

Operate Orchestrate and Originate

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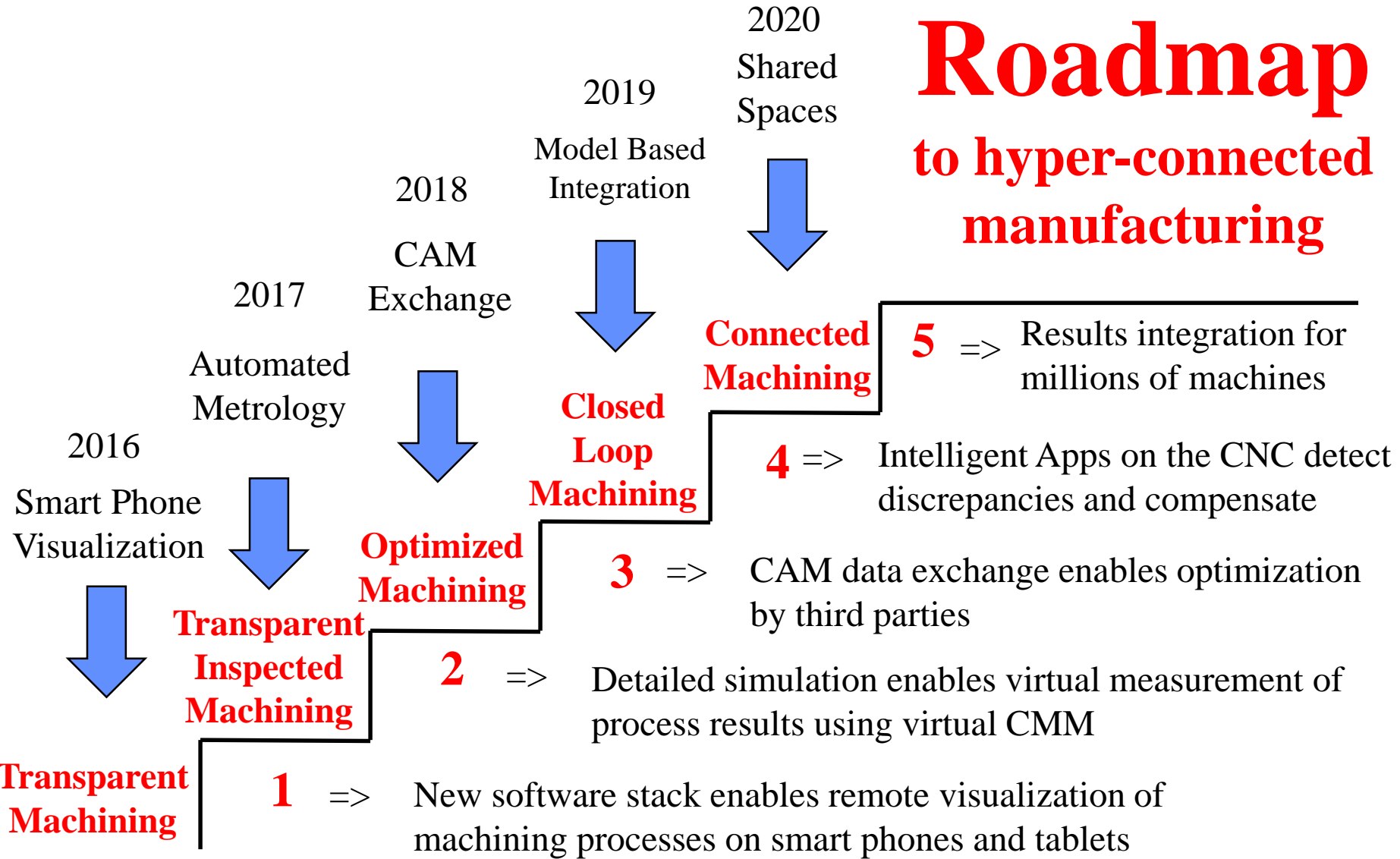
Problem Statement

- The DARPA AVM program created many designs
 - But adding the detail to enable manufacturing assembly was formidable
- The DMDII AVM program (14-02) has identified services that can provide a solution
 - Auto-compute the assembly tolerances GD&T
 - Auto-generate NC programs to meet the GD&T
 - Machine the parts while monitoring the results
 - Test using virtual metrology and real metrology

