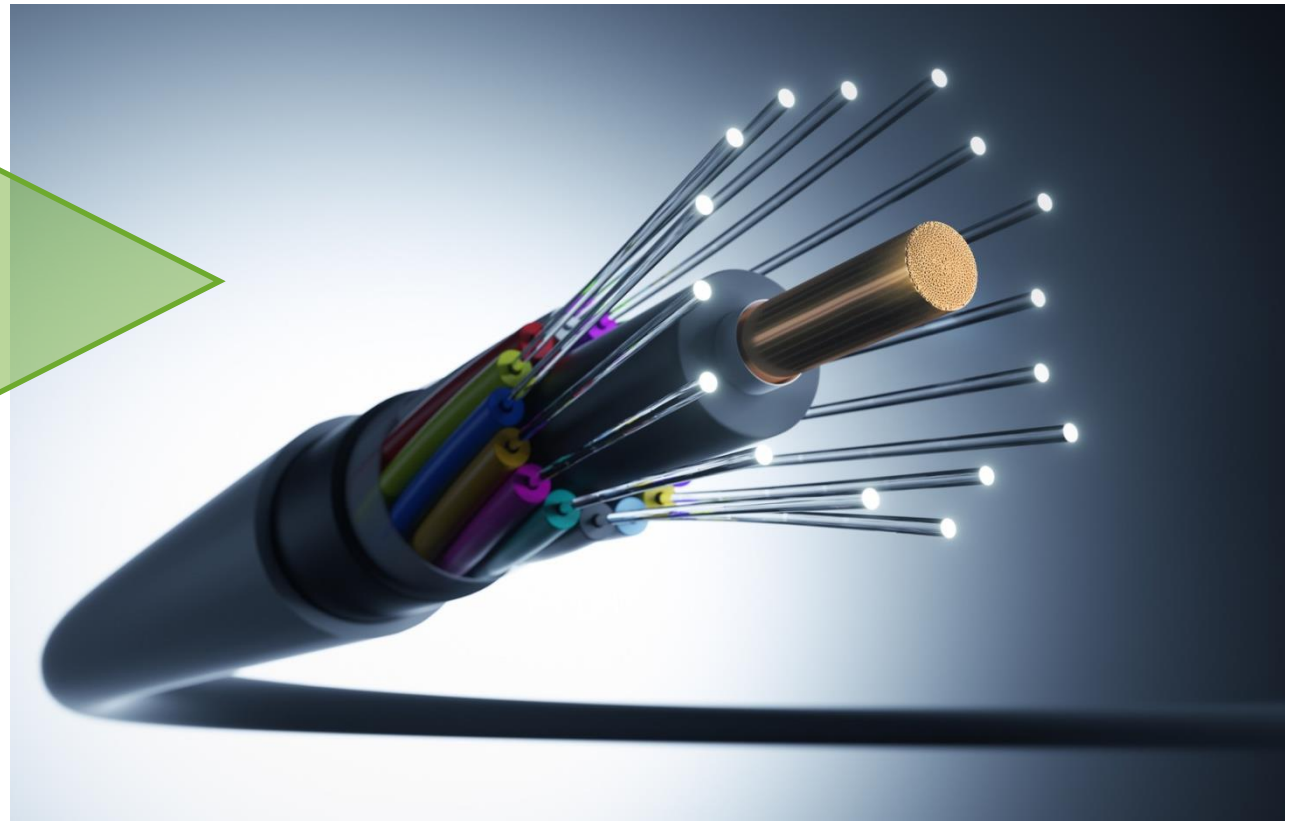
The global standard for "M2M" in SMT assembly

Innovation in Communication
“Telecommunications Infrastructure”

From „One line – Two wires each“…

… to multi channel glass fibre.



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IPC-HERMES-9852
The global standard for "M2M" in SMT assembly

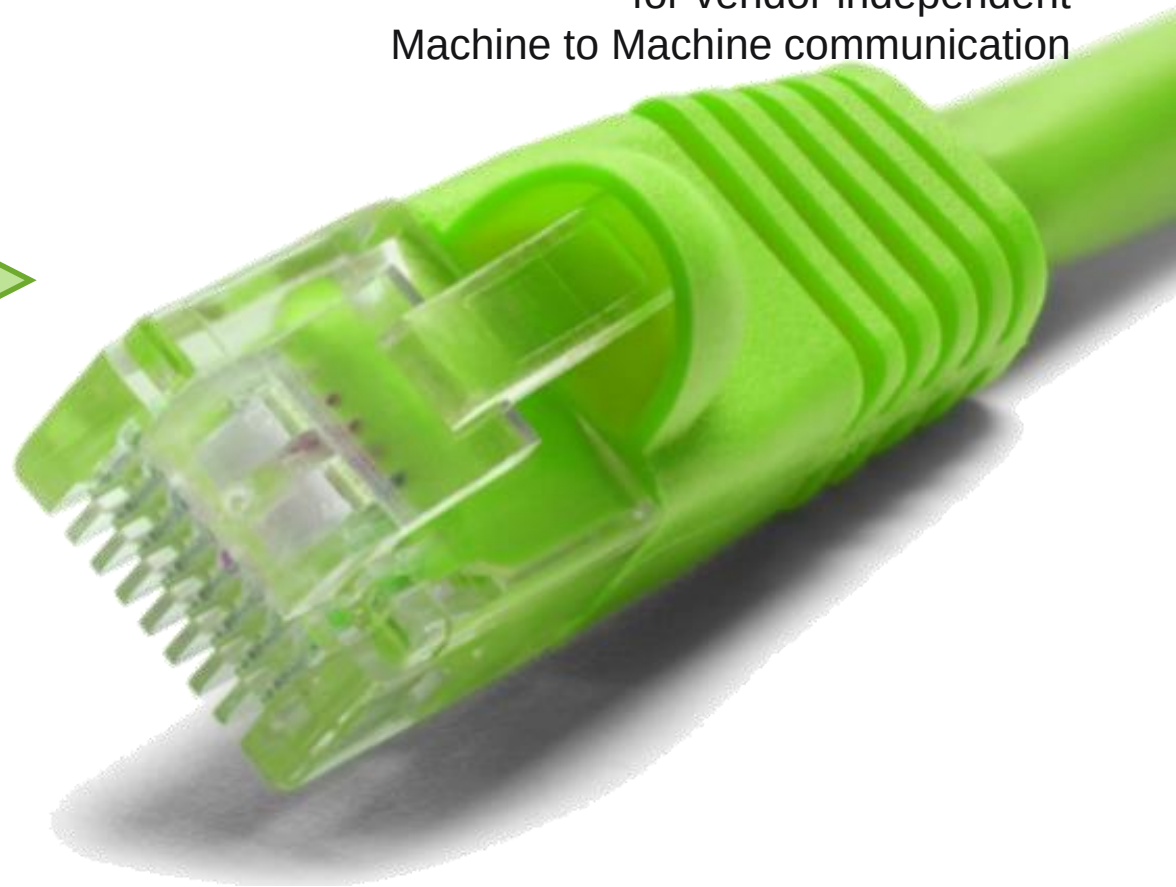
Innovation in Communication
“Along the SMT Line”

IPC

From IPC-SMEMA 9851…

… to The Hermes Standard

for vendor independent
Machine to Machine communication



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IPC-HERMES-9852
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Innovation in Communication
“Along the SMT Line”

From IPC-SMEMA 9851…

… to The Hermes Standard

for vendor independent
Machine to Machine communication

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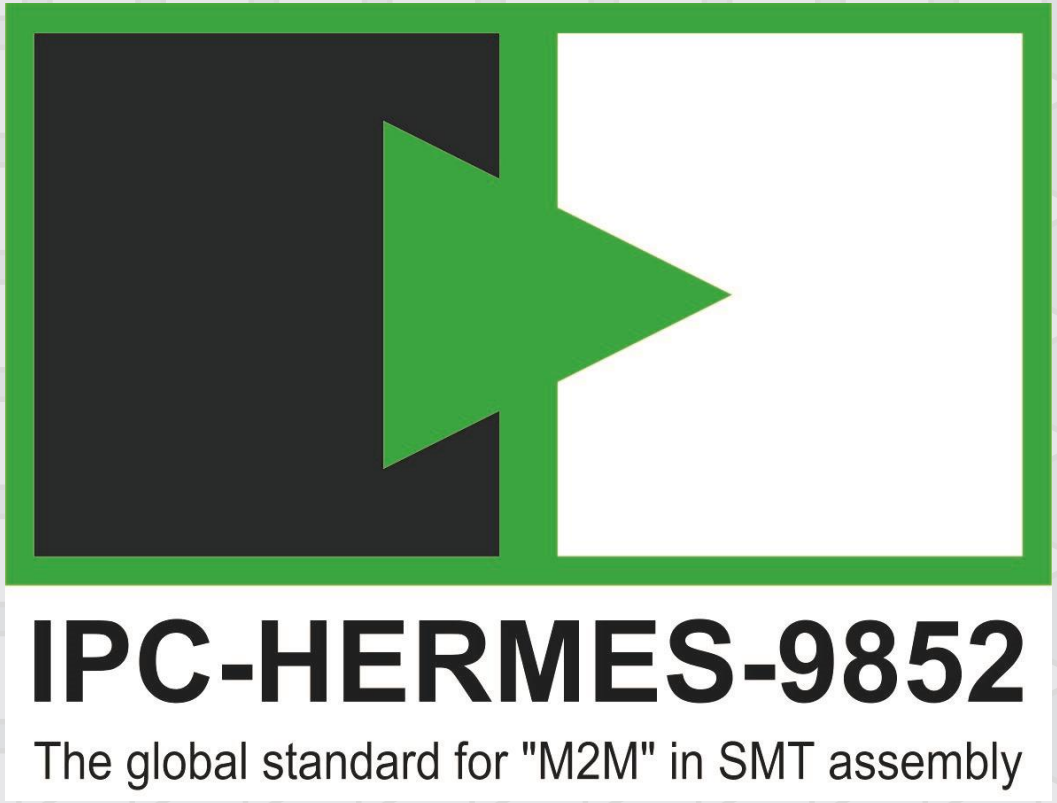
Innovation in Communication

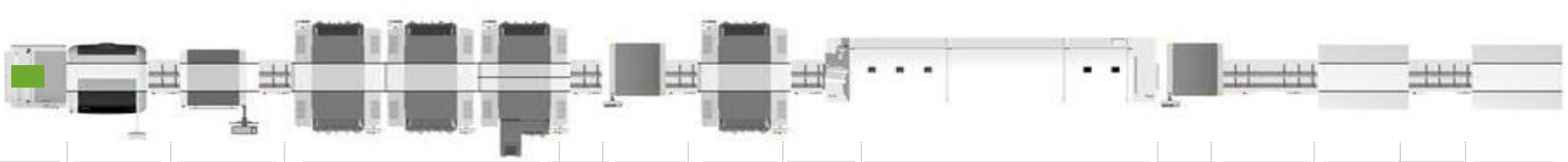
“Welcome to The Hermes Standard”



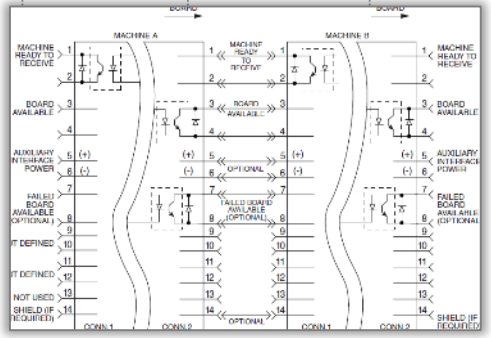
Challenges: The Situation before The Hermes Standard
How does SMEMA* work?

Source: IPC SMEMA 9851 Mechanical Equipment Interface Standard, IPC, Rev. 2007

E.g.: Communication for board transfer



Load | Print | SPI | Place | Trans | CPI | Shield | Trans | Oven | AOI | Repair | ICT | Repair | F-Test



Connector/Cable	Function	Condition	Description
Pair 1-2 (Note 1)	Machine Ready to Receive	Contacts Closed (Notes 2,3)	Machine is ready to receive next board.
Pair 3-4 (Note 1)	Board Available	Contacts Closed (Notes 2,3)	Machine has a good board ready to send. All boards are considered to be "good" if the Board Fail option is not being used.
Pair 5-6	Auxiliary Interface Power (optional)		Available; user to document purpose and operating parameters.
Pair 7-8 (Note 1)	Failed Board Available (Optional)	Contacts Closed (Notes 2,3)	Default (no connection or, if used, contacts are open) is that the incoming board is good and suitable for use. Optional use is to provide closed contacts when it has been determined that the board should stop transfer or be diverted. In such cases, these contacts shall be closed in lieu of (and not in addition to) the normal Good Board Available contacts.
Pair 9-10	Not defined		Available; user to document purpose and operating parameters.
Pair 11-12	Not defined		Available; user to document purpose and operating parameters.
13	Not used	Not used	Not used.
14	Cable shield (Optional)		Cable shield attachment if required; follow good engineering practices (connect at only one end).

