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# Interface A: Early Evaluation

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# Overview

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## *AE Diagnostic Network Evaluation Project*

- **Objectives**
- **Methodology**
- **Early results**
- **Conclusions**

# AE Diagnostic Network Evaluation Project

- **Objectives**

- Evaluate feasibility of implementation for proposed Interface A standards
  - Can a knowledgeable person implement the standard with no information beyond the written document?
- Provide quantitative support to the standards effort
  - Performance benchmarks

- **Methodology**

- Partner with Colorado State University for “blind” evaluation
- Calculate and experimentally validate performance parameters
- Investigate performance on holistic level
  - Inter-tool and intra-tool considerations

# Project Team



- **Ralph Castain**  
*VP/GM – Integrated Controls*
- **Tim Ash**  
*Director of Software Engineering*
- **Mike McDonald**  
*Software Engineering Manager*
- **Roger Alexander**  
*Professor of Computer Science*
- **Sudipto Ghosh**  
*Professor of Computer Science*
- **Julie Cormani**  
*Graduate Student, Computer Science*

# Project Plan

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- **Benchmark SEMI 3508/3563**
  - Validate the proposed standard document
    - **Does it work as written?**
    - **Can a knowledgeable person build a working system from it?**
  - Evaluate consistency with other proposed e-diagnostic standard documents
    - **Are the multi-document “hooks” and roles consistent and interoperable?**
- **Quantify required diagnostic network bandwidth**
  - Focus on multi-tool traffic issues
- **Investigate information pathway inside the tool**
  - What can current subsystems, sensors, and intra-tool networks support?
  - What should future intra-tool systems look like?
- **Quantify end-to-end system performance**
  - From subsystem/sensor to fab database

# Current Status

Preliminary work complete

Partially complete/active

- **Benchmark SEMI 3508/3563**

- Validate the proposed standard document
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  - **Are the multi-document “hooks” and roles consistent and interoperable?**

- **Quantify required diagnostic network bandwidth**

- Focus on multi-tool traffic issues

- **Investigate information pathway inside the tool**

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- **Quantify end-to-end system performance**

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# Benchmark Evaluation

- **Initially performed on 3508**
  - Findings used to revise document for 3563
- **Current evaluation**
  - Reviewing 3563, 3507, 3509, 3510, and 3522
  - Expected completion by end October
  - Preliminary results
    - Documents found mostly consistent
      - Both self-consistent and interoperable “hooks”/roles
      - Some minor clean-up recommended
    - Interfaces appear well described and functional
      - Some concerns over error conditions and recovery
    - Some performance concerns

# Diagnostic Bandwidth Requirements

Depends strongly upon...

