Best Practices in Implementing Interface A / EDA Interfaces

Smarter Manufacturing Through Better Data: Applications and Benefits of SEMI Interface A / EDA Standards Workshop

January 10, 2020

Shanghai, China

Outline

- Factory expectations of equipment suppliers
- EDA implementation best practices
- Cimetrix best practices coverage
- OEM EDA development process
- Factory implementation alternatives
- Other factory best practices
- Discussion

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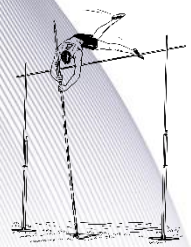
Expectations for equipment suppliers

- **Expectation #1**: Fab engineers expect fully integrated instrumentation on and around equipment to provide well established unambiguous HVM sensing BKMs.
- **Expectation #2**: Fab engineers must be able to access and model empirically selected trace data from all instruments/gauges designed into semiconductor equipment. We need sensor response times, settling times and setpoints. We also need to know PID closed-loop controller adjustments to understand when instruments are working harder than normal, i.e., degrading.
- **Expectation #3**: Onboard equipment operating systems and supporting hardware must be improved to enable >99% automation stability.
- **Expectation #4**: Equipment design and automation is not providing all the necessary Fault Detection capability. Fabs expect this issue to be addressed faster with deeper collaboration around FMEA and 'unambiguous' process and equipment health signals.



* "Raising the Bar: Foundry Expectations for Equipment Capability and Control," Boyd Finlay, Principal Member Technical Staff, GLOBALFOUNDRIES, October 2017

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Summary

Top 10 EDA Implementation Best Practices

1. Understand customer's real requirements
2. Consider non-functional requirements as well
3. Define robust system architecture
4. Choose platform with extra "headroom"
5. Implement E164 common metadata standards
6. Use equipment modeling tools
7. Provide complete visibility into equipment behavior
8. Build in "hooks" for field service support
9. Develop thorough test plans and use them
10. Use proven commercial software

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Understand factory's real requirements

- Functional – as stated in purchase specifications
- Standards compliance – beyond the specifications
- Operational – expected production use
- Key application support – where the data will go…
- Naming conventions – factory-level equipment data schema

- In summary: make your customer's job as easy as possible (next slide)

These are some of the factory EDA issues…

- Determining the data collection requirements for each tool type
- Ensuring the metadata models support these requirements
- Testing compliance to standard requirements and factory specs
- Implementing performance management functions consistently
- Supporting multiple “freeze” versions across supplier base
- Designing tool-resident data collection schemes
- Managing data collection plans across the factory
- Deciding where and how to store collected data
- Synchronizing time stamps across tools/servers
- Building in the right level of fault tolerance
- Creating operational support tools

Consider non-functional requirements

- Performance
  - Max sampling rate, parameters per DCP, total bandwidth required
- Scalability
  - Size/range of potential equipment configurations
- Availability
  - % uptime, MTBF, MTTR
- Flexibility and extensibility
  - Additional features, multiple/new standards versions
- Ease of configuration and use
  - Customer skill set assumptions, expectations

Define robust system architecture

- Often dictated by non-functional requirements (previous slide)
- Separate EDA interface server from real-time equipment controller
- Implement an efficient internal data pipe
  - Minimize time to pass data from its sources to EDA data collection software
  - Give process data highest priority
  - Document maximum data throughput
  - Modularize APIs between data sources and EDA server (decouple)
  - Equipment re-architecture might be required
- Don’t put much (if any) other software on EDA server platform

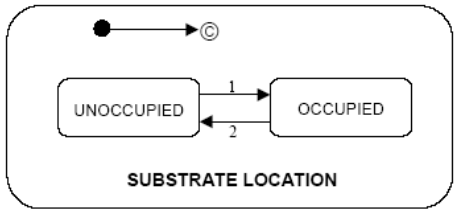
Choose platform with extra “headroom”