Note 1: Minimum requirements are to switch 30 Vdc, 10 mA.
Note 2: At 10 mA, the output "LOW" or contact closure shall not exceed 0.8 Vdc.
Note 3: Assure proper polarity if using optional optical isolator.
Note 4: Existing equipment not built to this standard may require modified pin-out on the connector and/or the interface cable.

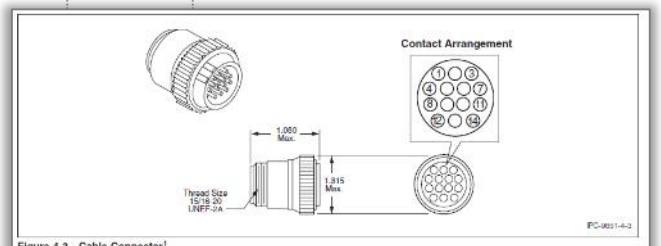


Figure 4-3 Cable Connector[1]

Note 1. All connectors shown are manufactured by AMP®. The following are AMP part numbers.
- 14 position, plug: P/N 206044-1
- Cable Clamp: P/N 206070-1
- Pin: P/N 66593-1

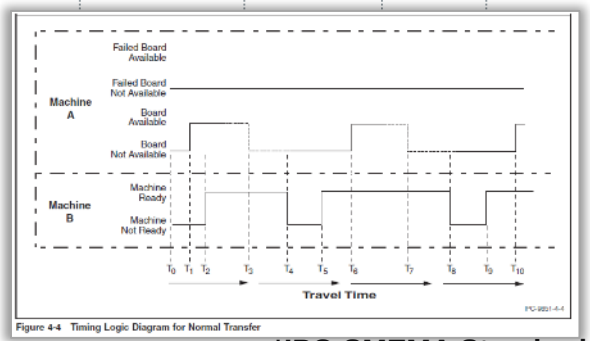


Figure 4-4 Timing Logic Diagram for Normal Transfer

*IPC-SMEMA Standard 9851

Challenges: The Situation before The Hermes Standard
How does SMEMA* work?

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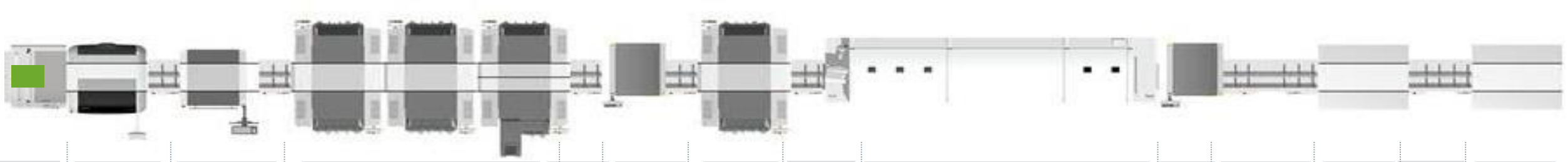
SMEMA reflects the state-of-the-art in automation... of the early 1990s.



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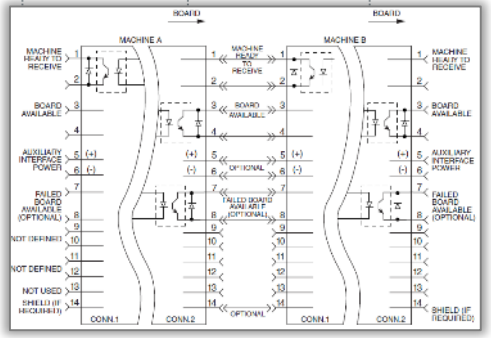

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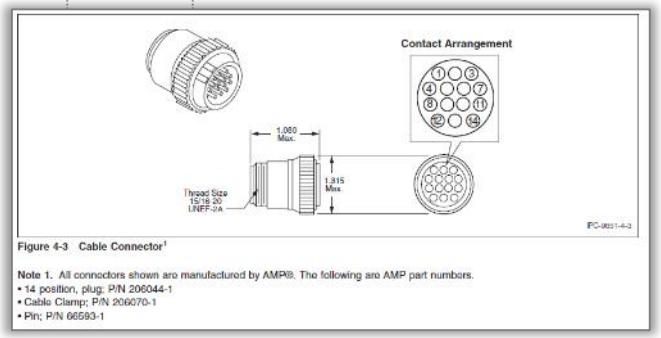

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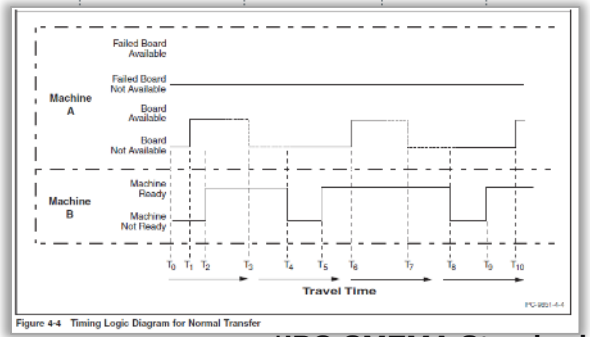
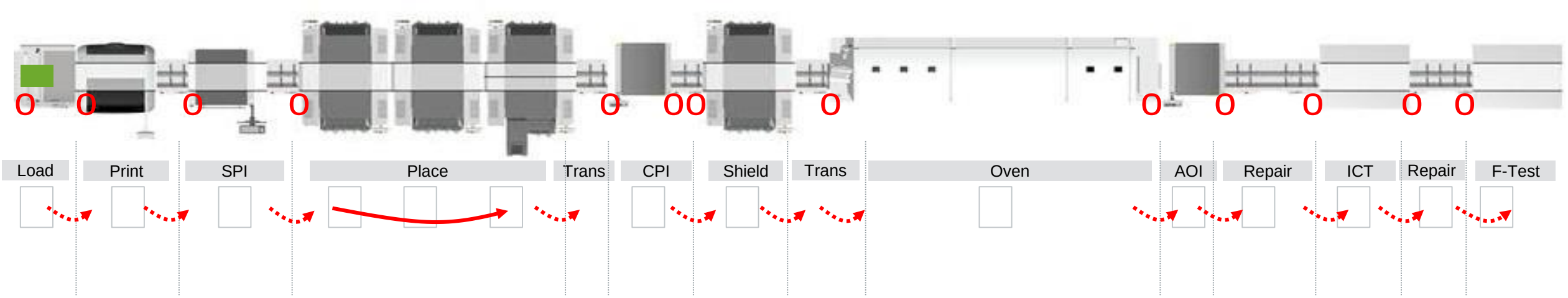


Figure 4-4 Timing Logic Diagram for Normal Transfer

*IPC-SMEMA Standard 9851

Challenges: The Situation before The Hermes Standard
How does SMEMA* work?

E.g.: PCB identification



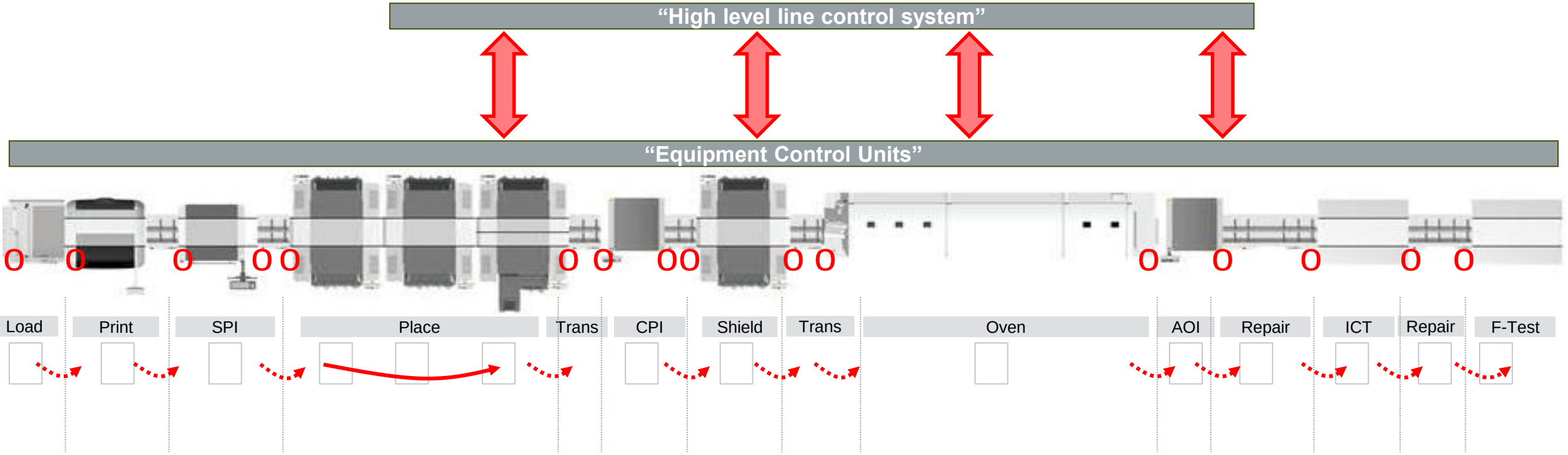
In mixed vendor lines,
ID readers were required
before each machine

o Board ID Scanning required

***IPC-SMEMA Standard 9851**

Challenges: The Situation before The Hermes Standard

High level line control was burdened with additional load and complexity



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Challenges: The Situation before The Hermes Standard

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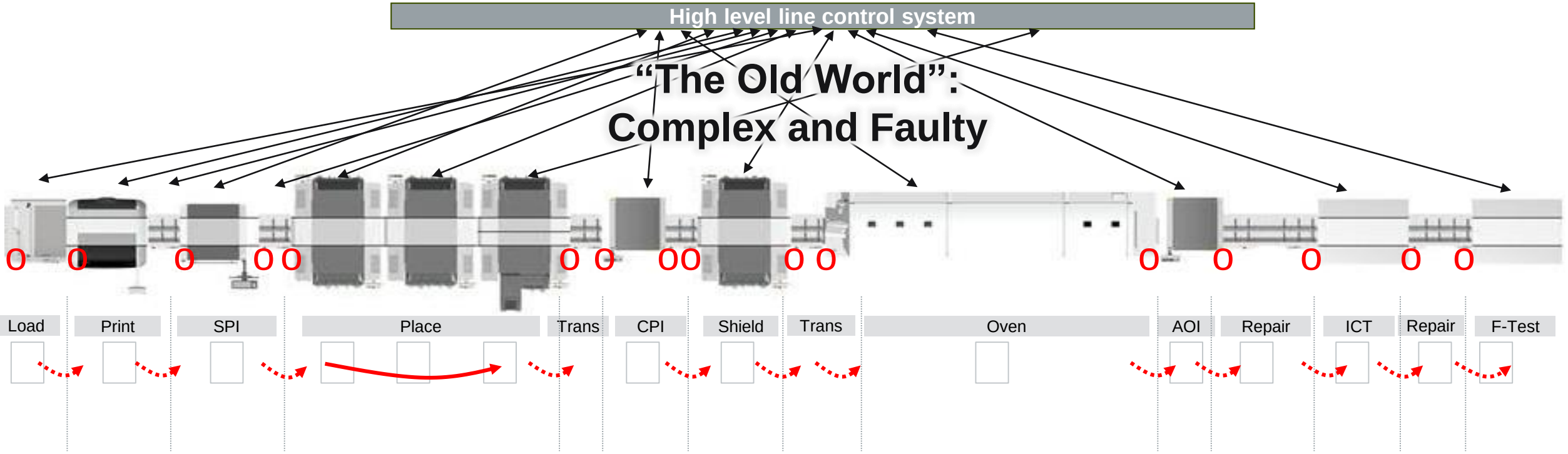

No data available, no closed loop handover.

