SEMI A1 PESCI Production Equipment Smart Connection Interface

- A general-purpose equipment connection interface for smart production line -

As of Feb. 12, 2020

Flow Manufacturing Forum / Automation Technology Committee, SEMI

Homepage: http://www1.semi.org/jp/SEMI_A1_PESCI

Position of This Document

This document introduces the concept and functions of

SEMI A1 PESCI

Production Equipment Smart Connection Interface

that makes production line smarter

For up-to-date information, please visit:
http://www1.semi.org/jp/SEMI_A1_PESCI

For Standards document and further information, please contact:
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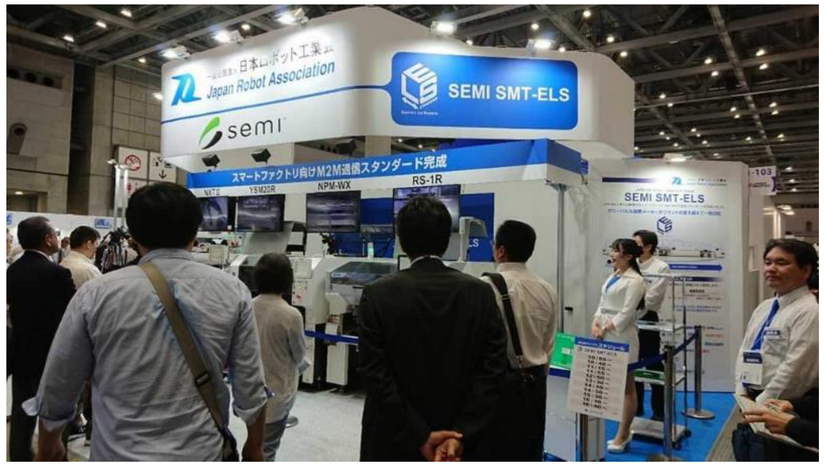
Application of SEMI A1 to SEMI SMT-ELS

- Demonstrations Done

• JISSO PROTEC	Tokyo	June	2019
• NEPCON ASIA	Shenzhen	August	2019
• Productronica	München	November	2019
• APEX	San Diego	February	2020