First demonstration

- To be held on October 5th at Future of Flight Museum in Mukilteo, WA
- Demonstration content
 - Monitor machining taking place at a local plant
 - Demonstrate model based metrology
 - Show why the use of models makes machining programs 15% more efficient
 - Using STEP, MTConnect and QIF

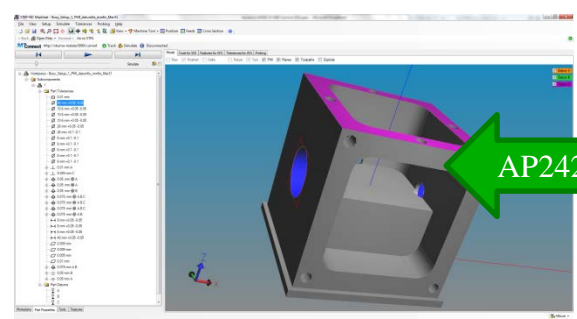
Roadmap to hyper-connected manufacturing



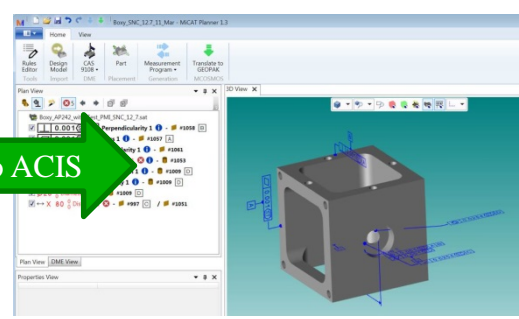
Early results for October 5th



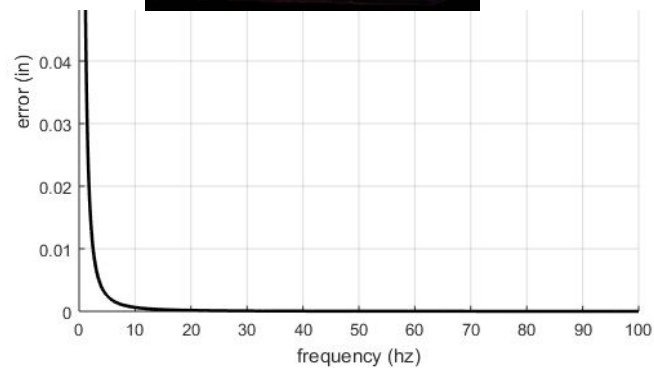
Smart
Phone
Control



AP242 to ACIS



GD&T data exchange



Error vs sampling rate

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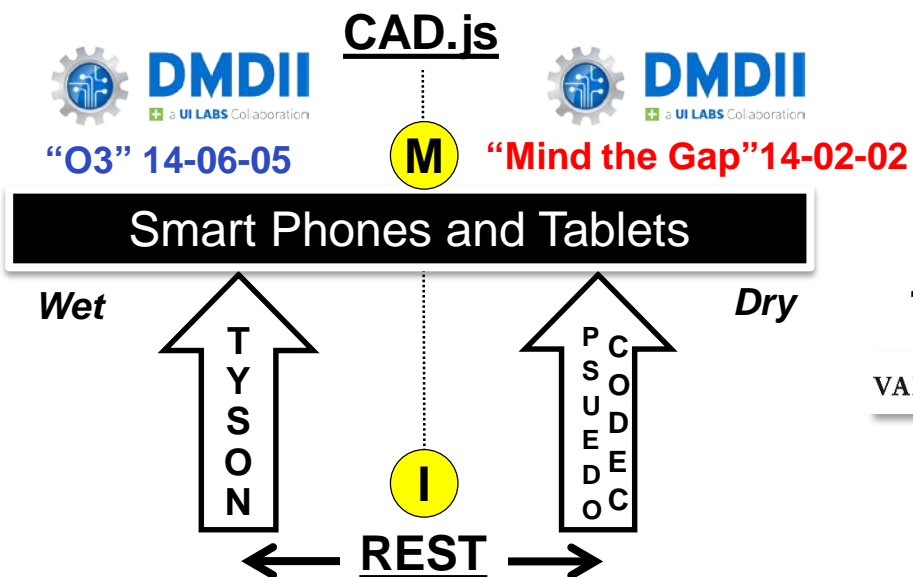
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QIF

Technology and Standards

- S** TEP Backbone
- W** eb Gateway
- I** nterpretation Env.
- M** anufacturing App.