- Board ID Scanning required

“Old” versus “New”
SMEMA cannot be upgraded to unleash the options of latest technology

IPC-SMEMA-9851

- Multiple cable types. At least 4 different types of cables: Plug – Pin, Plug – socket, Plug – plug and Pin – pin
- Rather expensive due to dedicated HW requirements.
- Need to check each machine to connect for getting the right cable
- Additional information needs to be modulated on the hardware signals
- There is no general system to keep additional information through several machines

SMEMA was leading edge process technology when defined, but it offers no option for “the future”

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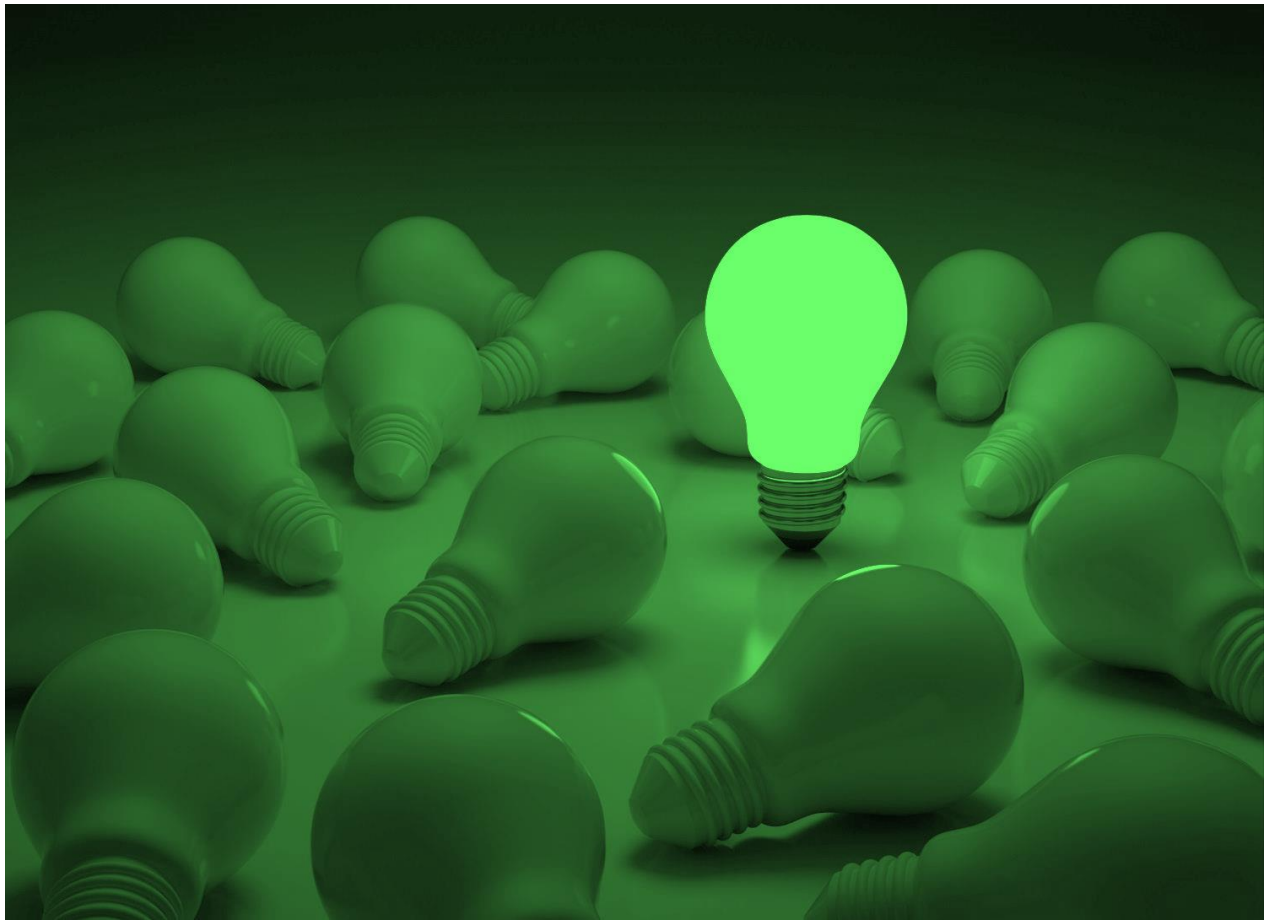
“Old” versus “New”
The Hermes Standard: New Generation Technology

Why is The Hermes Standard the better solution?

- **Protocol based** instead of “signal based”:
  Easy to adjust and easy to expand for integrating further information.
- **Standard components** instead of “special needs”:
  Cables, plugs and interfaces inexpensive and easily available .
- **Integrated data management** versus separation:
  Consistent board and data assignment.



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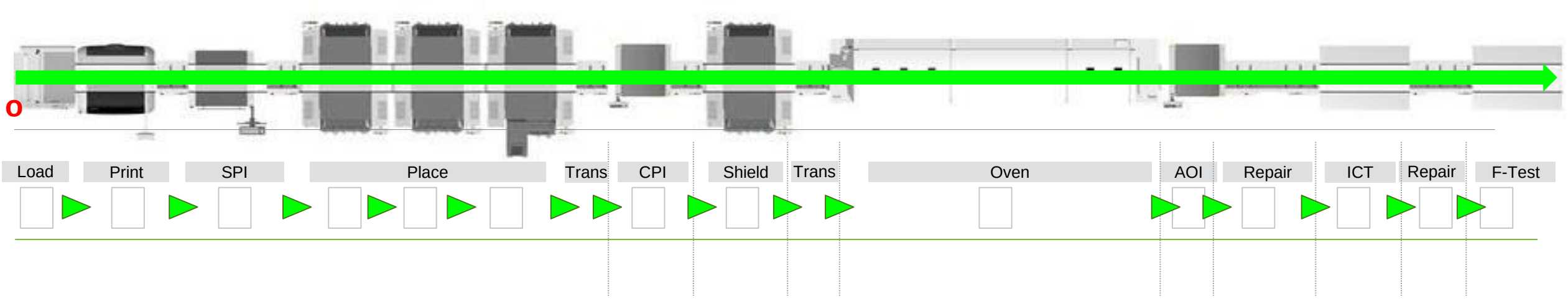
The Hermes Standard (IPC-HERMES-9852)

Full Process data availability, maximum line throughput & traceability.

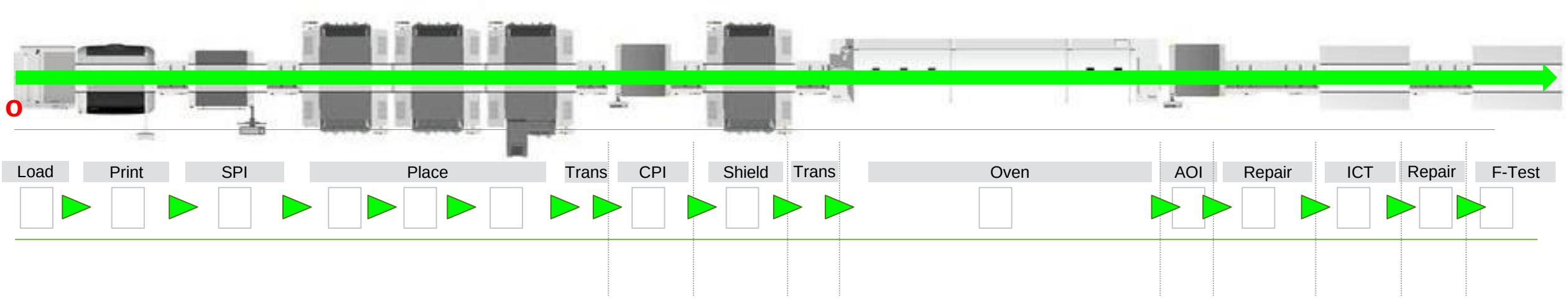


- Standardized M to M Interface via The Hermes Standard

- Need for board identification (Barcode scanning / RFID reading, etc) only once per line and typically at the beginning:

The Hermes Standard (IPC-HERMES-9852)

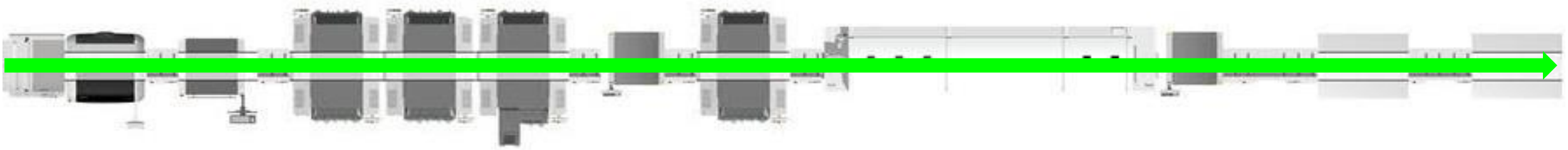
Full Process data availability, maximum line throughput & traceability.



The product drives the change!

The Hermes Standard (IPC-HERMES-9852)

Full Process data availability, maximum line throughput & traceability.



1) Generic communication back bone to work even in mixed-brand equipment lines.

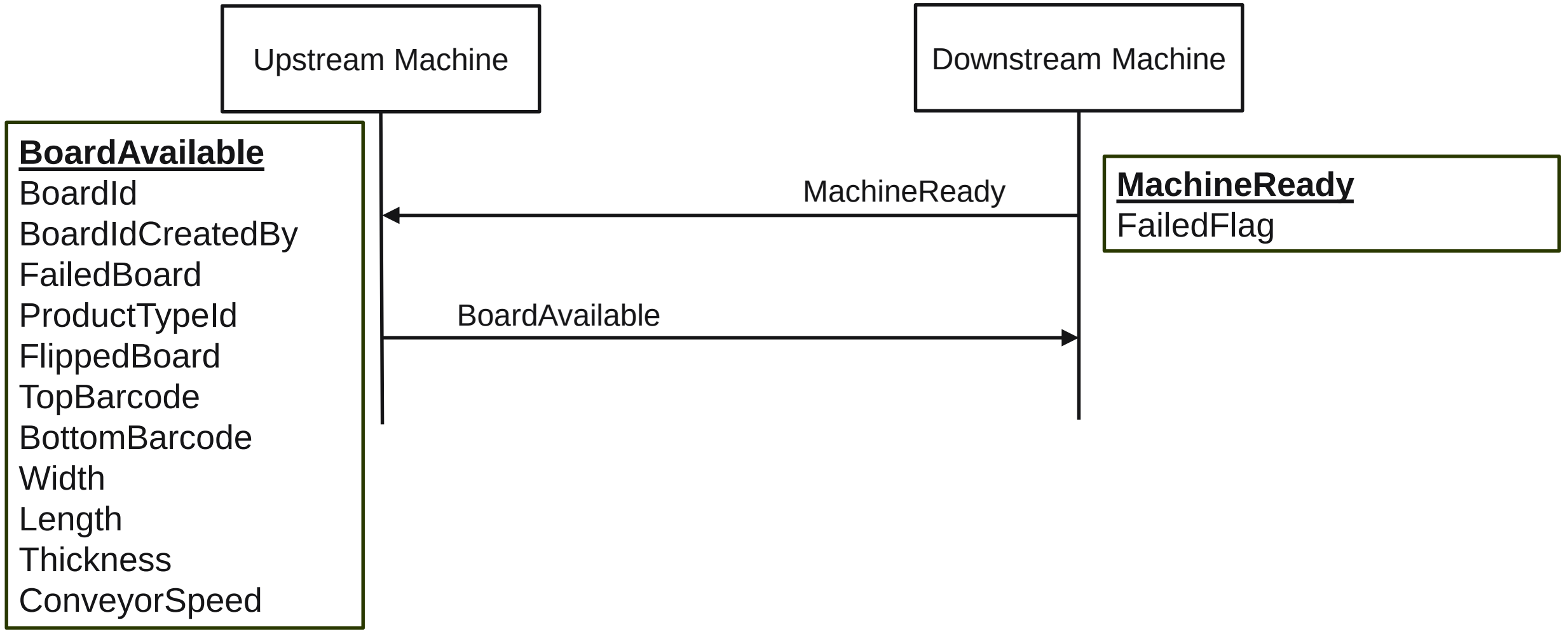
2) Product centric approach, keeping complexity under control.

3) Board tracking along the entire line with single board ID reading possible.

4) Open protocol, adaptable to further and future requirements.

5) Standard Interfaces (Ethernet) reduce cost and effort for installation.

The Hermes Standard protocol: “step by step”
Signalling MachineReady (downstream) and BoardAvailable (upstream)



The Hermes Standard protocol: “step by step”
What kind of data can be transmitted?

BoardAvailable	Type	Range	Optional	Description
BoardId	string	GUID	no	Indicating the ID of the available board
BoardIdCreatedBy	string	non-empty string	no	MachineId of the machine which created the BoardId (the first machine in a consecutive row of machines implementing this protocol). The MachineId is part of the Hermes configuration.
FailedBoard	int	0 .. 2	no	A value of the list below
ProductTypeId	string	any string	yes	Identifies a collection of PCBs sharing common properties
FlippedBoard	int	0 .. 2	no	A value of the list below
TopBarcode	string	any string	yes	The barcode of the top side of the PCB
BottomBarcode	string	any string	yes	The barcode of the bottom side of the PCB
Length	float	positive numbers	yes	The length of the PCB in millimeter.
Width	float	positive numbers	yes	The width of the PCB in millimeter.
Thickness	float	positive numbers	yes	The thickness of the PCB in millimeter.
ConveyorSpeed	float	positive numbers	yes	The conveyor speed preferred by the upstream machine in millimeter per second

FailedBoard may be one of the following values:

0 Board of unknown quality available
1 Good board available
2 Failed board available

FlippedBoard may be one of the following values:

0 Side up is unknown
1 Board top side is up
2 Board bottom side is up

The Hermes Standard protocol: “step by step”
What is a GUID?

