HiCONNECTS STANDARDS SURVEY

KDT JU KEY DIGITAL TECHNOLOGIES JOINT UNDERTAKING

HiCONNECTS

HiCONNECTS beyond-state-of-the-art standard requirement for RF/IT connectivity and heterogeneous integration smart manufacturing PREVIEW

First Name	
Last Name	
Gender	
Company Name	
Consortium Member (Y/N)	
Email	

Area of expertise/job title:

☐Program Management
☐Automation and Integration Engineering
☐Production Operations
☐Process Engineering
☐Maintenance Engineering/Technicians
☐Metrology Engineering
☐Procurement Management
☐(Other) _____

☐Application and System Engineering
☐Senior Management
☐Industrial Engineering
☐Equipment Engineering
☐Quality Engineering
☐Failure Analysis Engineering
☐Purchase Specification Development

Part 1: Beyond-state-of-the-art standard requirement for heterogeneous integration

1. Connectivity Standards

Connectivity features may be distributed over a vast number of functional blocks and different technologies, and these can be put together into a System-in-Package.

'Heterogenous integration' (HI) brings the electronic components and systems (ECS) into a new domain, which combines traditional silicon wafers integrated circuit (IC), InP based high speed electronics, and Si and InP photonics devices and interconnect.

1. **Which kind of elements does your organization heterogeneously integrate? (Y/N):**

   ☐My company does not perform integration

   ☐**Die**. If yes, please specify if new or modified manufacturing standards are needed in more details:_____

   ☐**Antennas/shielding**. If yes, please specify if new or modified manufacturing standards are needed in more details:_____

   ☐**Power amplifiers**. If yes, please specify if new or modified manufacturing standards are needed in more details:_____

   ☐**Specialized processors**. If yes, please specify if new or modified manufacturing standards are needed in more details:_____

   ☐**Photonics and electronics Co packaging**. If yes, please specify if new or modified manufacturing standards are needed in more details:_____

   ☐**DRAM**. If yes, please specify if new or modified manufacturing standards are needed in more details:_____

   ☐**Flash memory**. If yes, please specify if new or modified manufacturing standards are needed in more details:_____

   ☐**Resistor/capacitor/inductor**. If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐**RF filters/connectors**. If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐**MEMS / sensors**. If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐(Other) _____

2. **For the connectivity standards listed below, indicate if they are aligned with the beyond state-of-the-art heterogeneous integration efforts, or if new or modified standards are required (Y (aligned), N (not aligned)). If new or modified HI standards are required, please specify what are the state-of-the-art gaps and what is required.**

☐**ETSI ERM WGRM**. If N, please specify what are the gaps and what is required:_____

☐**ETSI ERM WGEMC**. If N, please specify what are the gaps and what is required:_____

☐**ETSI ERM TG28**. If N, please specify what are the gaps and what is required:_____

☐**ETSI ERM TG30**. If N, please specify what are the gaps and what is required:_____

☐**ETSI ERM TG34**. If N, please specify what are the gaps and what is required:_____

☐**ETSI ERM TG37**. If N, please specify what are the gaps and what is required:_____

☐**ETSI ERM TGSRR**. If N, please specify what are the gaps and what is required:_____

☐**ETSI ERM TGUWB**. If N, please specify what are the gaps and what is required:_____

☐**ETSI ITS** (including subgroups ITS, WG1, WG2, WG3, WG4, WG5). If N, please specify what are the gaps and what is required:_____

☐**V2X C2C**. If N, please specify what are the gaps and what is required:_____

☐**V2X 5GAA**. If N, please specify what are the gaps and what is required:_____

☐**UWB FIRA**. If N, please specify what are the gaps and what is required:_____

☐**UWB CCC**. If N, please specify what are the gaps and what is required:_____

☐**UWB ALLIANCE**. If N, please specify what are the gaps and what is required:_____

☐**IEEE 802.3**. If N, please specify what are the gaps and what is required:_____

☐**IEEE 802.11** (including n/ac/ax/be/p/bd/ay/bf …). If N, please specify what are the gaps and what is required:_____

☐**IEEE 802.15** (including .1/.2/.3/.4 …). If N, please specify what are the gaps and what is required:_____

☐**IEEE PAM-4 DR-4 and FR-4 Ethernet standards**. If N, please specify what are the gaps and what is required:_____

Part 2: beyond-state-of-the-art standard requirement for advance manufacturing

1. Manufacturing connectivity

Indicate if the following parameters can gain by improving fab fast and reliable connectivity such as equipment data collection system (Y/N).