- Watch the demo videos on: http://www1.semi.org/jp/SEMI_SMT-ELS

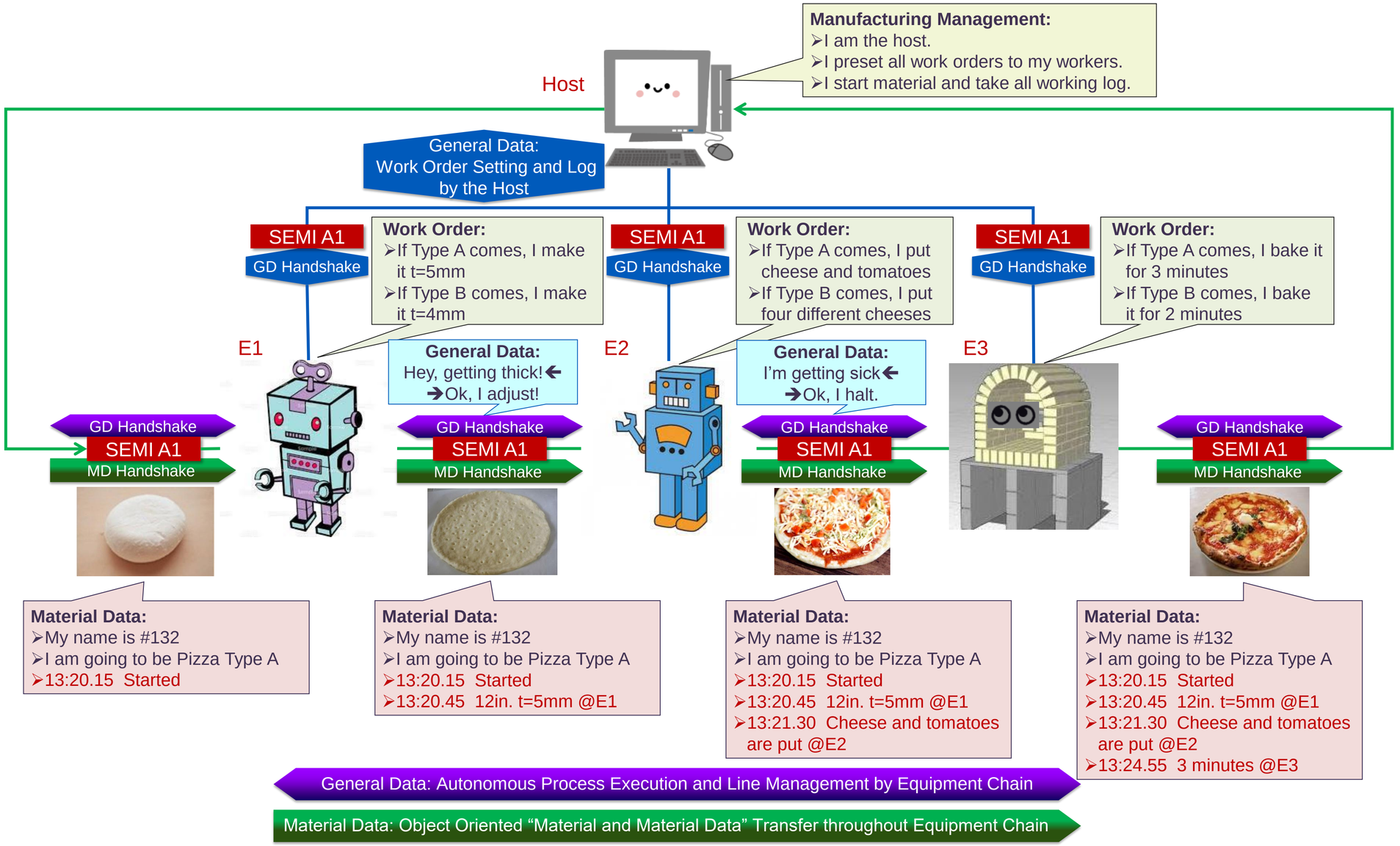


JISSO PROTEC / Tokyo
June 2019

NEPCON ASIA / Shenzhen
August 2019

Productronica / München
November 2019

Pizza Factory Analogy of SEMI A1 Application



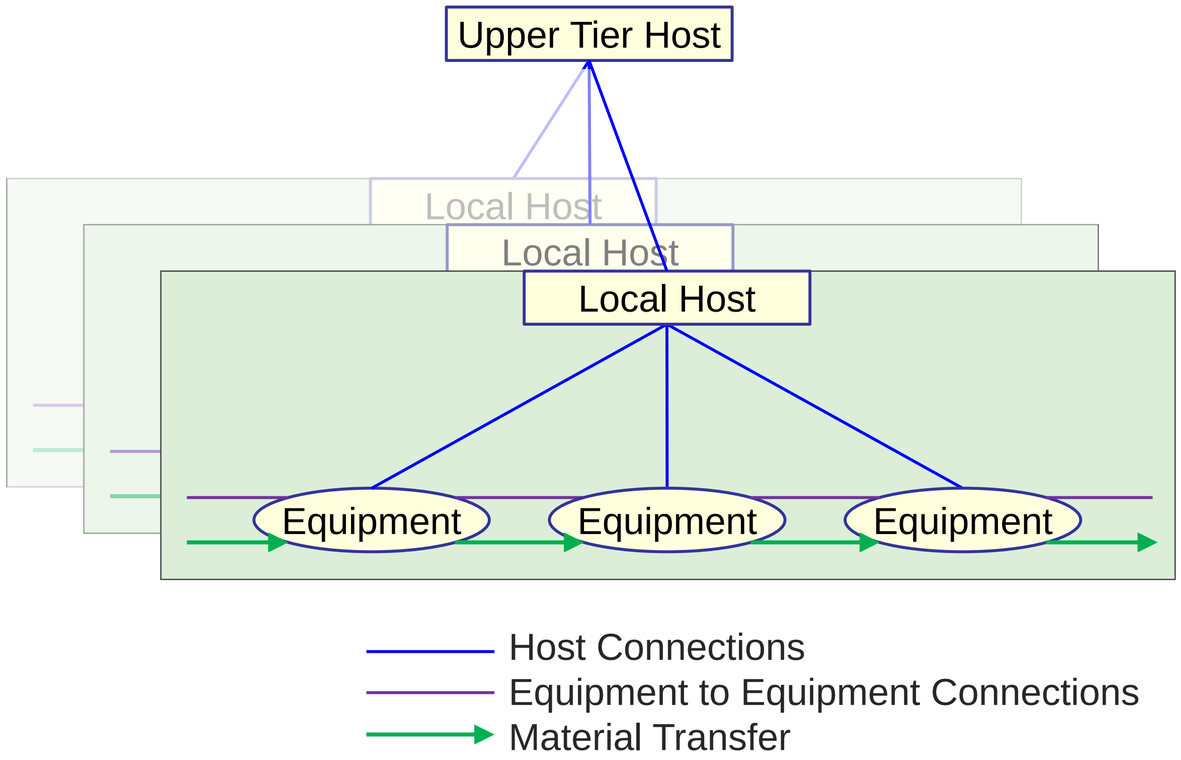
Concept of SEMI A1 PESCI

The General-Purpose Equipment Interface

What is SEMI A1 PESCI?

- A general-purpose Production Equipment Smart Connection Interface

- SEMI A1 provides connections between:
  - An upper tier host and local hosts
  - An upper tier host and equipment
    (via a local host or direct)
  - A local host and equipment
  - Equipment and equipment

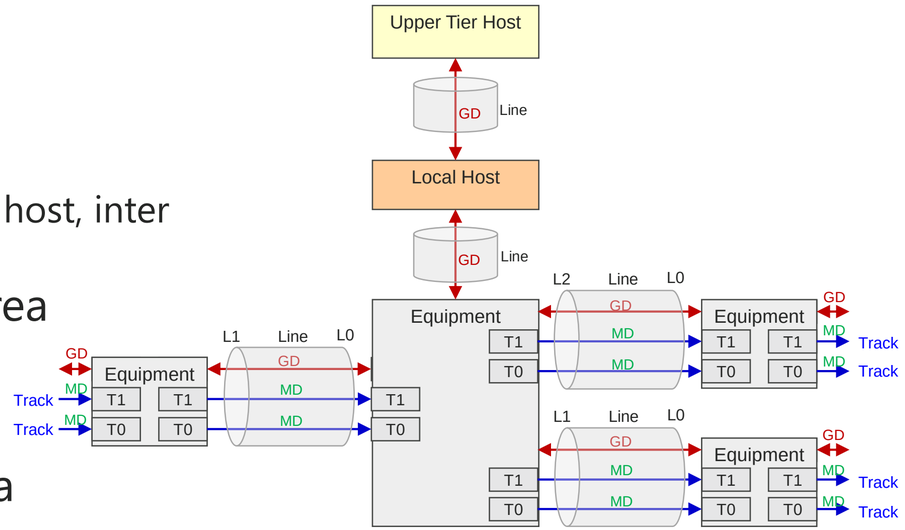


What is SEMI A1 PESCI?

- A general-purpose Production Equipment Smart Connection Interface

- General-purpose Data communication channel (GD)
  - Tiered Host connection
    - Equipment Group ➔ Local Host ➔ Upper Tier Host
  - Various addressing modes
    - Equipment to equipment, equipment to the local host, equipment to upper tier host, inter host
  - Message definitions are open to upper tier Standard per application area

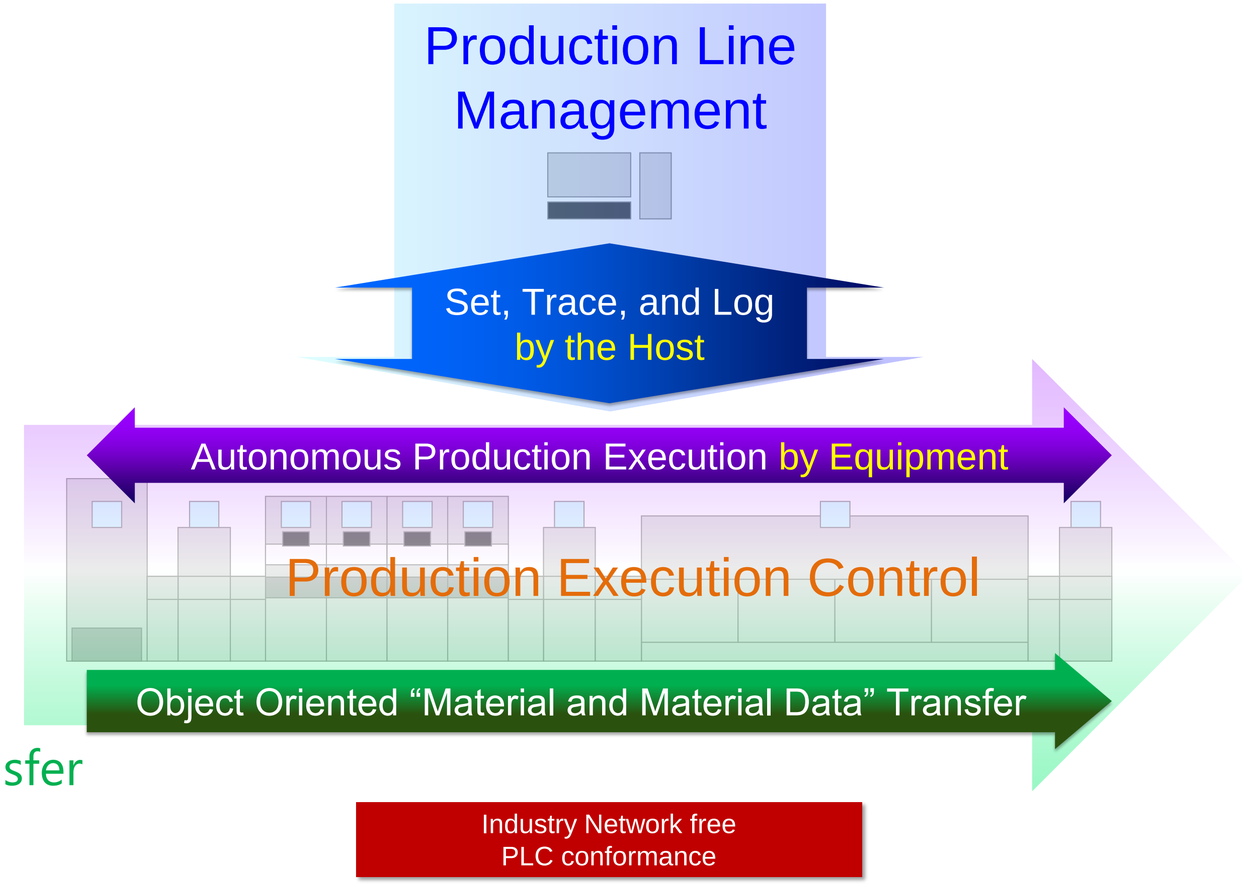
- Up to ten Material and Material Data transfer channels (Tracks)
  - Object Oriented simultaneous transfer of Material and its Material Data
    - Material Data definition is open to the upper tier Standard per application area
  - Compatible with various transfer means such as conveyors, AGVs, robots
  - Support Uni-direction, Alternate-direction, and Bi-direction transfer operation



Orthogonal “Line Management” and “Execution Control”