Globally Unique Identifier

eg. 123e4567-e89b-12d3-a456-426655440000

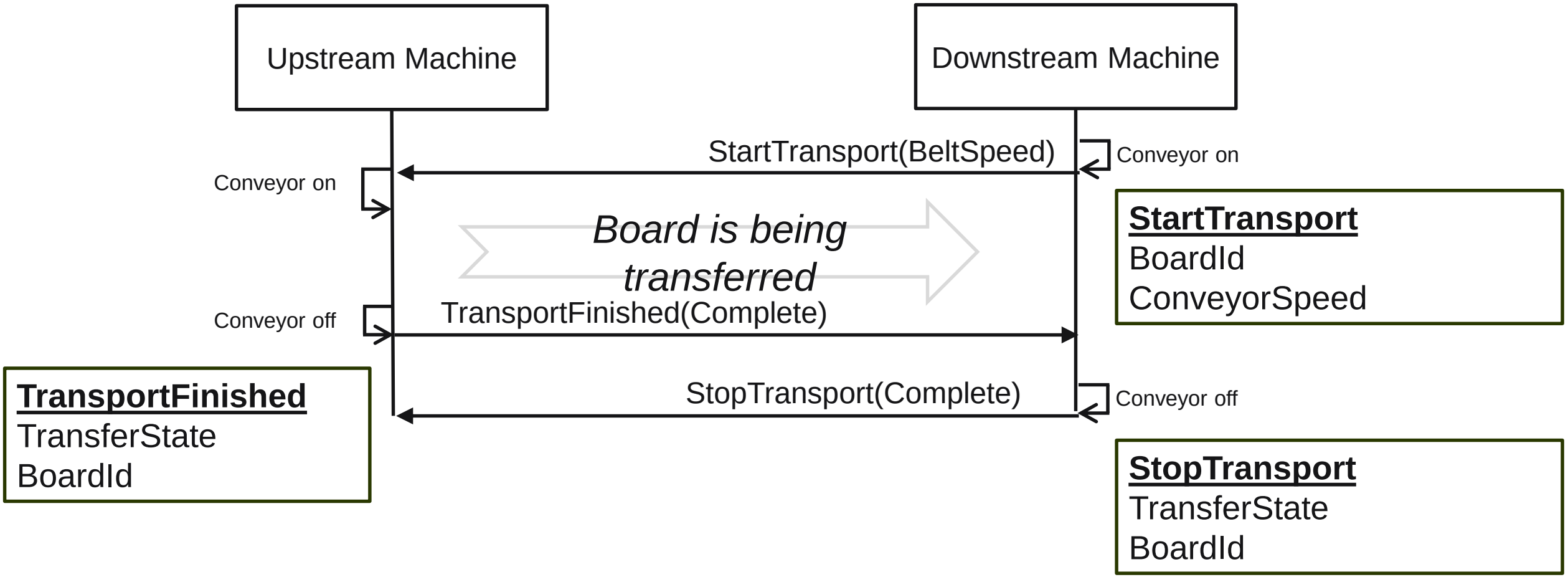
Chances of collision are negligable

5.3x10^{36} randomly generatable GUIDs exist

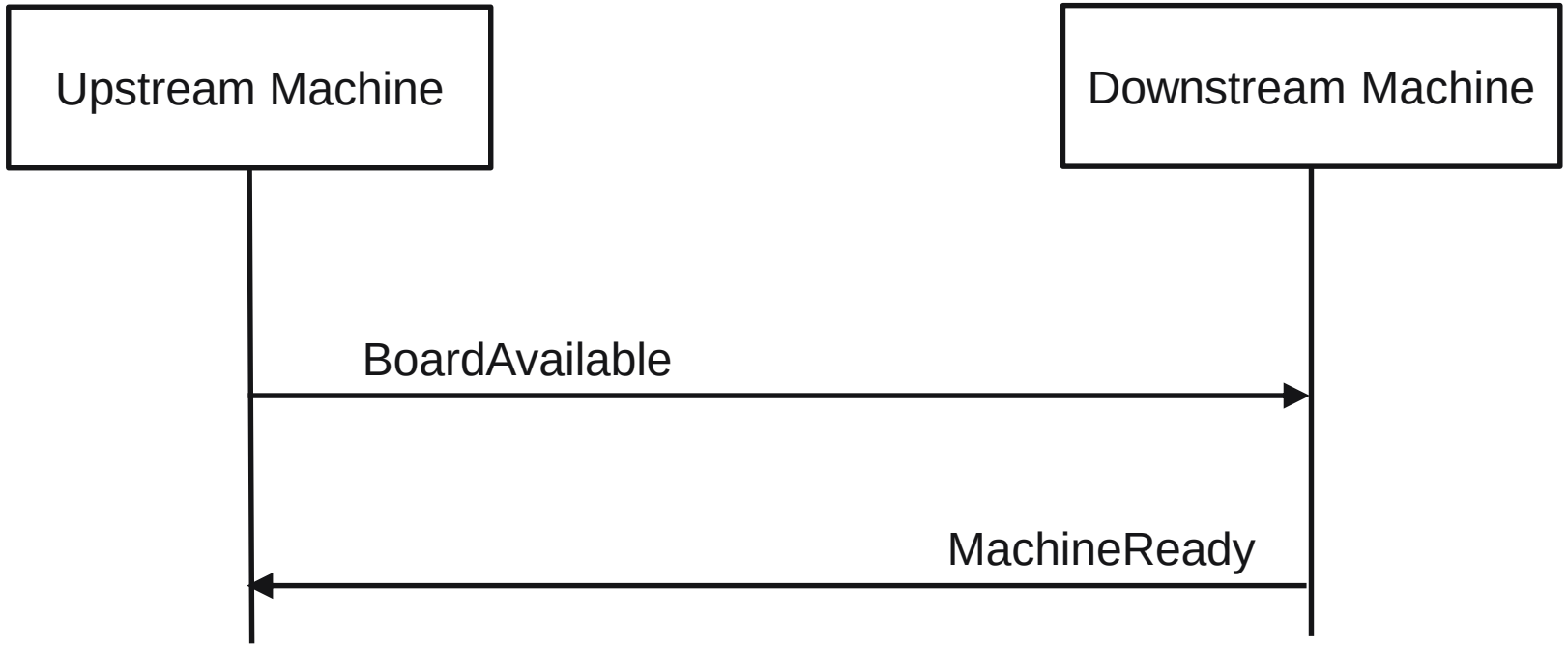
Need to generate 2.7x10^{18} for a 50% collision chance

Hermes uses GUIDs as a handle to uniquely identify and track boards

The Hermes Standard protocol: “step by step”
Board Handover



The Hermes Standard protocol: “step by step”
… and so on …



Standing on the shoulders of giants: TCP/IP and XML

TCP/IP

Reliable connection-oriented communication protocol

Provides time-out handling

XML

Tagged data to ensure compatibility with future versions of Hermes

Predefined W3C standards for date, time, representation of floating point numbers etc.

For simplicity, restricted to UTF-8 (for Hermes 1.0, this effectively amounts to ASCII).

Overhead in size irrelevant for Hermes messages

IPC-HERMES-9852
The global standard for "M2M" in SMT assembly

Welcome to The Hermes Standard
IPC-HERMES-9852 for M 2 M communication

IPC

The Hermes Standard gets everything connected.

The Hermes Standard for vendor independent machine-to-machine communication in SMT Assembly.

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Connectivity Needs Cooperation

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IPC-HERMES-9852
The global standard for "M2M" in SMT assembly

The Hermes Standard Initiative
Core guidelines

- **The Hermes Standard Initiative is a joint project of leading vendors of electronics assembly equipment.**
- **Active participation is open to all vendors of electronics assembly equipment.**
- **All members are equally important in a fair and open decision making process.**

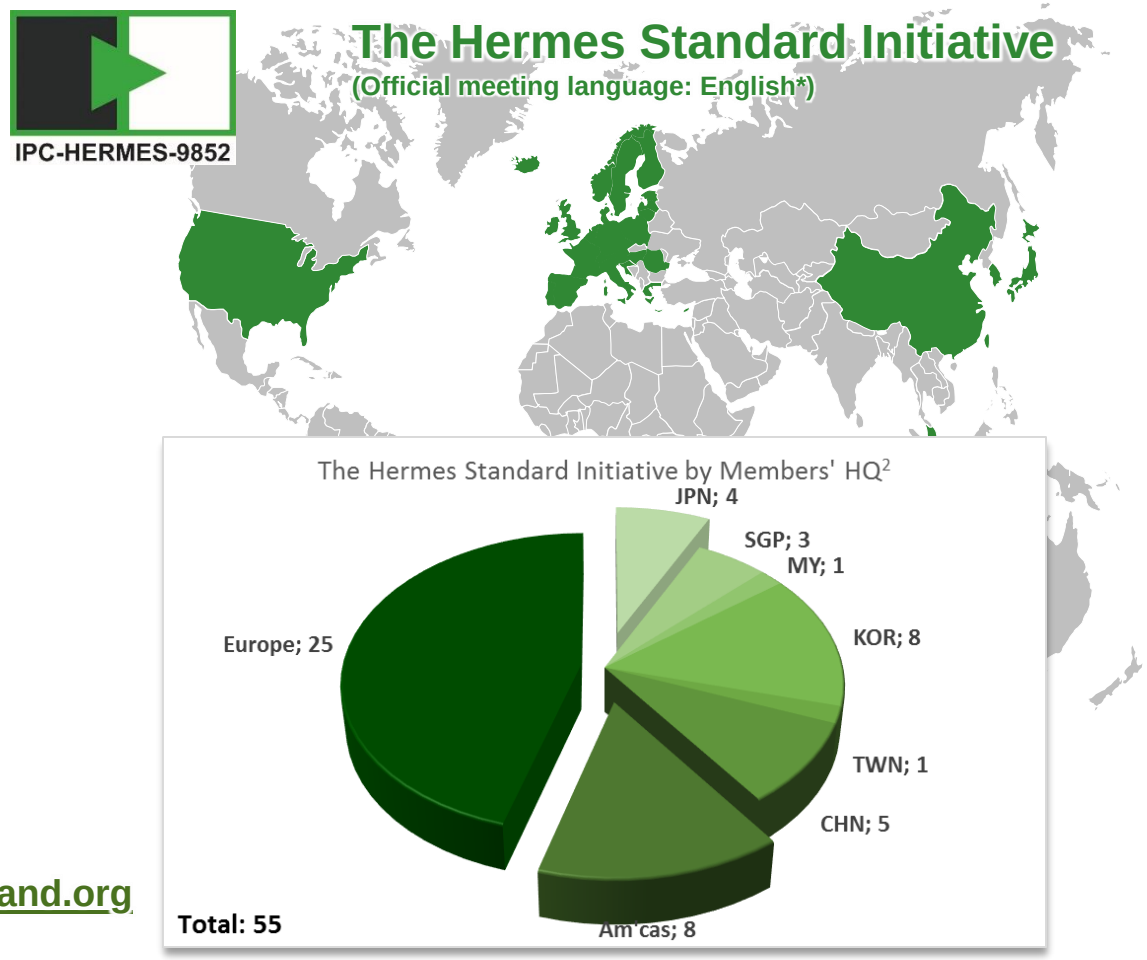
IPC-HERMES-9852
The global standard for "M2M" in SMT assembly

The Hermes Standard Initiative
A global footprint defines a global standard

All equipment vendors are invited to join!