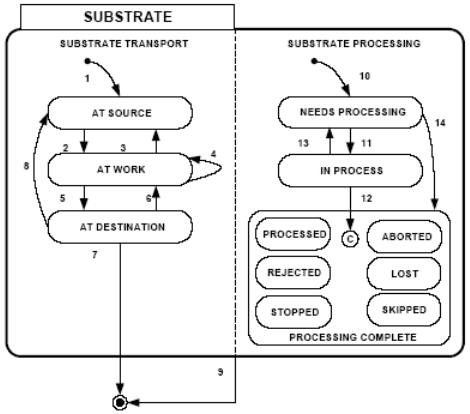
- Hardware is inexpensive compared to downtime and support cost
- Cimetrix guidelines based on many years of production experience
  - CPU speed/# cores
  - Memory
  - Disk size, max utilization
  - Network interface
  - Operating system

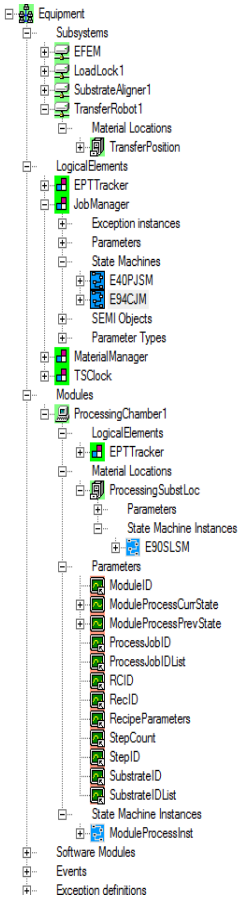
- Plan for possible platform upgrades in the field
- Trigger PerformanceWarning before performance is compromised

Implement E164 (EDA Common Metadata)

- Incorporates “best practices” from many EDA implementations
- Includes all required GEM300 information and E157
- No more difficult than any other model structure
- Ensures consistency across multiple equipment types
- Genuine opportunity to exceed customer expectations







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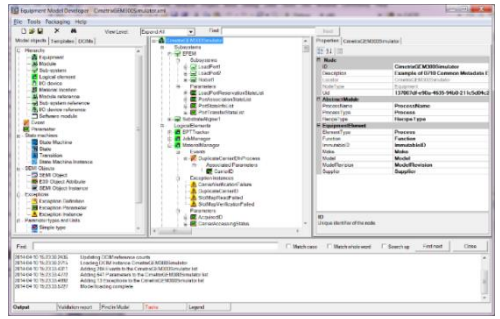
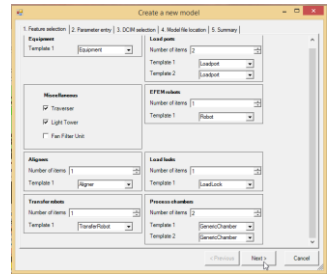
Use equipment modeling tools

- Typically 75% of the development & maintenance time
- Use model generation “wizards” as starting point
  - Capture specifics of equipment configuration
  - Generate E164-compliant model as baseline
  - Add process-specific information to this structure
- Create a common template for all equipment
  - Minimizes model differences between equipment types





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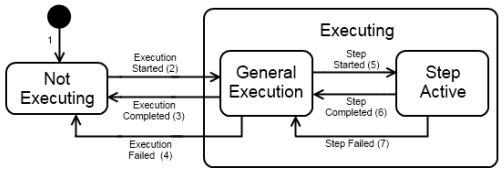
Provide visibility into equipment behavior

- Implement E164-defined structure as starting point
- Provide all key process variables, events, and exceptions
- Document underlying mechanisms and associated variables
  - Sensors, actuators, I/O, exception conditions, …
- Implement E157 "steps" and make them meaningful
  - Used to enable/disable high speed trace data collection
  - Number of steps depends on process duration and complexity
- Anticipate and address customer's key application requirements
  - Consider process performance and productivity monitoring
- Basic principle: When in doubt… include it