☐**Yield**. If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐**Factory Cycle Time / Factory Throughput (critical ratio).** If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐**Delivery performance**. If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐**Equipment Cycle Time / Productivity / Throughput**. If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐**Effective capacity**. If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐**Scrap rate**. If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐**Overall Equipment Efficiency (OEE)**. If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐**Equipment MTBF/MTTR (Mean Time Between Failures, Mean Time to Repair.** If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐**Process / Productivity Excursion MTTD (Mean Time to Detect).** If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐**Equipment/Process Qualification.** If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐**Factory Production Ramp Rate (Time to money).** If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐**Process Development / Optimization (shrink).** If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐**NPI (New Product Introduction).** If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐**Cost (direct/indirect labor, material, test wafers, etc.).** If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐**EHS metrics (Environmental Health and Safety).** If yes, please specify if new or modified manufacturing standards are needed in more details:_____

___ (Other 1) _____

2. **For the applications listed below, indicate if relies on high-speed and detailed equipment data collection (Y(or (N). If yes, please specify if new or modified manufacturing connectivity standards are needed in more details.**

☐**Fault Detection and Classification (FDC).** If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐**Feedback / Feedforward Control (R2R Control).** If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐**Fleet / chamber matching.** If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐**Equipment mechanism fingerprinting.** If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐**AI / Machine Learning / Big Data Analysis.** If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐**Virtual Metrology (VM).** If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐**Predictive Maintenance (PdM).** If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐**Lot completion estimation.** If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐**Production Scheduling / Lot Release to Production.** If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐**Real-Time Dispatching (RTD).** If yes, please specify if new or modified manufacturing standards are needed in more details:_____

Equipment Throughput Monitoring. If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐**Resource utilization monitoring.** If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐**Equipment / Process Characterization (Design of Experiments).** If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐**Recipe optimization.** If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐**Yield Management.** If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐**Failure Analysis.** If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐**Facilities monitoring and control.** If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐**Sub-fab component monitoring and control.** If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐**Field Service Support.** If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐(**Other**) _____

3. Are the SEMI Standards that address specific applications in previous section relevant (Y/N)

☐**SEMI E116** - Specification for Equipment Performance Tracking. If no, please specify if new or modified manufacturing standards are needed in more details:_____

☐**SEMI E120** - Specification for the Common Equipment Model (CEM) . If no, please specify if new or modified manufacturing standards are needed in more details:_____

☐ **SEMI E125** - Specification for Equipment Self Description (EqSD) . If no, please specify if new or modified manufacturing standards are needed in more details:_____

☐ **SEMI E126** - Specification for Equipment Quality Information Parameters (EQIP) . If no, please specify if new or modified manufacturing standards are needed in more details:_____

☐ **SEMI E133** - Specification for Automated Process Control Systems Interface. If no, please specify if new or modified manufacturing standards are needed in more details:_____

☐ **SEMI E134** - Specification for Data Collection Management. If no, please specify if new or modified manufacturing standards are needed in more details:_____

☐ **SEMI E160** - Specification for Communication of Data Quality. If no, please specify if new or modified manufacturing standards are needed in more details:_____

☐ **SEMI E164** - Specification for EDA (Equipment Data Acquisition) Common Metadata. If no, please specify if new or modified manufacturing standards are needed in more details:_____

4. What are your principal reasons for requiring Equipment Data Acquisition (EDA) standards (Y/N)?

- ☐ High-frequency equipment signals (10Hz or higher)
- ☐ High-granularity time-series data (parameters and events), especially from components not typically sampled via SECS/GEM
- ☐ Large # of critical signals that cannot all be collected at once via SECS/GEM
- ☐ Large volume of signals of all types
- ☐ Flexibility for changing data collection approach during production
- ☐ Other _____

5. 5.1 Does the Equipment Purchase Specification of your company include Equipment Data Acquisition (EDA), Cybersecurity and Automation standards and requirements (Y/N) ?

☐ Simple list of SECS/EM standards (and their versions). If no, is there a new or modified standards required?

☐ Simple list of the EDA standards required (and their versions). If no, is there a new or modified standards required?

☐ Specific equipment control platform architecture (hardware, software). If no, is there a new or modified standards required?

☐ Specific system / interface software components required. If no, is a new or modified standards required?

☐ Specific equipment metadata model structure and content. If no, is there a new or modified standards required?

☐ References to SEMI E164 (Standard Equipment Metadata). If no, is there a new or modified standards required ?

☐ Additional detail for each of the EDA standards (E120, E125, E132, E134, E164, others) . If no, is there a new or modified standards required?

☐ Process-specific parameters and events. If no, is there a new or modified standards required?

☐ Detailed performance and data quality expectations (# parameters, maximum sampling rate (perhaps by parameter type), # active data collection plans (DCPs), maximum allowable latency, etc.). If no, is there a new or modified standards required?

☐ Field support and problem diagnosis expectations (#machine temporal series, #daily check results, #machine alarm, etc.), if no, is there a new or modified standards required?

☐ Acceptance testing process description (pre- and post-delivery) . If no, is there a new or modified standards required ?

☐ Incremental deliverables (equipment model, interface simulator, etc.). If no, is there a new or modified standards required?

5.2 Sample Supplier Response Checklist (Y/N)

Cybersecurity criteria:

☐Strong Password. If no, is there a new or modified standards required

☐Backup & Restore Documentation. If no, is there a new or modified standards required?