The Hermes Standard Initiative		
Achat5	Holly	Rejoint
allSMT	ILJIN	Rundfunk Gernrode
ASM	IPTE	SAKI
ASYS	ITW	SEHO
BESI	JAPAN UNIX	SEICA
BTU	KIC	Seica Automation
CTI	KOH YOUNG	SMT
CTS	kolb CLEANING TECHNOLOGY	Solderstar
CYBEROPTICS	Kulicke and Soffa	Sonic Technology
ECD	Magic Ray Technology	SPEA
Kurtzersa	MIRTEC	SYSTECH Europe
EUNIL	MYCRONIC	TRI
EXELSIUS	Nordson Asymtec	Universal Instruments
FENIX	NUTEK	VISCOM
FlexLink	OMRON	ViTrox
GKG	OSAI	YJ LINK
Göpel	PARMI	Yxlon
Hanwha	PEMTRON	
Heller	REHM	

- **All vendors of SMT equipment are invited to join.**
- **Participation is free of charge.**
- **All results are published via www.the-Hermes-standard.info**
- **Committed to open standard principles as published at www.open-stand.org**



*A notable comment because at “JARA” meetings, you need to understand Japanese. **If** you are invited at all…

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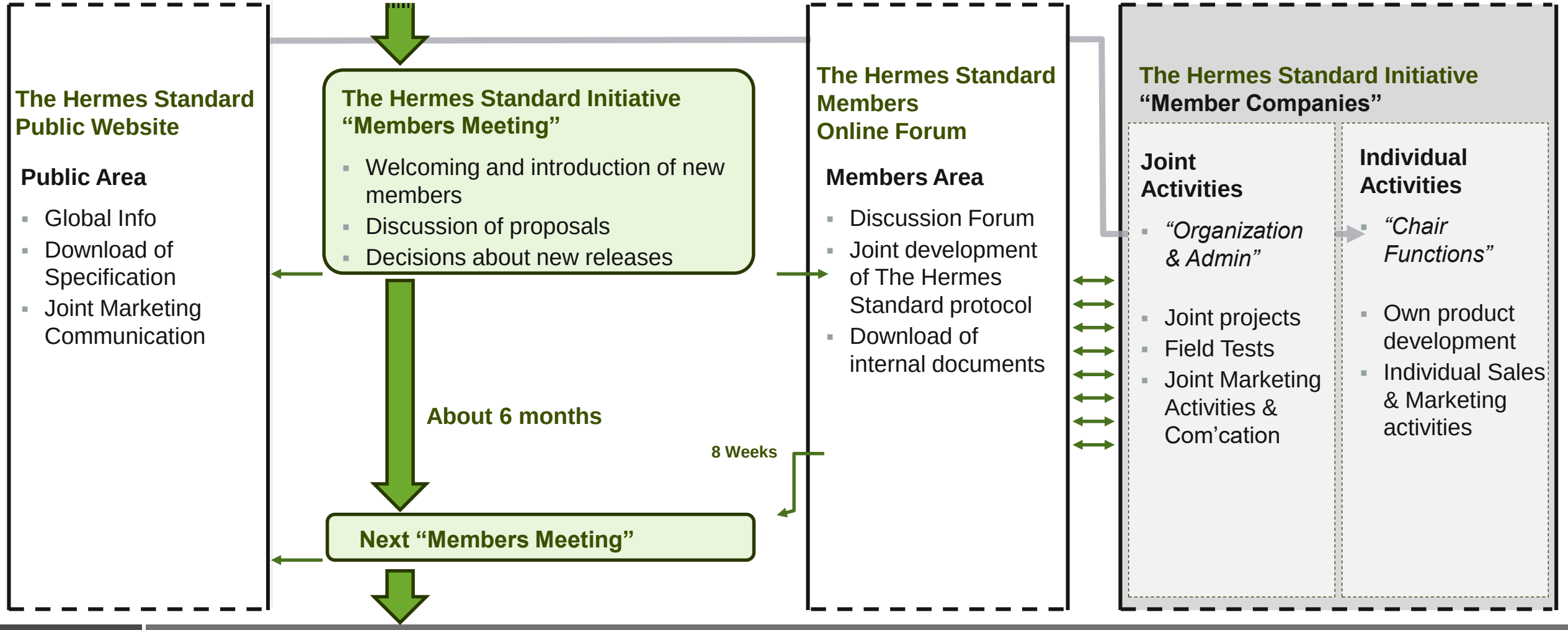
The Hermes Standard Initiative
Digitalization need cooperation



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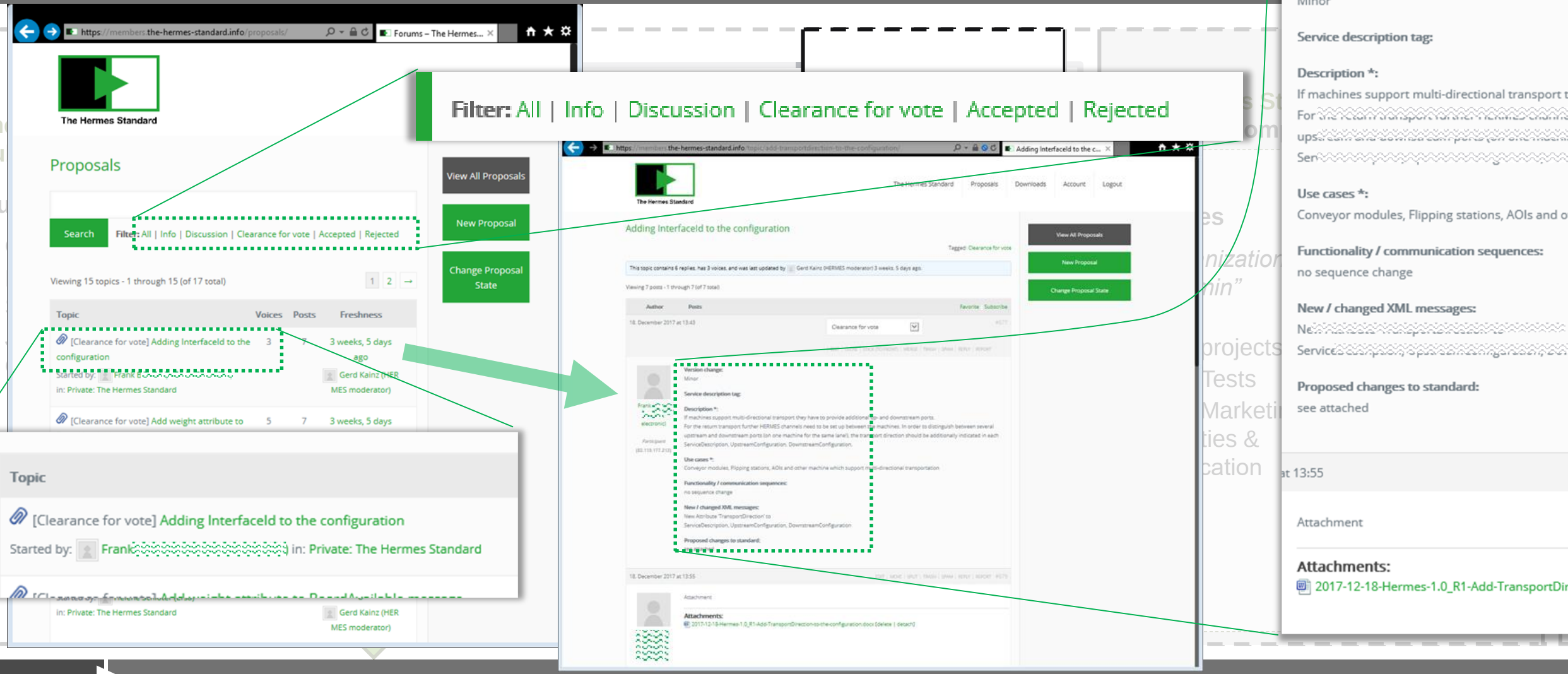

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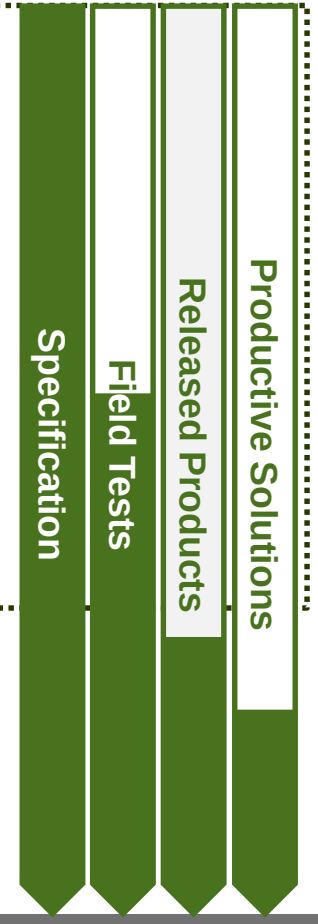
The Hermes Standard time line
"From Zero To Hero" in under 18 months

Early 2016	First Discussions	
March 2017	Foundation Meeting (First "Members' Meeting") Agreement on Release Vso.1.0	16 members
April 2017	Public Website Online	
June 2017	"Members' Forum" website online	
November 2017	Second "Members Meeting", official Go Live!" and exhibiting at Productronica in Munich; Release of Vso 1.0 Rev1	27 members
February 2018	Joint activity with ipc cfx and exhibiting at APEX in San Diego	
April 2018	Third "Members' Meeting" and exhibiting at Nepcon China Planned to release Vso 1.1	~ 45 members
August 2018	Announcement of IPC-HERMES-9852	> 50 members
January 2019	Fourth "Members Meeting" at APEX Expo in San Diego, CA, USA	

Just One Year

Next Event:



The Hermes Standard: Core advantages in a nutshell
The new backbone for board-flow data management in Smart SMT Factories

The Hermes Standard: „Better By Design“

- The Hermes Standard will replace the current “SMEMA” Standard.
- There is only need for one board ID reader for a whole line.
- Based on well established technologies such as TCP/IP and XML, the protocol is easy to adapt to future requirements.
- Utilizing Standard components makes it inexpensive and ultimately flexible.
- Data Management and Traceability features are fully integrated.

The Hermes Standard Initiative: Open, transparent, agile.

- The Hermes Standard Initiative is open for all vendors of assembly equipment.
- Cooperation is based on clear processes and procedures.
- After only one year, about fifty companies are supporting the standard. And the initiative keeps growing

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Thank You!

www.the-hermes-standard.info

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IPC-HERMES-9852

The global standard for "M2M" in SMT assembly

IMAGE SOURCES

Tag	Filename	Fotolia User (now at Adobe.com)
Night Highway	Fotolia_101923684_XL	Martin Lang
Switch Board	Fotolia_104437081_M	everettovrk
Smartphone in cafe	Fotolia_105552827_M	Pab_map
Digital World	Fotolia_111464713_L	bluebay2014
Traffic Chaos	Fotolia_123366219_L	wildman
Hand	Fotolia_127385336_L	chombosan
Glass Fibre	Fotolia_137703376_M	psdesign1
Light Bulb	Fotolia_138558102_XL	masterzphotofo
Handshake	Fotolia_138970001_L	Sergey Nivens
Dead End	Fotolia_145004279_M	javarman
Telephone lines	Fotolia_26000906_M	Fisch
Connected World	Fotolia_67621479_XL	Amgun
Ethernet Cable	Fotolia_91369464_M	pixelrobot
		(All Fotolia images are licensed for ASM Assembly Systems)

Tag	Source	
SMEMA Schematics	ipc.org	Courtesy of ipc
The Hermes Standard	the-hermes-standard.info	Courtesy of The Hermes Standard
SMEMA Plugs	www.englishtaobao.net	Courtesy of LinHao Inc