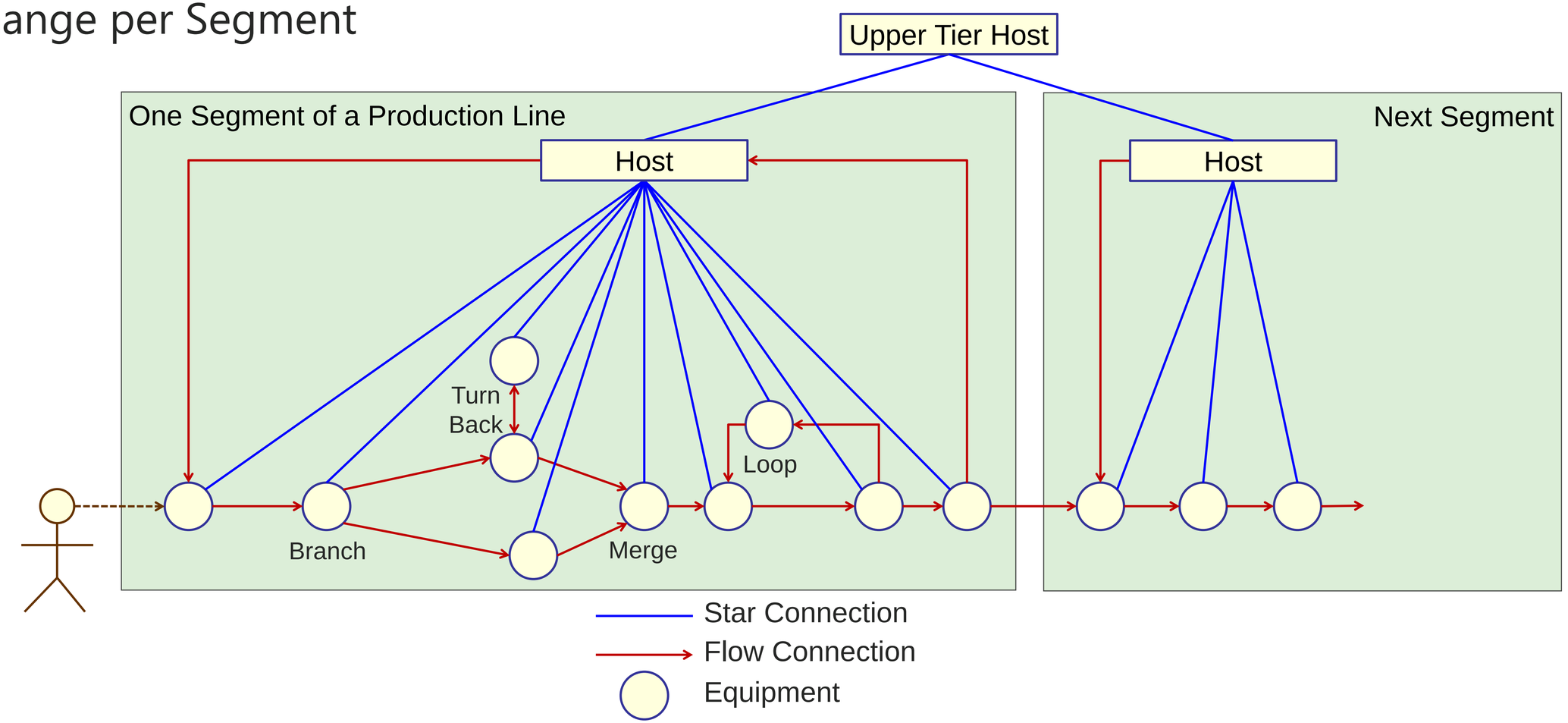
Production Line Management in Vertical and Production Execution Control in Horizontal

- Production Line Management:
  - Through Host-equipment communication (Point to Point)
  - Equipment settings and observations
  - Material tracking
- Production Execution Control:
  - By equipment-equipment communication (Daisy chain)
  - Autonomous Production Execution:
    - By equipment-equipment collaboration
    - Through General Data communication
  - Object Oriented Material and Material Data transfer
    - Simultaneous handoff of Material and Material Data
    - Direct reference of attached Material Data
    - Exception handlings of handoff (Pause – Recovery)



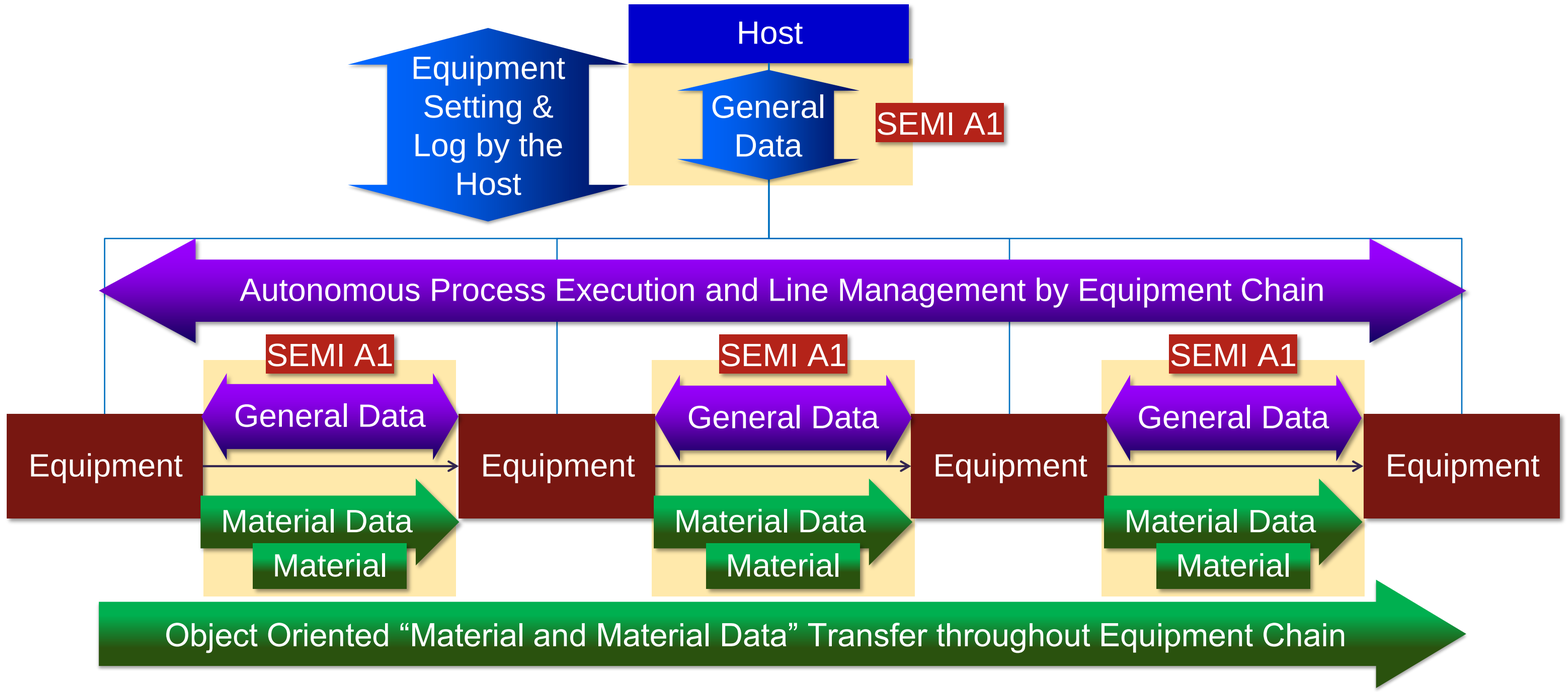
Segment and Tiered Host Operation Capability

- Tiered Host operation
- Localization of equipment dependent detail control in a Segment
- Easy to change per Segment