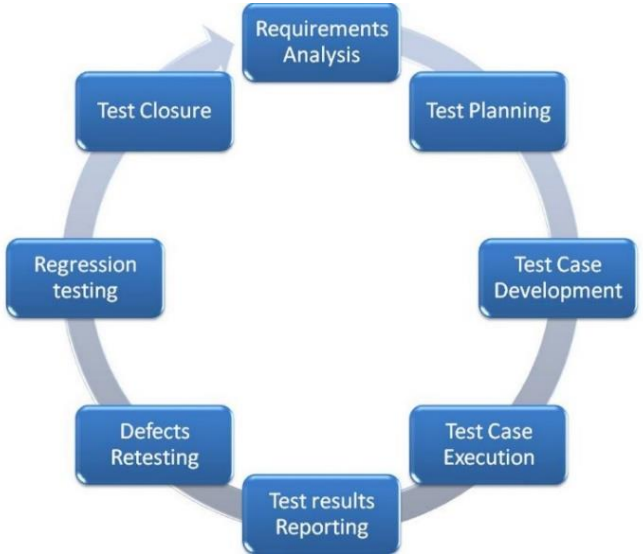


Build in “hooks” for field service support

- Include basic “sniff” test
  - Is EDA interface alive and communicating?
- Capture snapshot and recent history of EDA operating environment
  - Active client sessions, data collection plans (DCP), report (DCR) statistics
  - Use the “built-in DCP” features to cover important diagnostic use cases
- Likewise for platform operating condition
  - Register complete set of performance parameters with Perfmon
- Define and document multi-level logging strategy
  - Train customer in configuration and use
- Provide one-step process for generating required diagnostic logs

Develop/use thorough test plans

- Unit, system and regression
- Standards conformance
- Performance and reliability
- Customer-specific requirements
- Pre- and post-delivery acceptance



Use proven commercial software

- All industry standards are moving targets
- EDA standards are especially complicated
- Minimize time to market with working implementation
- Focus software engineering team on tool differentiation
- Use industry-accepted standards validation software
- Choose companies and products with proven track record

Cimetrix Best Practices Coverage

Cimetrix Best Practices Coverage

Best Practice	Coverage	Notes
1. Understand customer's real requirements	✓	Participation in EDA development since beginning provides unique perspective
2. Consider non-functional requirements as well	✓	OEM and factory implementation experience drives Cimetrix product content
3. Define robust system architecture	✓	CIMPortal modular architecture (esp. DCIMs) supports wide range of configurations
4. Choose platform with extra "headroom"	✓	Cimetrix platform recommendations address this question
5. Implement E164 common metadata standards	✓	Equipment Model Developer directly supports generation of E164-compliant models
6. Use equipment modeling tools	✓	EM Developer includes template library, model migration, and many other features
7. Provide complete visibility into equipment behavior	✓	Production experience with fab customers/applications confirm the value of this practice
8. Build in "hooks" for field service support	✓	Cimetrix "passionate support" team thoroughly understands production requirements
9. Develop thorough test plans and use them	✓	Techniques used in-house to test EDA products and their compliance to standards
10. Use proven commercial software	✓	Cimetrix is unquestioned market leader in commercial EDA product implementation

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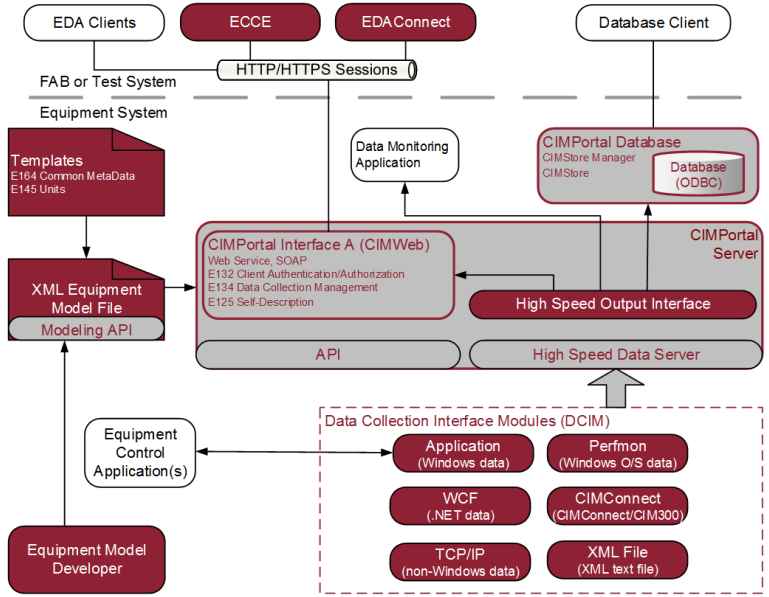
OEM Development Process