IPC-HERMES-9852

The global standard for "M2M" in SMT assembly

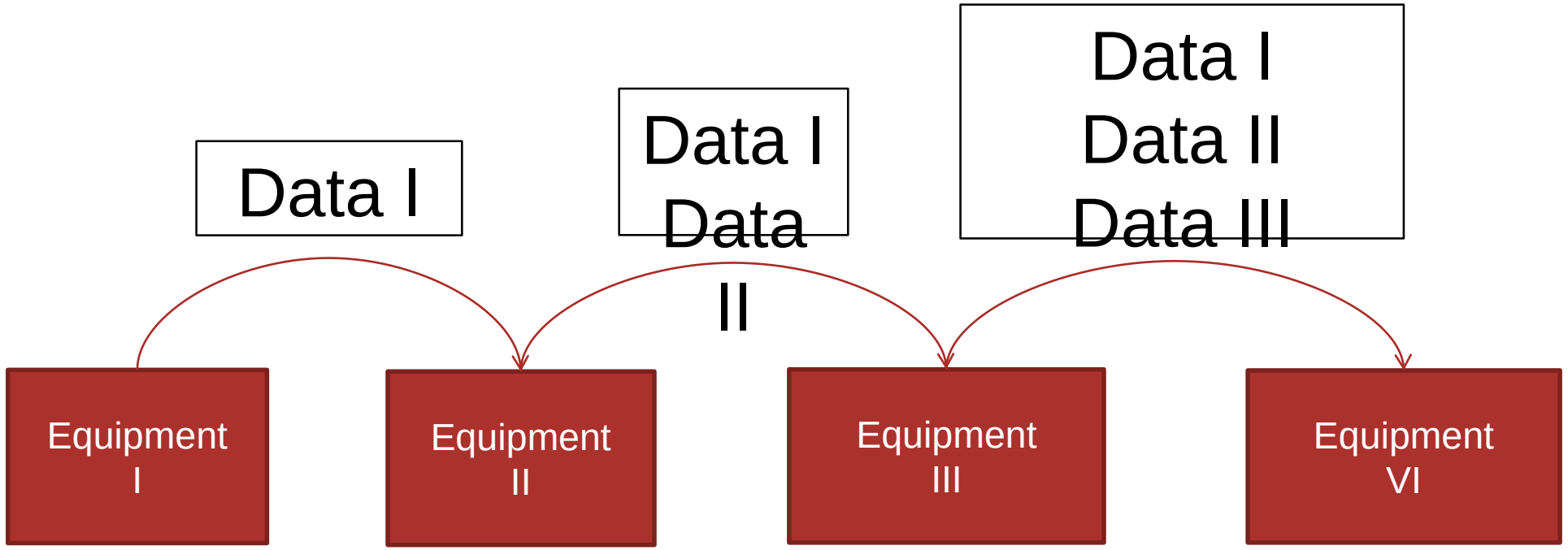
APPENDIX

IPC-HERMES-9852
The global standard for "M2M" in SMT assembly

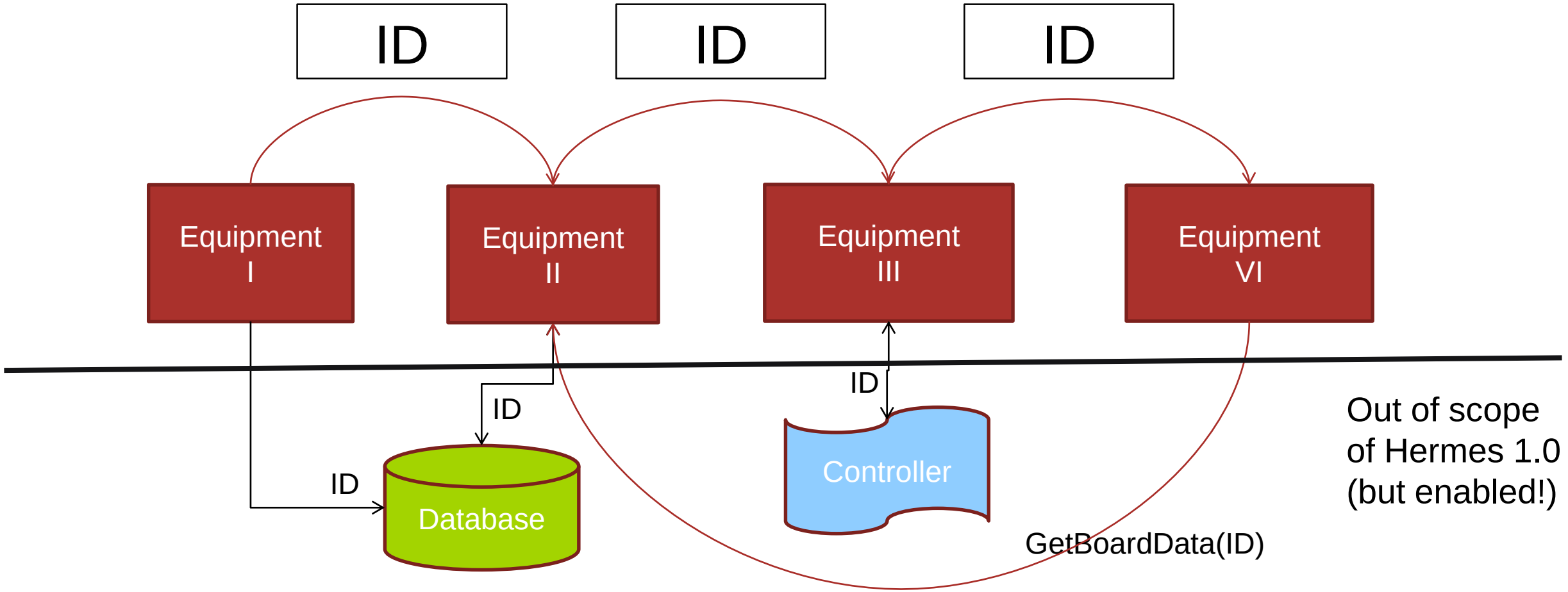
Giving Evidence of current advantages
Old “SMEMA problems” versus The Hermes Standard solutions

The Issue	At SMEMA	At The Hermes Standard (1.0)
1) Scenario definitions in the protocol	▪ Several error scenarios undefined: e.g. PCB is signalled to be handed over but has not arrived because the signal “PCB arrived” is missing	▪ Most error scenarios already defined ▪ Easily expandable in future versions
2) Dealing with defective Cables	▪ Variety of specified cable set makes it hard to bring the exact replacement to the site or requires broad stock.	▪ Only one standard cable type, which is easily and inexpensively available: Ethernet cables.
3) Hardware installation effort	▪ Cables are “hand made” w/o standard lengths. ▪ Installation of SMEMA box & adapter ▪ Separate cables for LAN and SMEMA ▪ “Dual Lane” requires second set of entire hardware	▪ Only Ethernet port necessary ▪ No separate SMEMA cable necessary ▪ “Dual lane” required no (!) additional hardware, it is fully covered by the protocol
4) Synchronizing PCB data and hand-over message	▪ Data is transfer requires separate Ethernet interface ▪ Data must be synchronized with SMEMA signals assigned to PCB ▪ Timing must match all vendors to ensure correct assignment	▪ No synchronization is necessary and no timing issues exist as data is transferred together with handover message. ▪ Implementation of transferring data between different vendors very easy.
5) Flexibility at changing line configurations	▪ Specific cable length is necessary, therefore any change in the line configuration leads to new cabling	▪ Standard Ethernet cables: Easily available and specific length is not required.

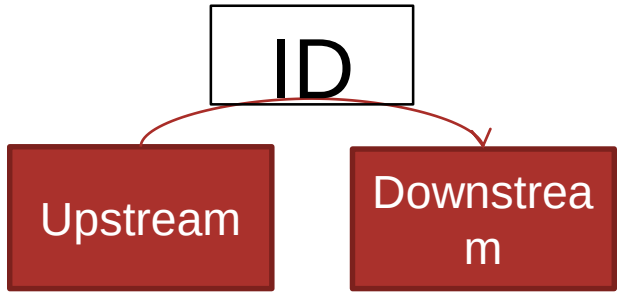
The naïve approach to data transfer

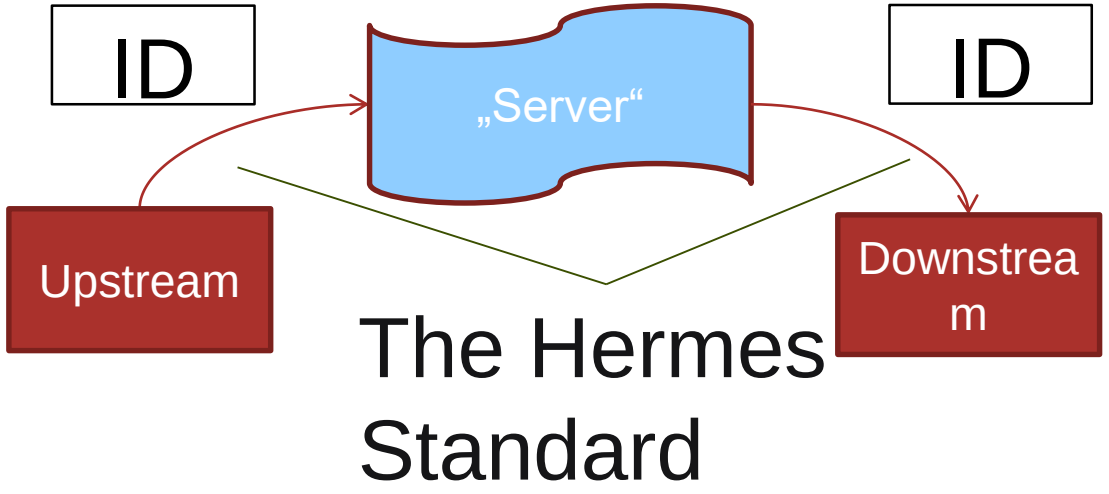


Hermes transfers keys (unique ID, barcode), not data



Hermes: Peer to Peer or Client-Server?



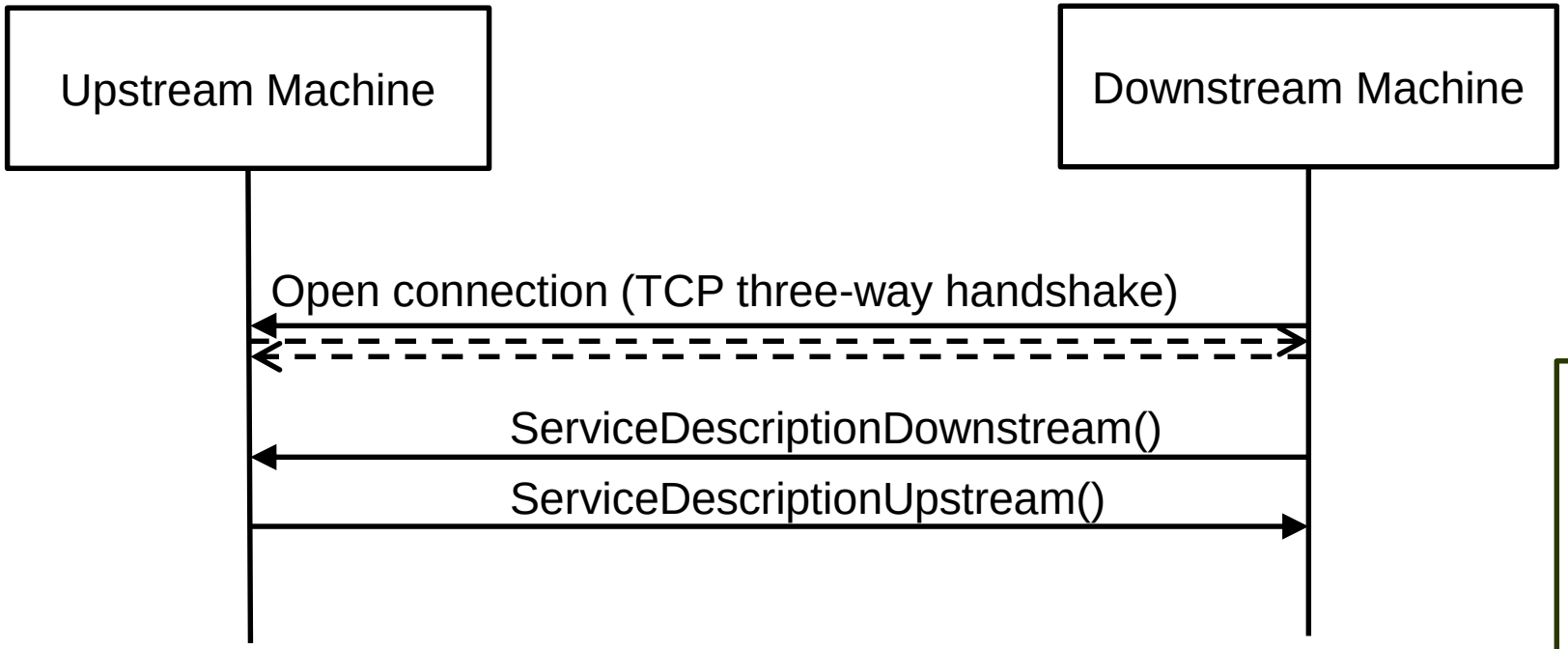


The Hermes Standard

The Hermes Standard facilitates a Server („Man in the Middle“) in order to

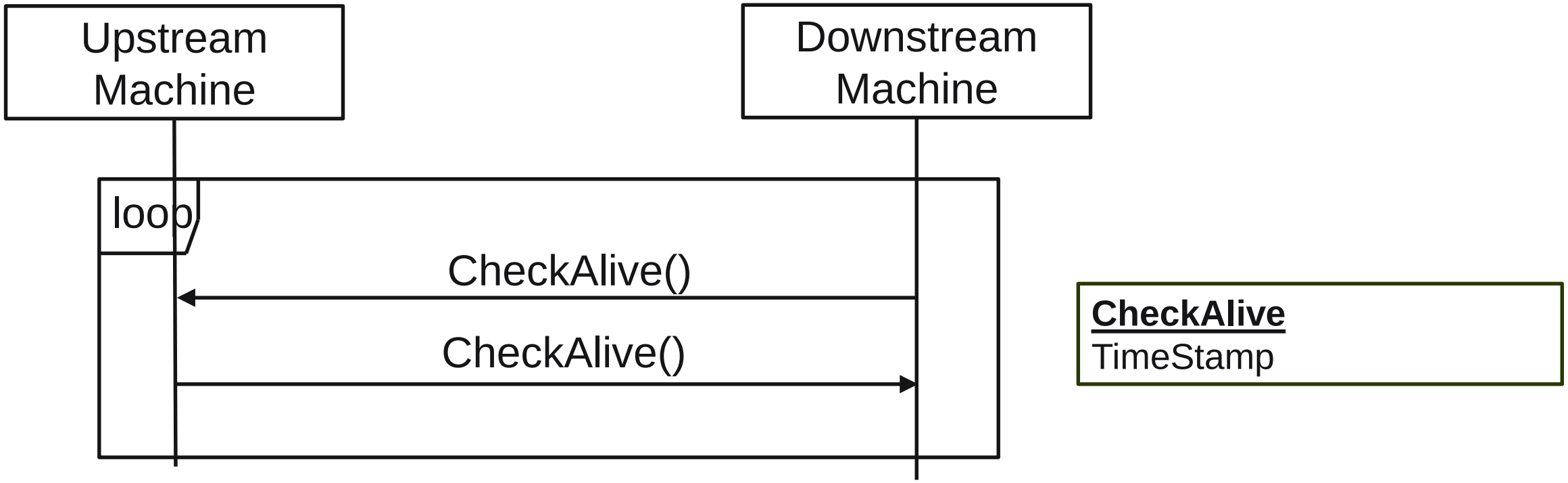
- route through different network segments
- track the board flow
- intercept the board flow