Application of SEMI A1 PESCI

- Host and Equipment connection (point to point) for:
  - Equipment management
  - WIP tracing
- Equipment and Equipment connection (daisy chain) for:
  - Generic communication between equipment via the adjacent equipment
  - Simultaneous handoff of Material and its Material Data



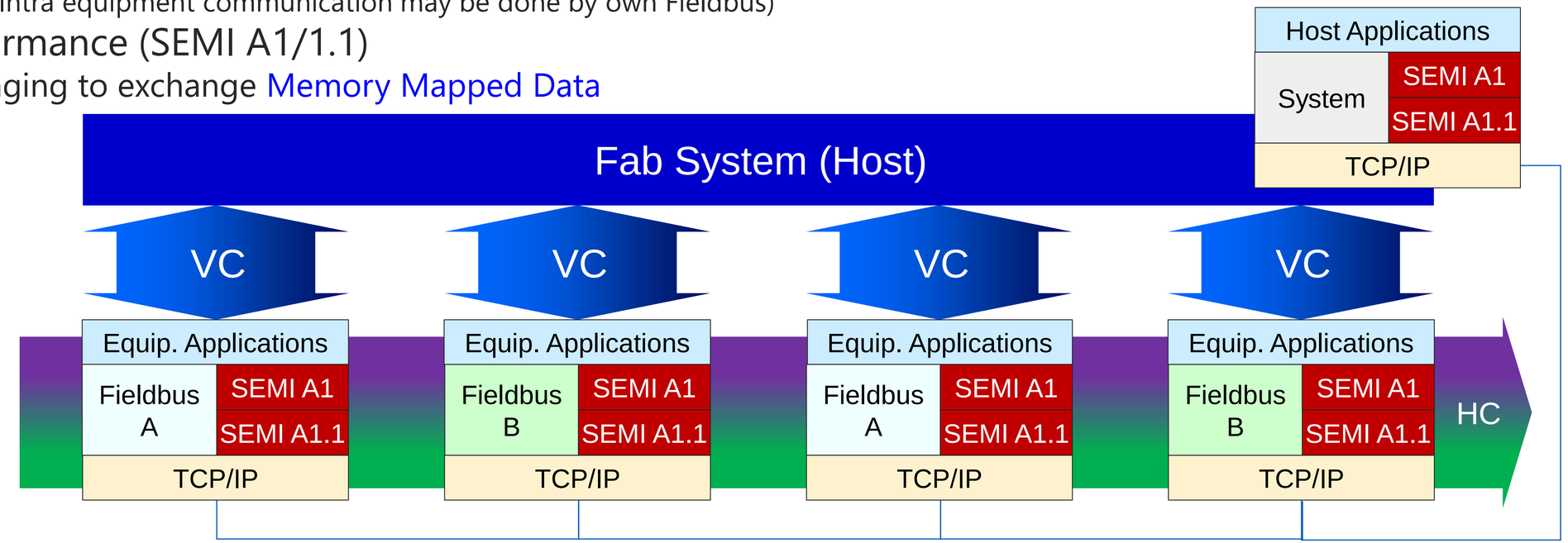
Definition Overview of SEMI A1/1.1

- SEMI A1 defines communication channels for equipment
  - Material and Material Data (MD) (Material Handshake)
    - Performs simultaneous handoff of Material and its Data
  - General Data (GD) (Data Handshake)
    - Performs generic data communication
    - Both for host-equipment and equipment-equipment communications
  - Simple “Memory Image Exchange” type of messaging
    - Better conformance even with low-end PLC

- SEMI A1.1 defines TCP/IP interface for SEMI A1
  - TCP/IP interface for both MD and GD Handshakes
  - “Memory Image Exchange” messaging scheme
    - for better conformance with low cost control components such as PLC
  - Direct mapping on TCP/IP
    - for higher compatibility among various control components

Connectivity and Interoperability

- Connections for production line (SEMI A1)
  - General Data between the host and equipment — Data Handshake
  - General Data between adjacent equipment — Data Handshake
  - Material and Material Data handoff between equipment — Material Handshake
- Communication Protocol for SEMI A1 (SEMI A1.1)
  - Direct mapping on TCP/IP
    - Connectivity between PLCs based on different Fieldbus
      (Intra equipment communication may be done by own Fieldbus)
- PLC conformance (SEMI A1/1.1)
  - Messaging to exchange Memory Mapped Data

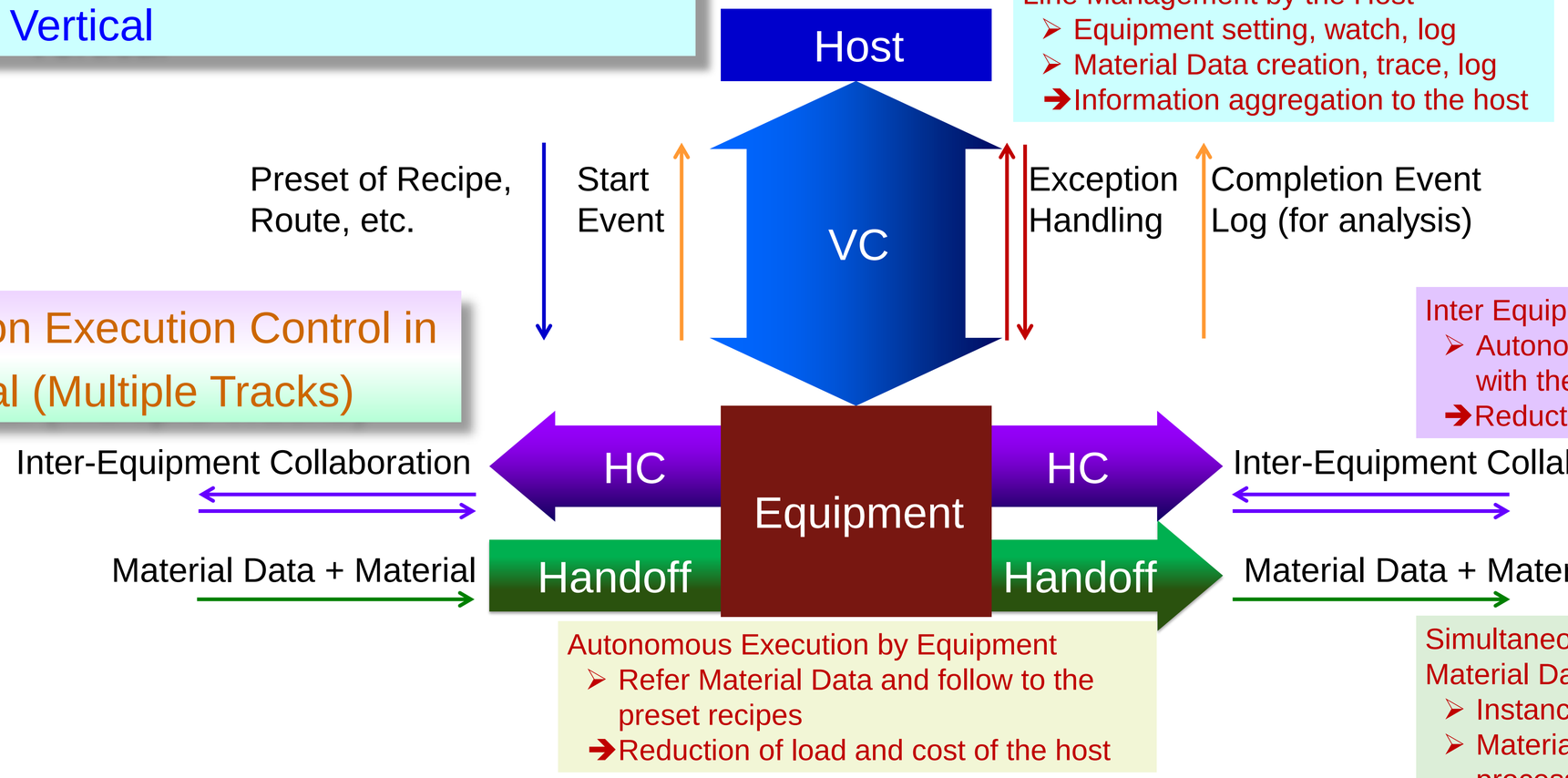


VC: Vertical Communication
HC: Horizontal Communication

Equipment Model of SEMI A1 PESCI

- Production Line Management in Vertical

- Production Execution Control in Horizontal (Multiple Tracks)