OEM EDA Development Process

Using Cimetrix CIMPortal Plus product

1. Select DCIM Packages
2. Configure DCIM Instances
3. Create Equipment Model
4. Map DCIM
5. Validate system configuration
6. Generate Deployment Package
7. Deploy Equipment Package



All of this can be done programmatically

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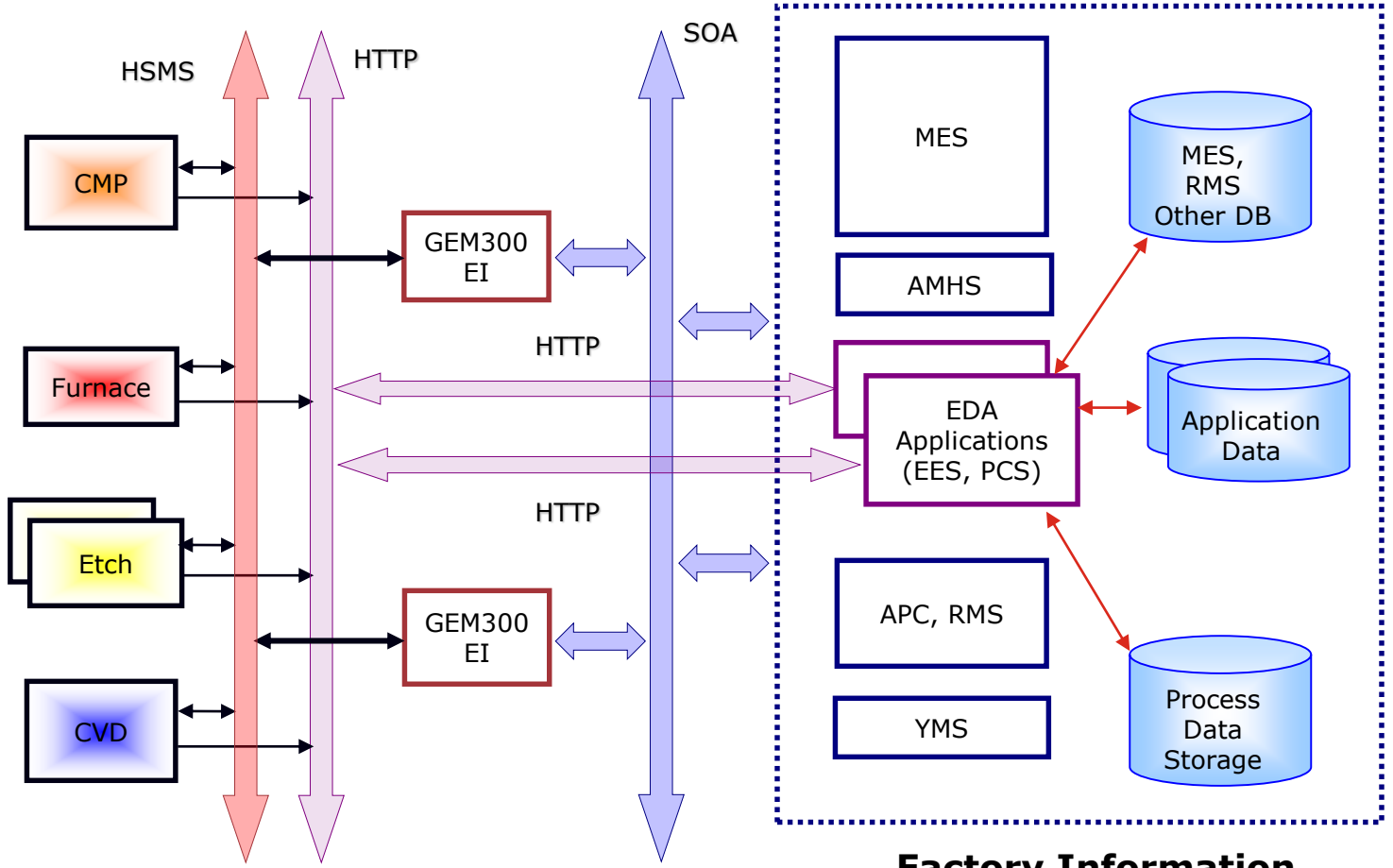
Factory Implementation Alternatives