Hermes step by step
I: Establishing the connection from down- to upstream



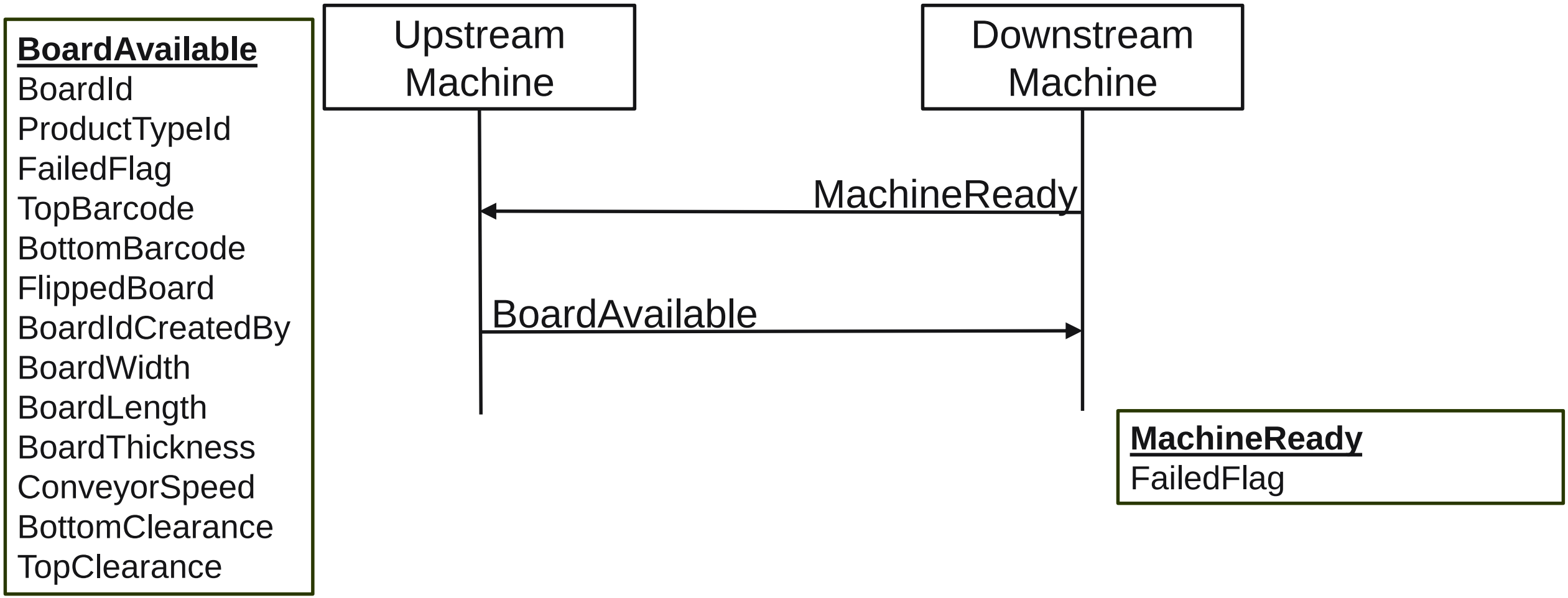
ServiceDescription
MachineId
LaneId
HermesVersion
SupportedFeatures

Hermes step by step
II: Exchanging CheckAlive messages

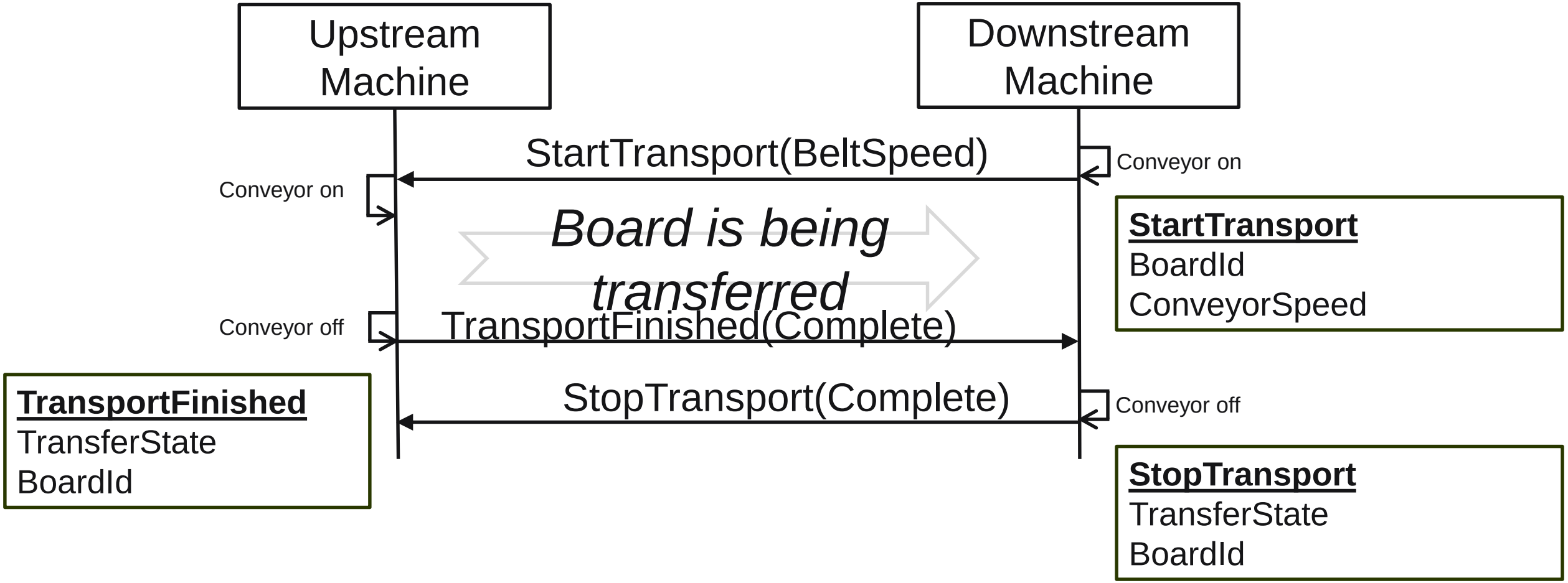


CheckAlive
TimeStamp

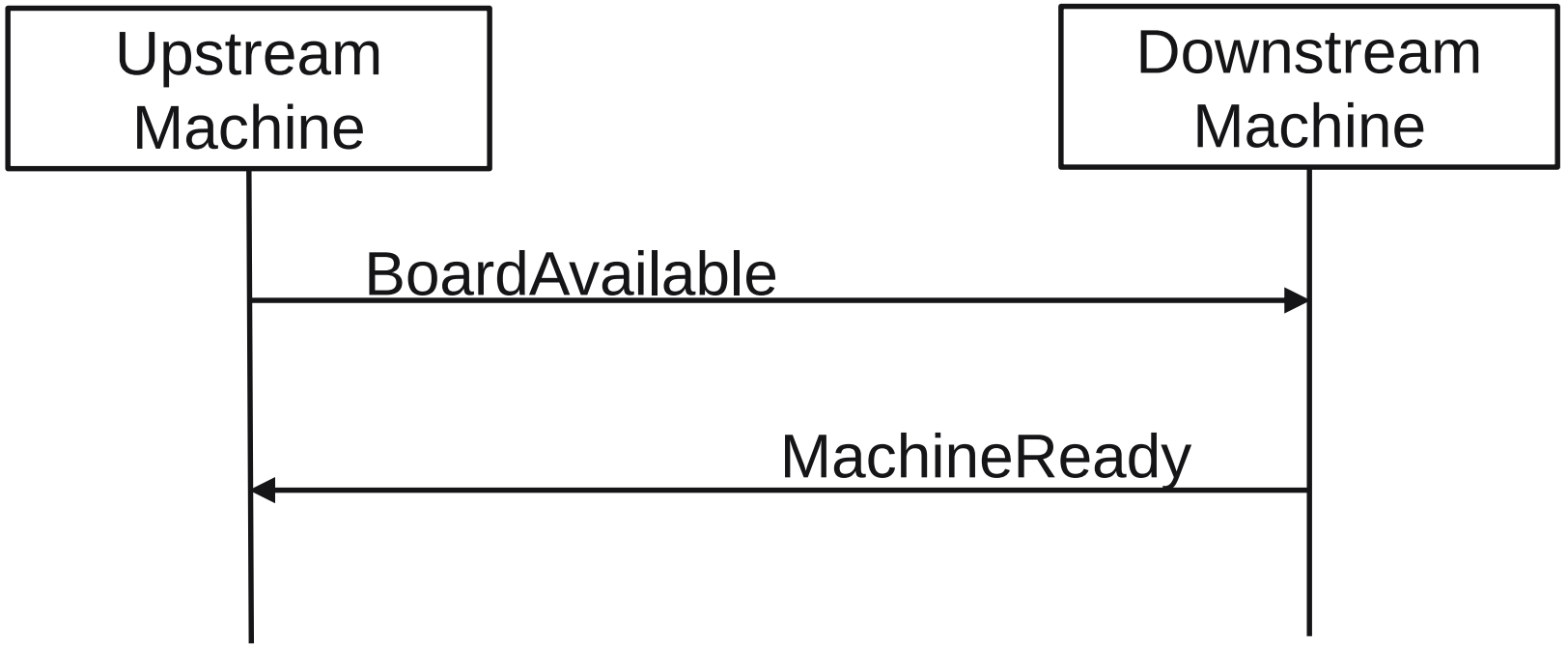
Hermes step by step
III: Signalling MachineReady (downstream) and BoardAvailable (upstream)