Line Management by the Host
- Equipment setting, watch, log
- Material Data creation, trace, log

➔Information aggregation to the host

Inter Equipment Communication
- Autonomous coordination along with the line

➔Reduction of Host load/cost

Autonomous Execution by Equipment
- Refer Material Data and follow to the preset recipes

➔Reduction of load and cost of the host

Simultaneous handoff of Material and Material Data
- Instance ID, Product ID, Log
- Material require equipment to process according to the Material Data

➔Object Oriented

Standardized communication specification
- Direct use of TCP/IP
- Memory Block transfer for PLC conformance

➔Connectivity, quick launch

VC: Vertical Communication
HC: Horizontal Communication

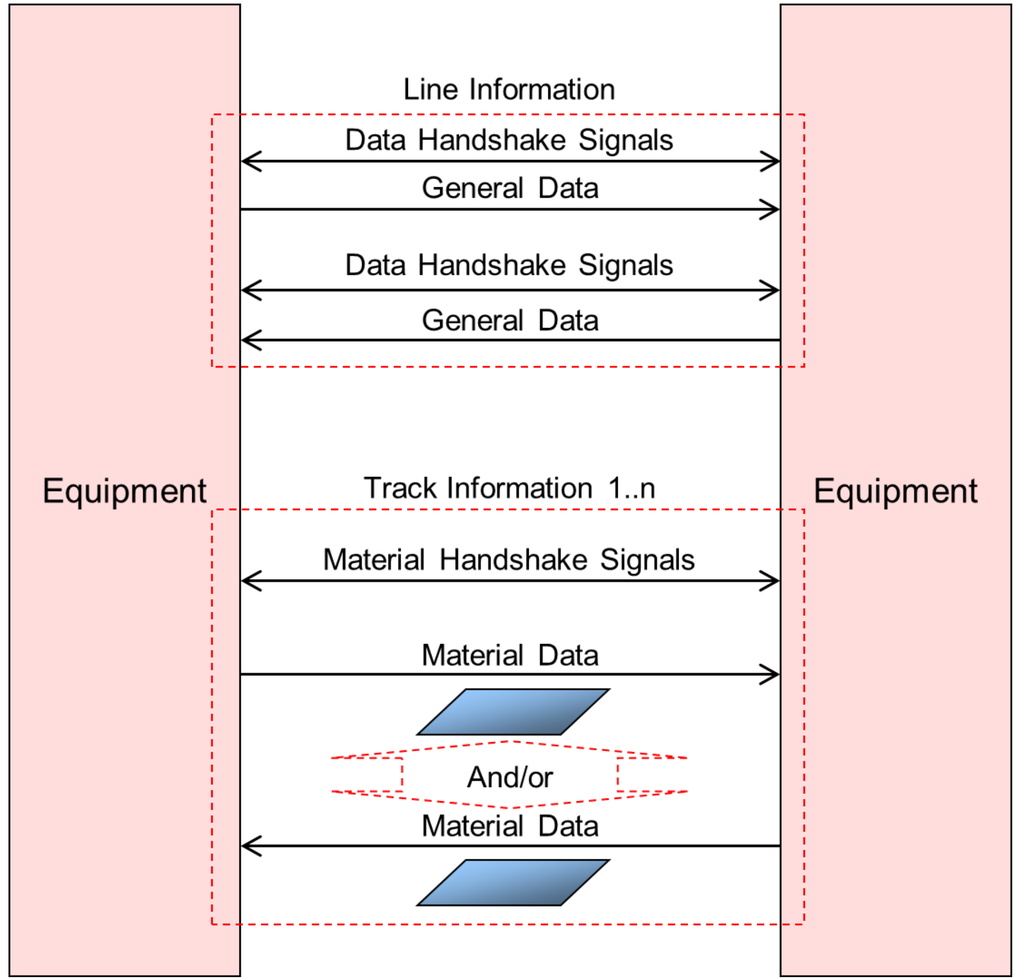
“Line” a Connection between Equipment

One “Line” Consists of

- One Line Information channel
- Up to ten Track Information channels

- Line Information
  - Full duplex data channel
  - For “General Data”
  - By “Data Handshake”

- Track Information 1 .. n
  - n tracks of half duplex transportation channels
  - For “Material and Material Data”
  - By “Material Handshake”

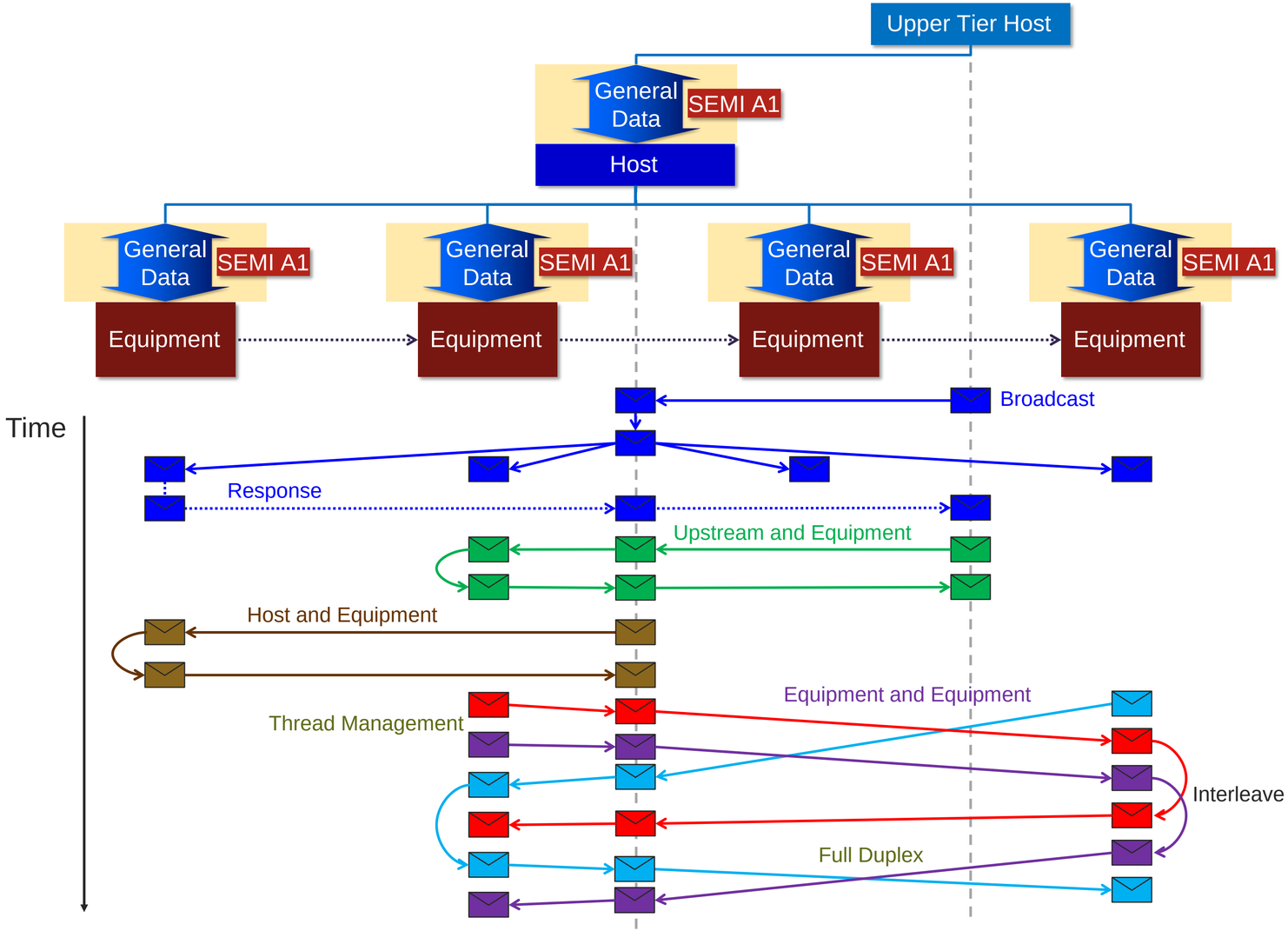


General Data Communication

For message exchange.