☐Antivirus software. If no, is there a new or modified standards required?

☐Sealing software. If no, is there a new or modified standards required?

☐OS - Maintenance and support. If no, is there a new or modified standards required

☐List of software applications. If no, is there a new or modified standards required?

☐Data Transfer – Documentation. If no, is there a new or modified standards required?

☐Other _____

Metrology Tools

6. **What are the most prevalent issues in your metrology equipment which could require new or modified standards (Y/N).**

☐Dropped connections / session instability. If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐Missing data (even when sessions appear to persist). If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐Low sampling frequency. If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐Maximum # of parameters at a time. If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐Maximum # of simultaneously active DCPs. If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐Model inconsistencies across equipment types / suppliers (structure, naming conventions, coverage). If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐Poor visibility into equipment / process behavior (equipment models don't include enough detail in parameters and events). If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐Limited configuration flexibility (session management, error logging, problem diagnosis, ping intervals, client endpoints, etc.). If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐Improve software usability and manuals content. Manuals should have a detailed description of software options and technical aspects beyond the measurement. If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐All relevant sensors/parameters must be delivered to User network. If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐Selected and meaningful raw data must be shared with the User. If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐Allow Predictive Maintenance (PdM) and Virtual Metrology (VM) by also sharing recipe parameters (i.e.: measurement spot coordinates, categorical parameters). If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐Allow recipe modification by remote including input file to speed up recipe preparation (i.e.: reticle coordinates). If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐To allow autocalibration and deliver the results through automation protocol. If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐To manage recipes versioning. If yes, please specify if new or modified manufacturing standards are needed in more details:_____

☐(Other 1) _____

Part 3: Beyond-state-of-the-art standard recommendations

What are your beyond state-of-the-art standards recommendations and wishlist based on your domain of expertise :

_____

Acronyms

5GAA – (V2X) 5G Automotive Association

ACL – access control list

AMHS – automated material handling system

C2C – (V2X) CAR 2 CAR Communication Consortium

CA – certificate authority

CCC – (UWB) Car Connectivity Consortium

CEID – collection event ID (SECS)

CMP – chemical mechanical polish (or planarization)

DCP – data collection plan

DV/DVID – data variable ID (SECS)

EC/ECID – equipment constant ID

EDA – Equipment Data Acquisition

EPD – endpoint detection

ETSI – European Telecommunications Standards Institute

ETSI ERM – ETSI EMC and Radio Spectrum Matters

ETSI ERM WGEMC - ETSI ERM Working Group on Electro-magnetic Compatibility

ETSI ERM TG28 - ETSI ERM Task Group on Generic Short Range Devices

ETSI ERM TG30 - ETSI ERM Task Group on Medical Devices

ETSI ERM TG34 - ETSI ERM Task Group on Radio Frequency Identification

ETSI ERM TG37 - ETSI ERM Task Group on Intelligent Transport Systems

ETSI ERM TGSRR - ETSI ERM Task Group on Automotive and Surveillance Radar

ETSI ERM TGUWB - ETSI ERM Task Group on Ultra Wide Band

ETSI ITS - ETSI Intelligent Transport Systems. It includes the working groups WG1 (Application Requirements and Services), WG2 (Architecture and Cross Layer), WG3 (Transport and Network), WG4 (Media and Medium Related) and WG5 (Security)

FIRA – (UWB) fine ranging consortium

FMEA – failure modes and effects analysis

FDC – fault detection and classification

GEM – Generic Equipment Model (SEMI E30)

IEEE – Institute of Electrical and Electronics Engineers

IEEE 802.3 – IEEE ETHERNET WORKING GROUP

IEEE 802.11 – IEEE WIRELESS LOCAL AREA NETWORKS WORKING GROUP. It includes all subgroups such as n/ac/ax/be/p/bd/ay/bf…

IEEE 802.15 – IEEE Wireless Specialty Networks (WSN) WORKING GROUP. It includes all subgroups such as .1/.2/.3/.4…

IEEE PAM-4 – IEEE Pulse Amplitude Modulation 4-level

ISMI – International Sematech Manufacturing Initiative

KPI – key performance indicator

MCA – Metadata Conformance Analyzer

MCS – material control system

NIC – network interface card

NIST – National Institute of Standards and Technology

NTP – Network Time Protocol

OEE – overall equipment effectiveness

OES – optical emission spectrometer

OHT – overhead track

PHM – prognostics and health management

PO – purchase order

PTM – Product Time Measurement (SEMI E168)

R2R – run-to-run [control]

RFI – request for information

RGA – residual gas analysis (or analyzer)

ROI – return on investment

SECS – SEMI Equipment Communications Standard

SSL – secure socket layer

SV/SVID – status variable ID (SECS)

UWB – Ultra Wide-Band

UWB Alliance – UWB Alliance consortium

V2X – Vehicle-to-everything

W2W – wafer-to-wafer [control]

WTW – wait-time waste [control]