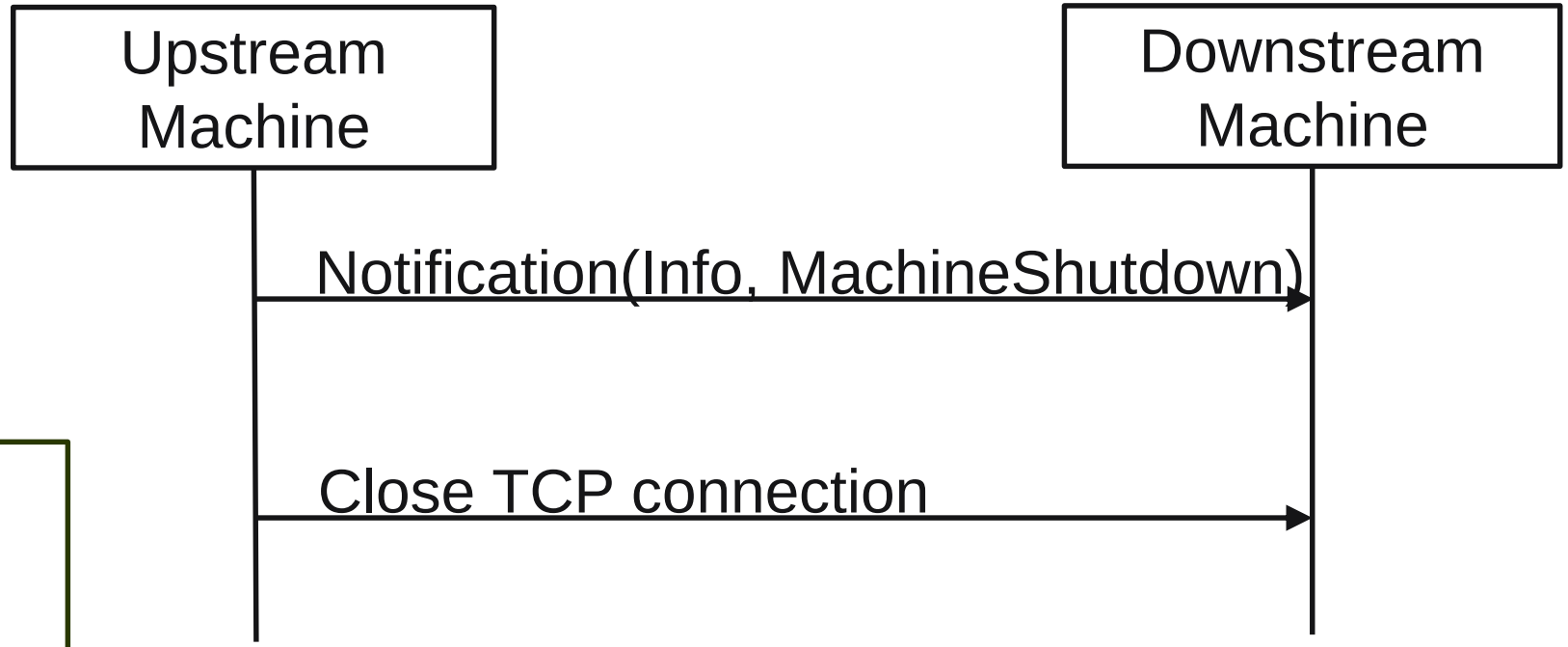
Hermes step by step
IV: Board handover



Hermes step by step
V: and so on …

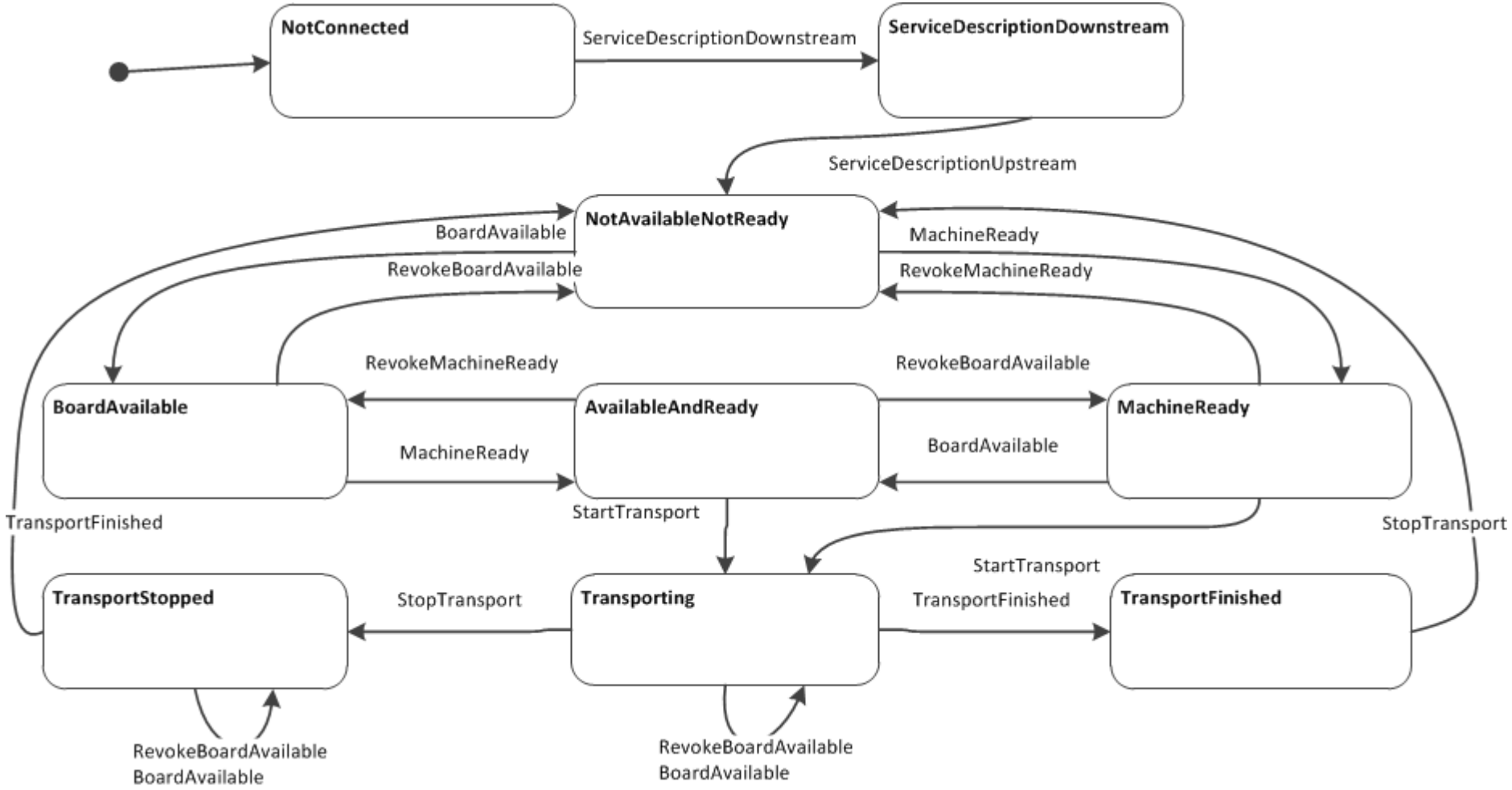


Hermes step by step
VI: Graceful shutdown

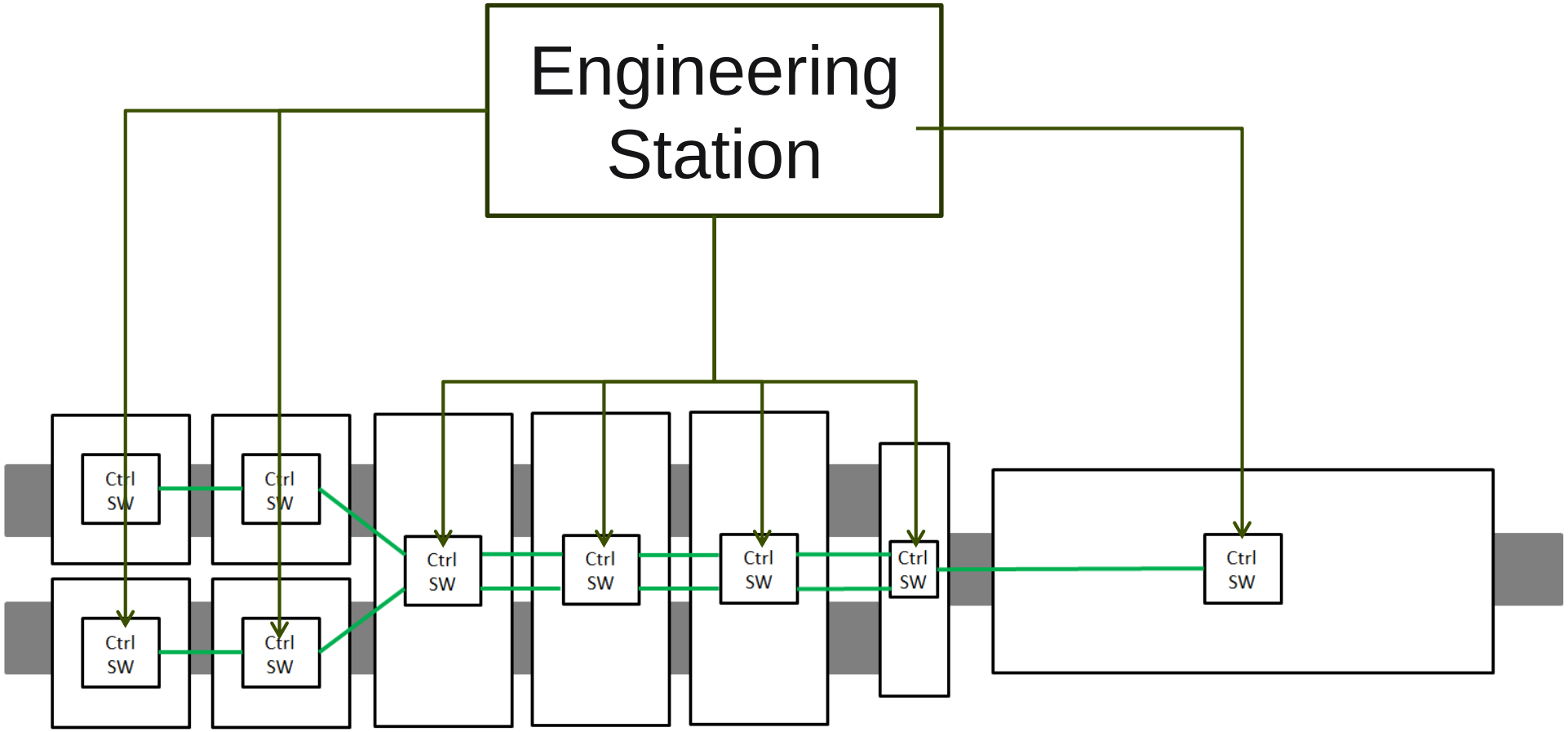


Notification
NotificationCode
Severity
Description

The Hermes Standard state chart



Hermes Configuration (I)



Hermes Configuration (II)

To ensure easy and fast configuration, The Hermes Standard protocol defines configuration messages

SetConfiguration
Used to configure the Hermes interfaces of a machine

GetConfiguration
Used to read out the configuration of the Hermes interfaces

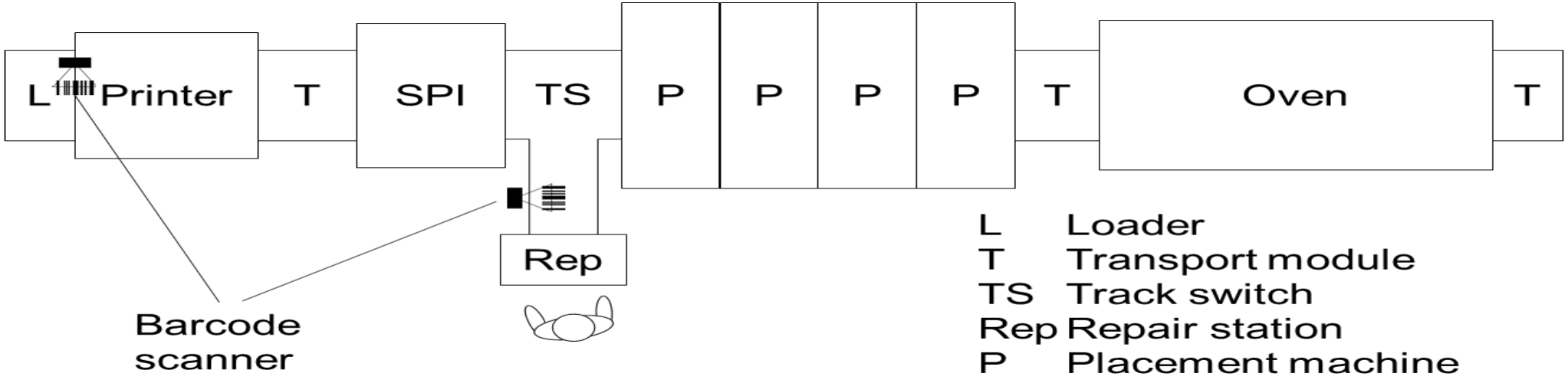
CurrentConfiguration
Response to a GetConfiguration-Message

Hermes Configuration (III)

SetConfiguration

```
<Hermes Timestamp="2017-03-22T13:20:30.452">
  <SetConfiguration MachineId="TRM01">
    <UpstreamConfigurations>
      <UpstreamConfiguration UpstreamLaneId="1" HostAddress="192.168.1.2" Port="50101" />
      <UpstreamConfiguration UpstreamLaneId="2" HostAddress="192.168.1.2" Port="50102" />
    </UpstreamConfigurations>
    <DownstreamConfigurations>
      <DownstreamConfiguration DownstreamLaneId="1" Port="50101" />
      <DownstreamConfiguration DownstreamLaneId="2" ClientAddress="192.168.1.4" Port="50102" />
    </DownstreamConfigurations>
  </SetConfiguration>
</Hermes>
```

Removing and re-inserting a board in an SMT assembly line



a) **The repair station creates a new BoardId and attaches the scanned barcode to it. An MES correlates the old and new BoardId and merges the various pieces of information.**

b) **The repair station queries the MES via barcode for the associated BoardId . Board handover continues using the old BoardId .**

c) **The repair station prompts the user to confirm that the inserted board is the one that was removed.**