Factory Architecture A

Application-driven multi-client EDA connections



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Architecture style
Wild West – chaotic

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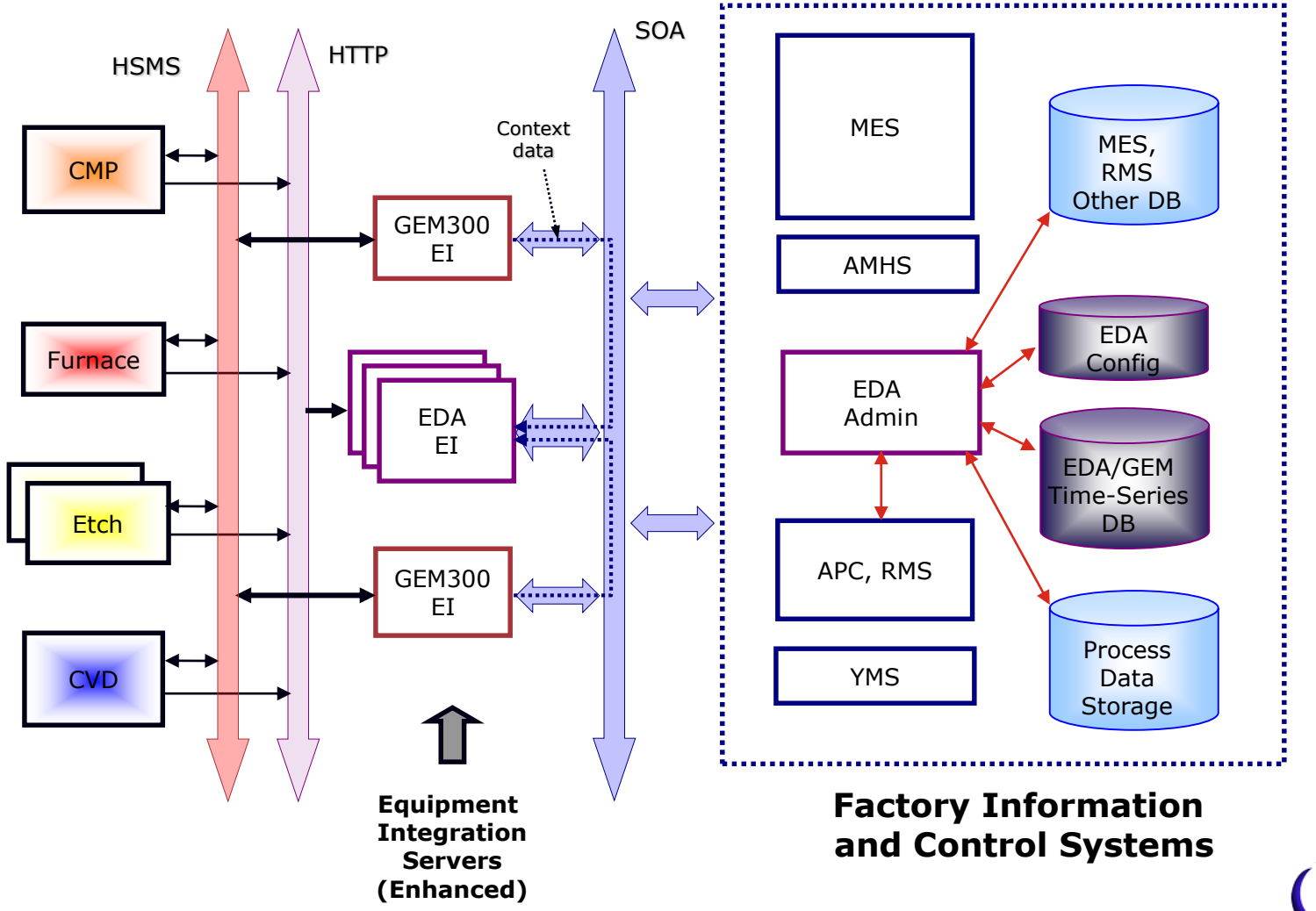
Factory Architecture B