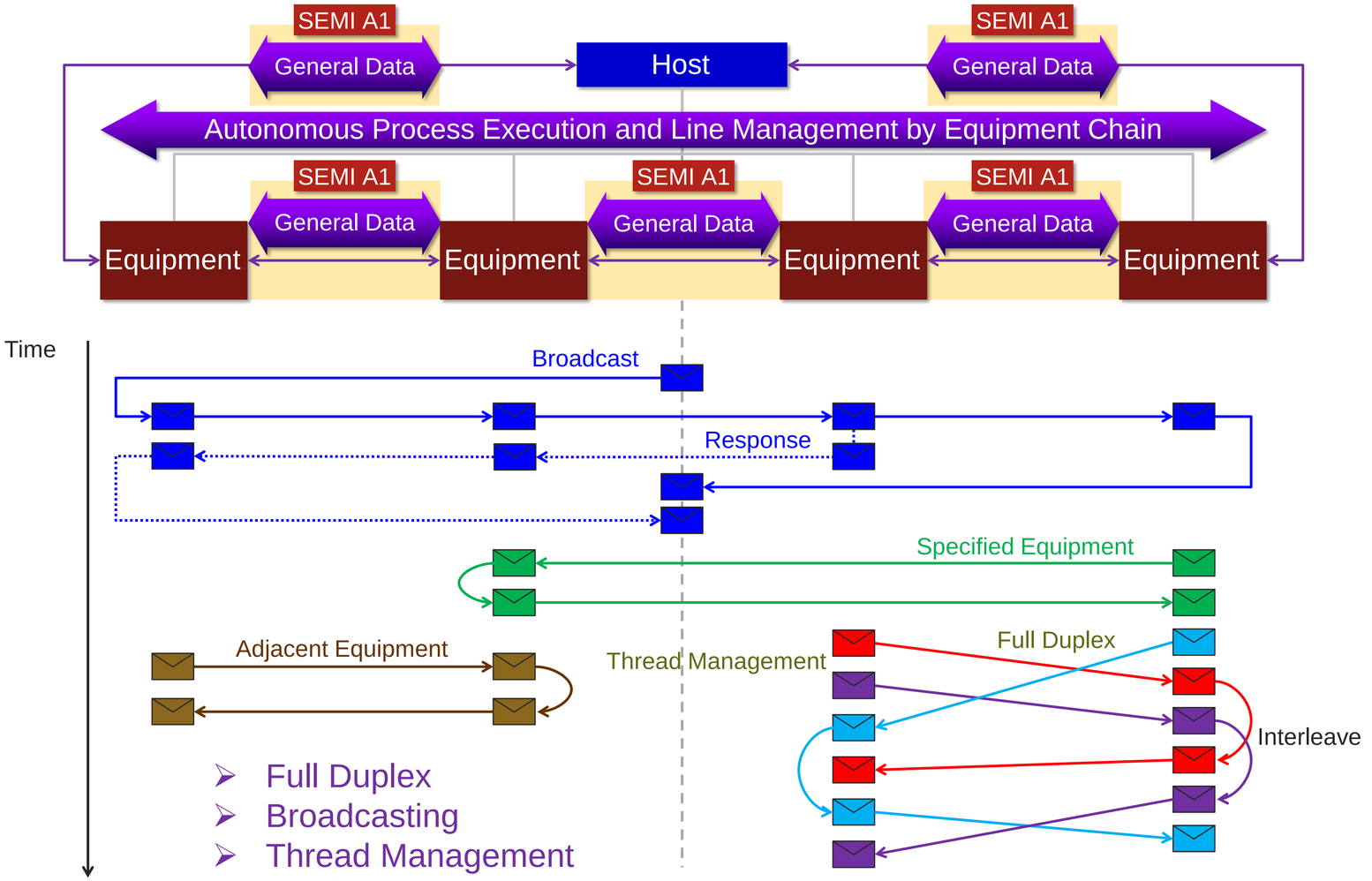
General Data Communication (Vertical)

SEMI A1 supports various Addressing Modes for Vertical Communication



General Data Communication (Horizontal)

SEMI A1 supports various Addressing Modes for Horizontal Communication



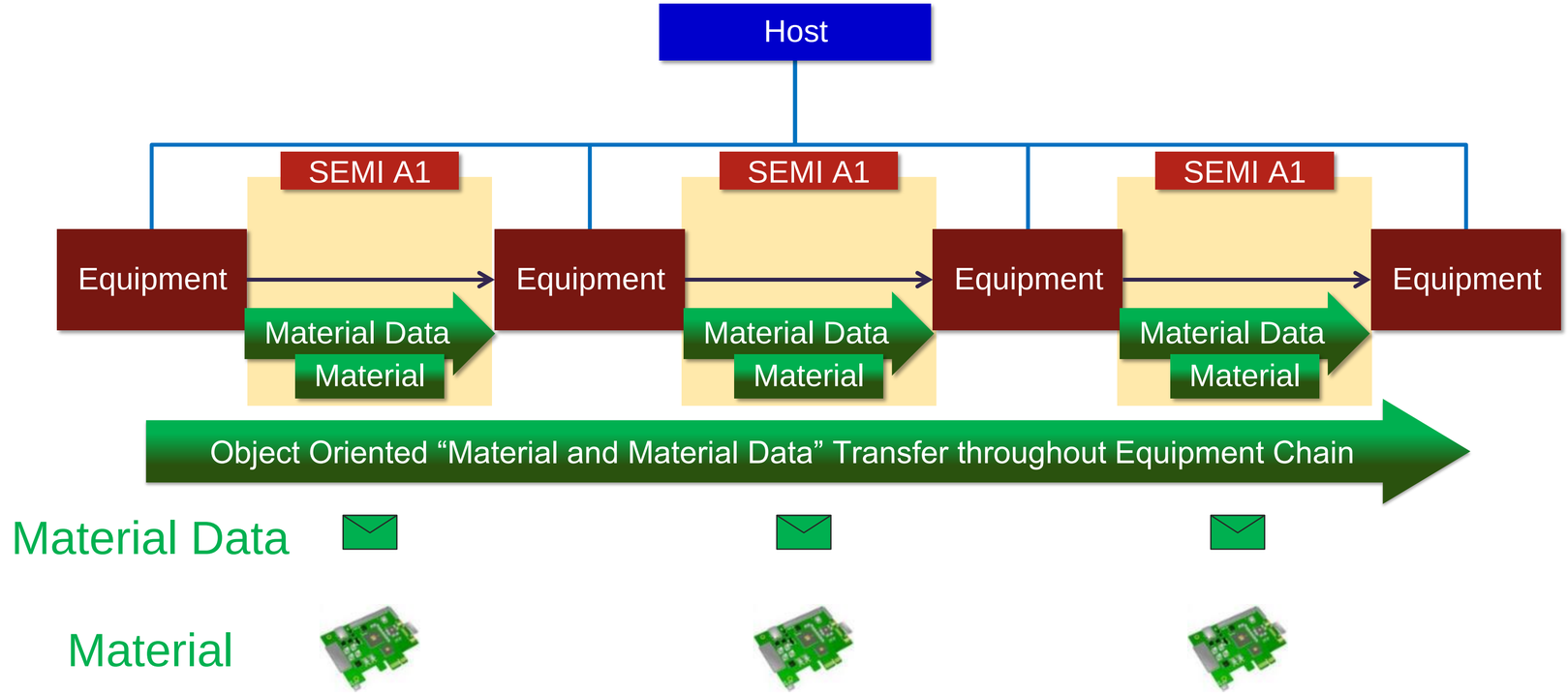
- Full Duplex
- Broadcasting
- Thread Management
- Interleaving Management

Material and Material Data Transfer

For message exchange.