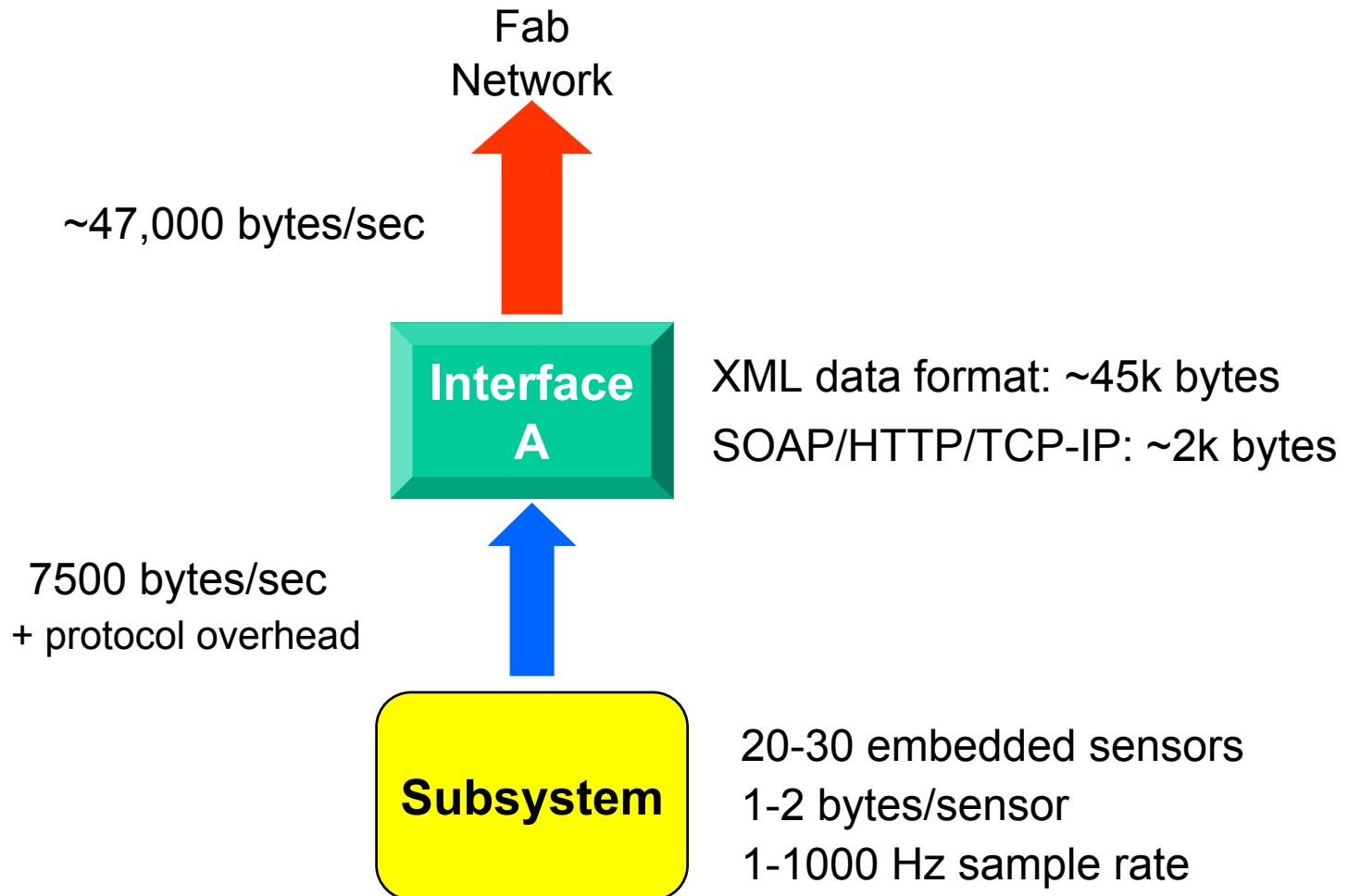
- **Application**
  - Multiple data points vs. single data point per transmission
  - Sample transmission rate
- **Data Collection Plans (DCPs)**
  - Number being executed
  - Execution strategy
    - Totally independent, grouped transmission, aggregated sampling, ???
    - This is not specified in the standard, but rather left to individual implementation
- **Protocols**
  - Currently specified as XML wrapped in SOAP, riding on HTTP and TCP/IP
  - Exact specification of XML metadata content per message not yet available
    - Can be major driver in overhead/message