1. Validation GUI

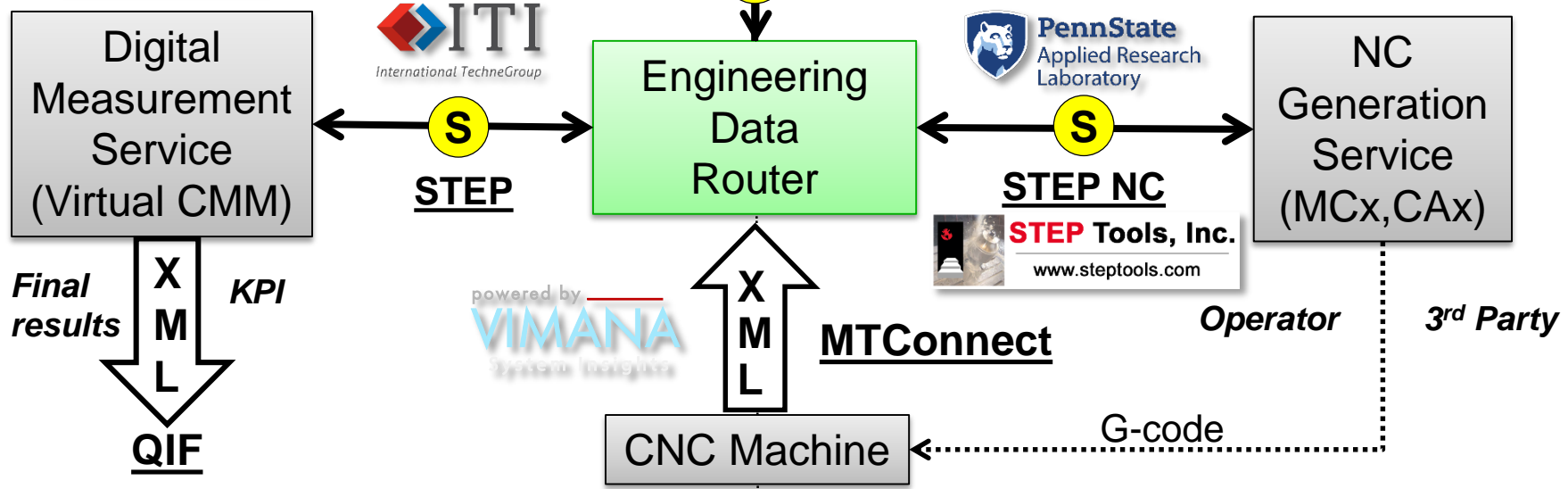
VANDERBILT UNIVERSITY®

2. Inspection

Mitutoyo

3. Optimization

AVM iFAB



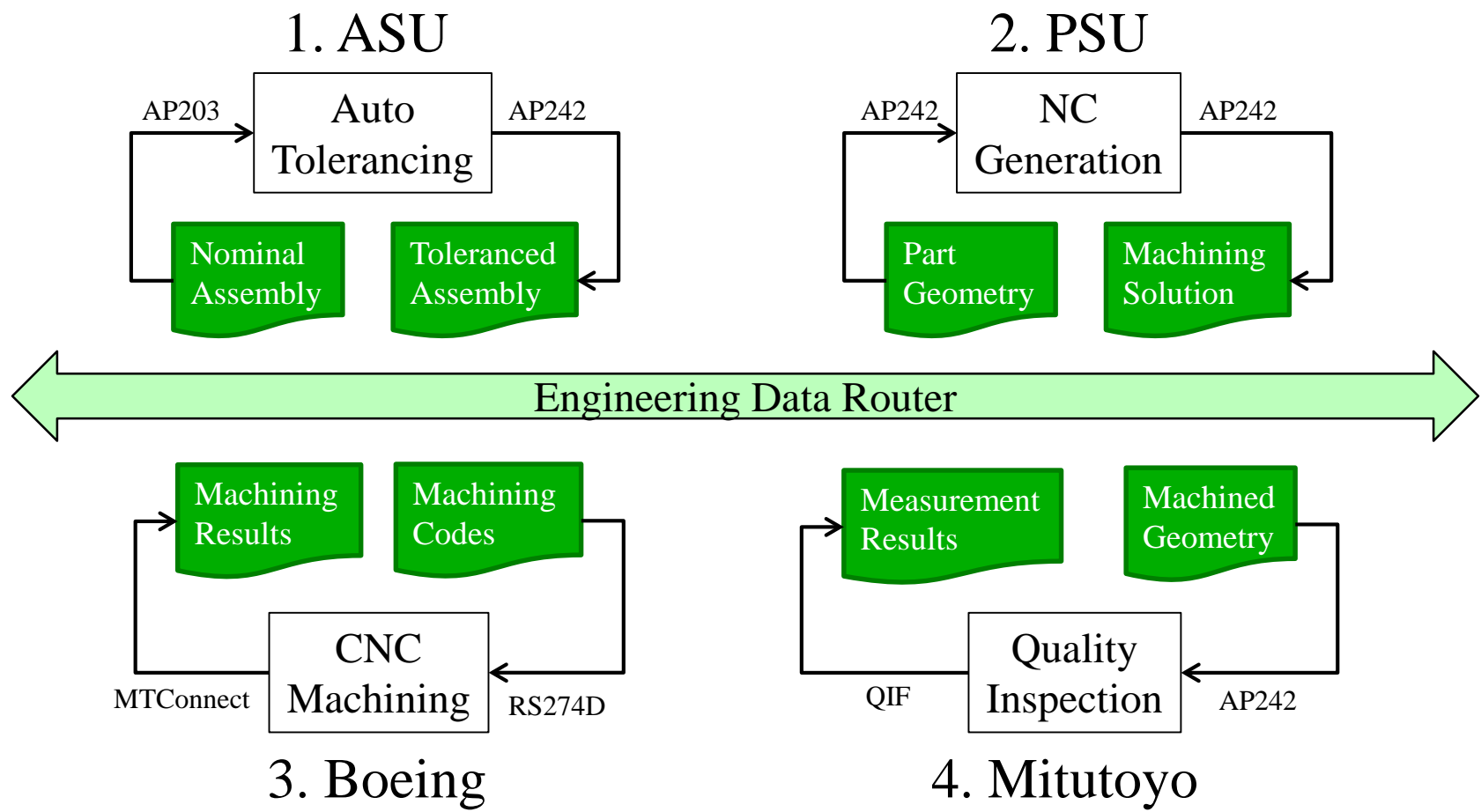
Deployment

Year	Router Capability	Enables
2016	Digital signatures	Secure communication
2017	Universally Unique Identifiers (UUID)	Tolerance sharing
2018	Anchors and references	Process sharing
2019	JavaScript	Machine sharing
2020	Hyper-connection	Digital manufacturing

- S** • STEP Backbone (Information Models)
 - http://www.steptools.com/support/stdev_docs/stpman/html/index.html
- W** • Web Gateway (P21 Edition 3)
 - http://www.steptools.com/support/stepnc_docs/stepncdll/
- I** • Interpretation Environment (appropriate schema definitions)
 - http://www.iso.org/iso/home/store/catalogue_ics/catalogue_detail_ics.htm?csnumber=63141
- M** • Manufacturing App (open source)
 - <https://github.com/ghemingway/cad.js/tree/master>

Follow-on Demonstration

Automated tolerancing for machining assembly



Location and date to be finalized

Concluding remarks

- We are building an infrastructure for automating machining and measurement
 - STEP for the product models
 - MTConnect for the machining results
 - QIF for the measurement results
- Understood benefits
 - 15% better machining by enabling 3rd party optimization
 - Reduced scrappage due to real-time measurement
 - Faster to market because of direct connections to machines and supply chain
 - Eventual deployment of less expensive, less rigid machines