Add-on fab-wide EDA infrastructure



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Architecture style

Evolutionary

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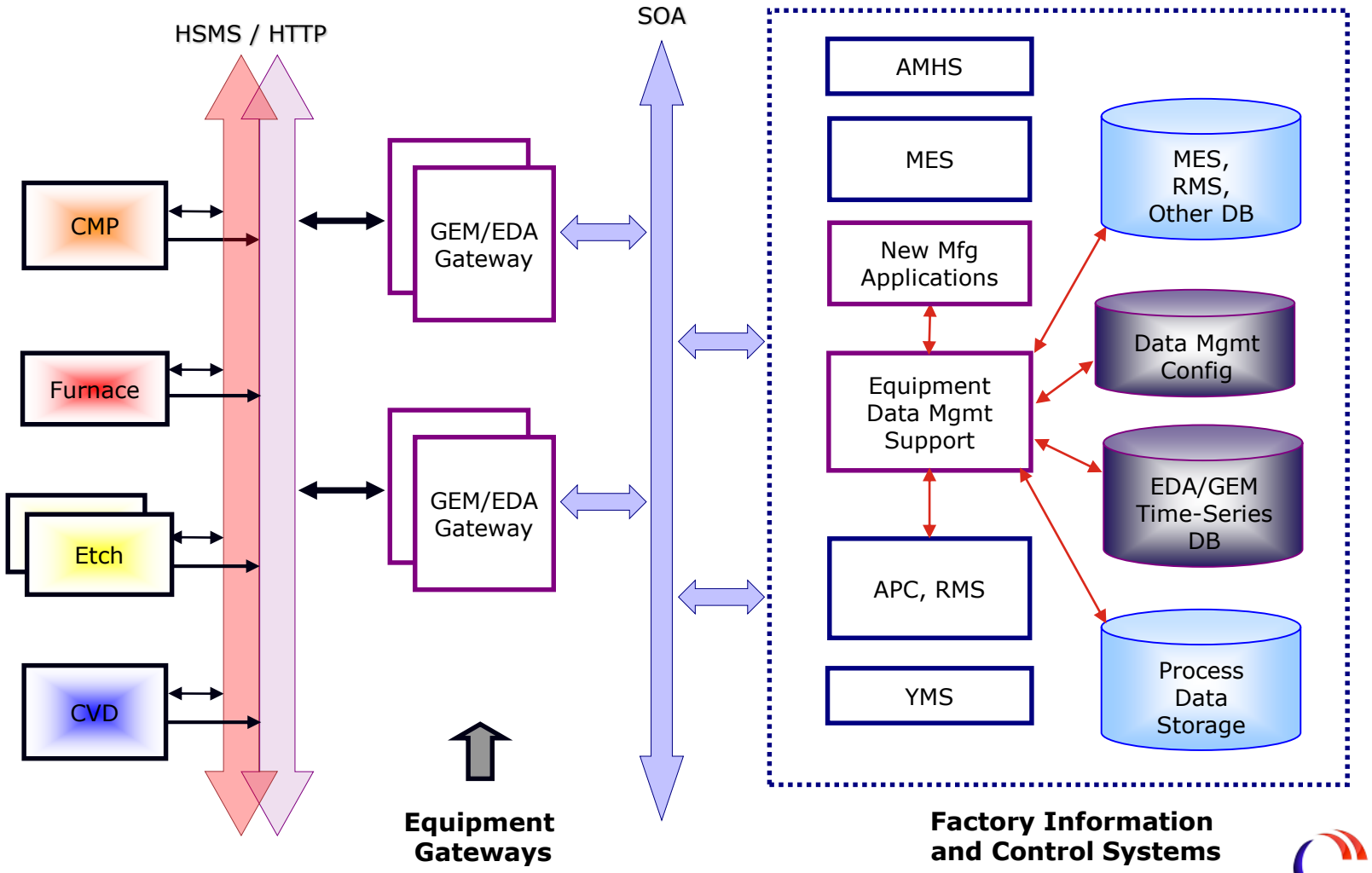
Factory Architecture C

Integrated production system architecture



Architecture style
Classical

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Thank you

- 谢谢
- Danke
- 감사합니다
- 謝謝
- Merci
- ありがとうございます
- Gracias