Material and Material Data Transfer

SEMI A1 supports simultaneous handoff of Material and Material Data
Multiple Tracks are controlled independently



- Object Oriented way
- Material carries its characteristics as Material Data
- Equipment refers Material Data and executes prespecified operation

Typical Example of Material Data (MD)

- Material Data is an identification tag of the WIP

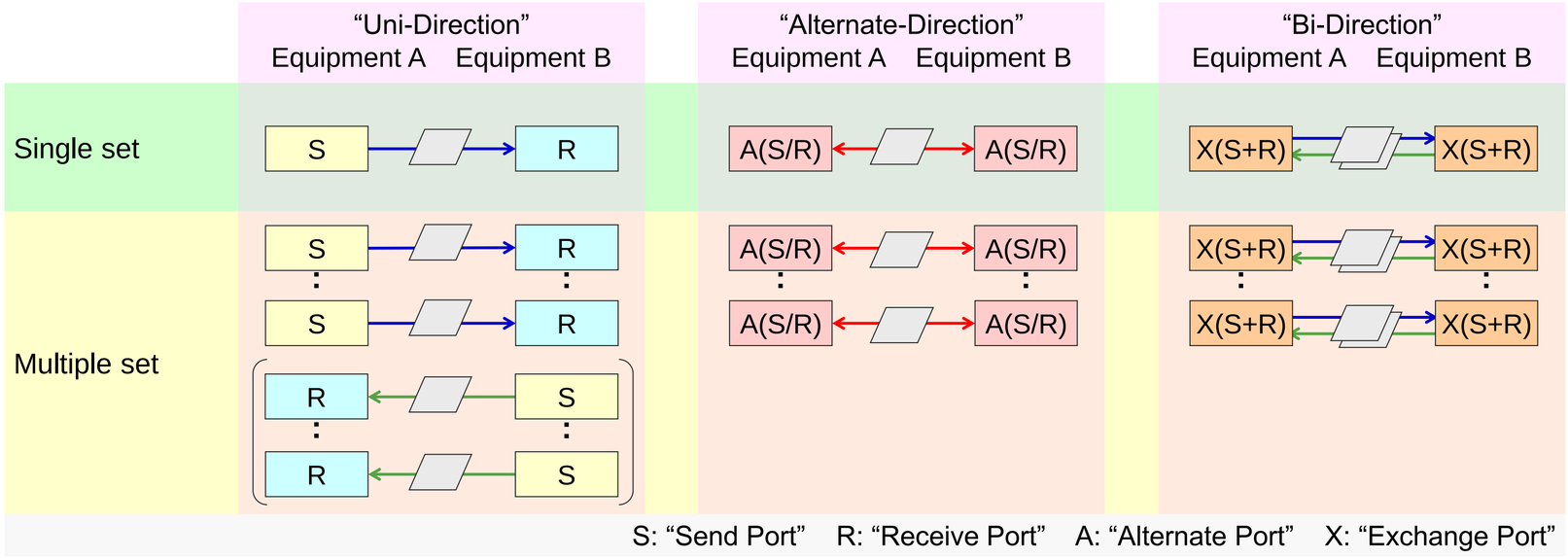
- Consists of the following three sections
  - Instance ID Identifier of the individual material
  - Class ID Identifier of the product class, the material belongs to
  - Log Result record at each equipment
    - Applied parameters or measured results (value or classification)
    - To be used as process log
    - May also be used for notifications for process/route changes to the equipment after

Field	Mnemonic	Definition	Usage
Instance ID	Material ID	Identifier of this individual material	To be used to identify this individual material
Class ID	Product ID	Identifier of Product this material to be	To be used to select recipe or route
	Version ID	Identifier of Version of the product	May be used for modification of recipe or route
Log	Result E0	Result record at equipment 0	Control of process or branch in the equipment after
	Result E1	Result record at equipment 1	
	Result E2	Result record at equipment 2	
	…….	…….	
	Result En	Result record at equipment n	

Track Types

- Three Track Types
  - Uni-Direction — Material flows to one direction
  - Alternate-Direction — Material flows both directions alternatively
  - Bi-Direction — Materials are swapped in one cycle

- Multiple Tracks per one Line



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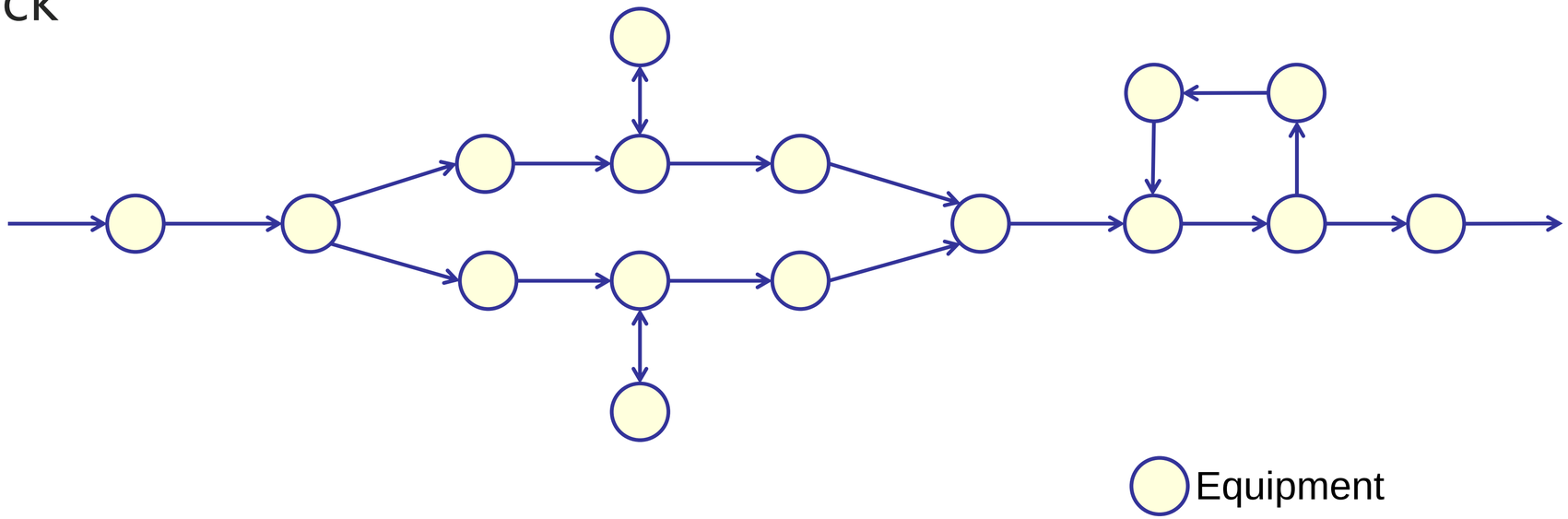
Line Topology

- Supports line topology that includes:
  - Branch
  - Merge
  - Loop
  - Turn back



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Handoff Function

- Handoff Step function
  - Compatible with handoff mechanisms that require multiple handoff steps
  - Conveyor, Robot, Isolation doors, etc.

- Operator assistance and recovery
  - Pause – Recovery functions
    - Operator or equipment initiated upon handoff exception
    - Restart, Resume, Forward, Abort can be selected for recovery

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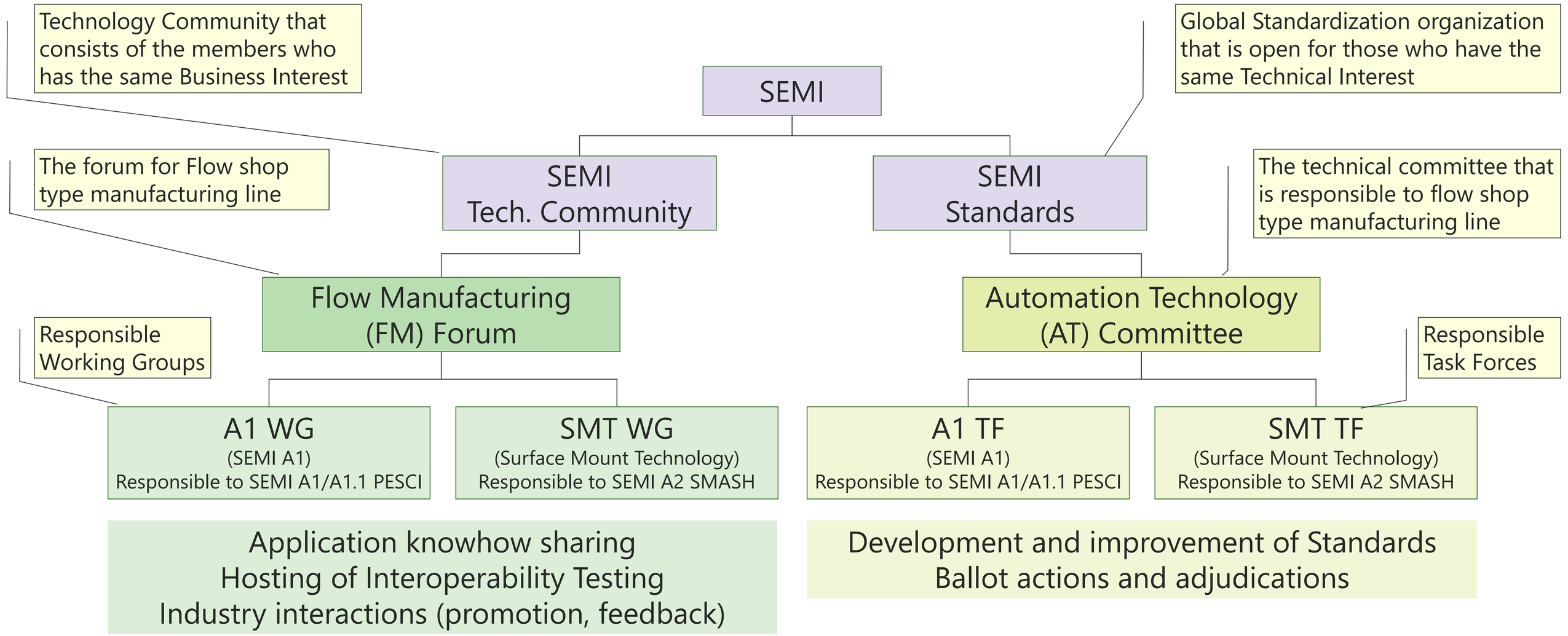
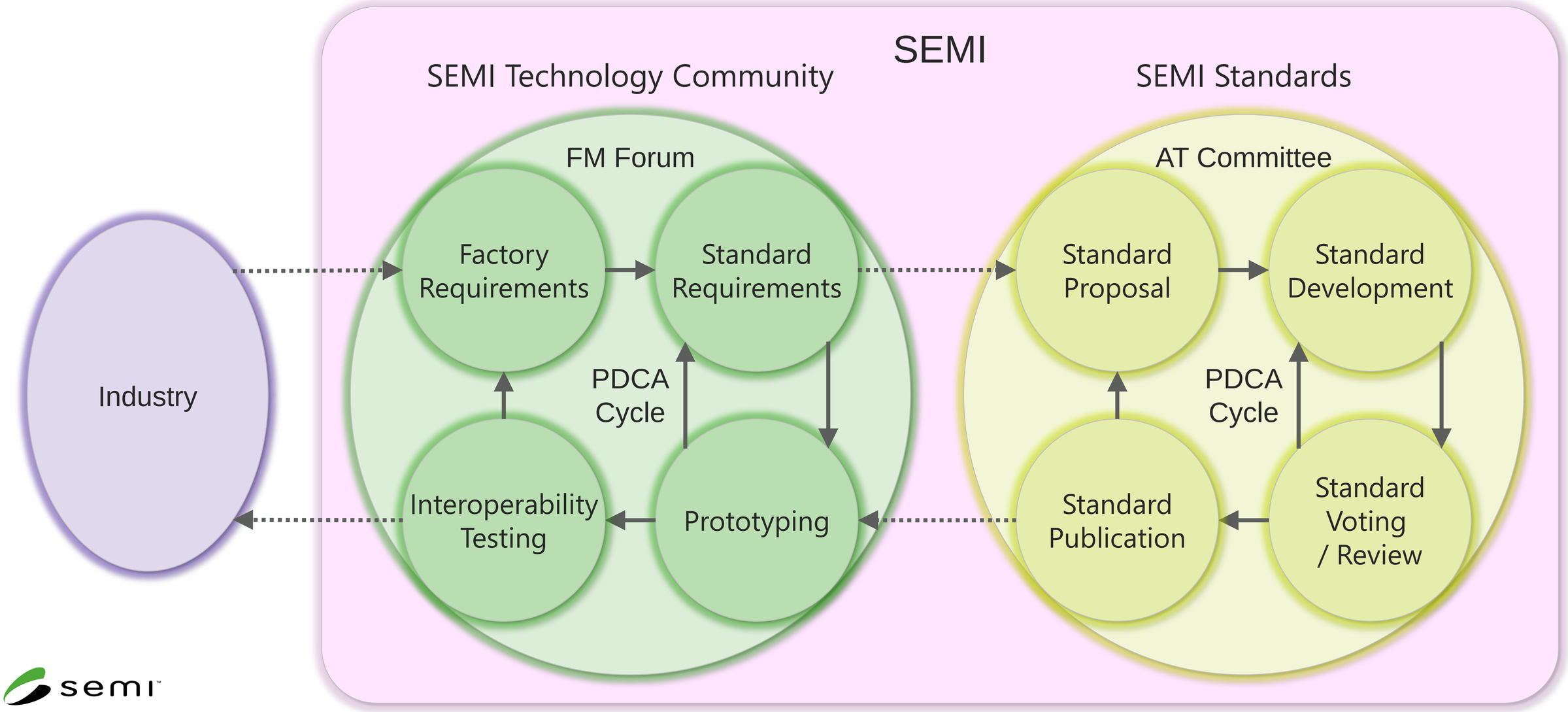
SEMI A1 PESCI Activities

Organization and Activities

Organization



Relationship between FM Forum and AT Committee



Interoperability Testing Support

- Flow Manufacturing Forum hosts interoperability testing
  - Interoperability should be managed by the forum members since SEMI should be neutral and is not in the position to test or certificate

- Participants who appropriately performed the testing with multiple proven members are posted to SEMI A1 PESCI homepage

- Please visit SEMI A1 PESCI homepage for up-to-date information

Thank you!

SEMI A1 PESCI