# Example Calculation

## Assumptions:

Full Transmission of subsystem diagnostic data

Block transmission @ 1Hz update rates from Interface A

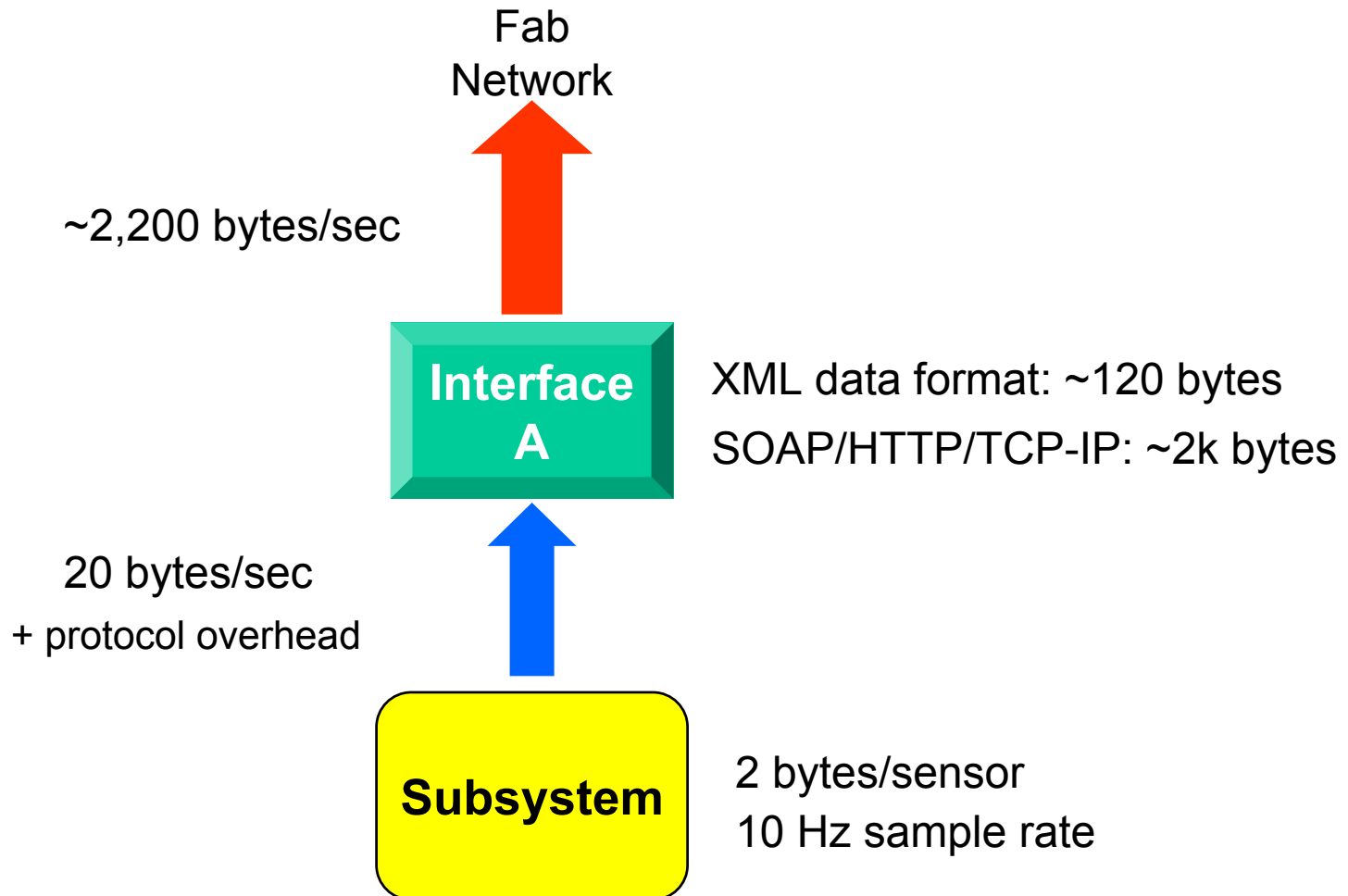


# Example Calculation

## Assumptions:

Transmission of single 2-byte sensor reading from subsystem

Point-by-point transmission @ 10Hz update rate from Interface A



# Current Intra-Tool Capabilities: 200mm plasma tools

- **Most sensors and actuators connected with only analog and discrete digital signals**
  - Provides only those signals absolutely required to create and control recipe

| <i>Control Signals</i>                                    | <i>Sensor Signals</i>                                       |
|---|---|
| <b>Single Set-point<br/>(Power, Temp, Flow, Pressure)</b> | <b>Single major read back<br/>associated with set-point</b> |
| <b>On/off</b>   | <b>Single bit with on/off state</b>                         |
| <b>Regulation Mode</b>                                    | <b>Single fault bit</b>                                     |

- Difficult to acquire advanced sensor information or equipment statistics
- **Embedded software not designed with data collection requirements in mind**
  - Control vs. data priorities

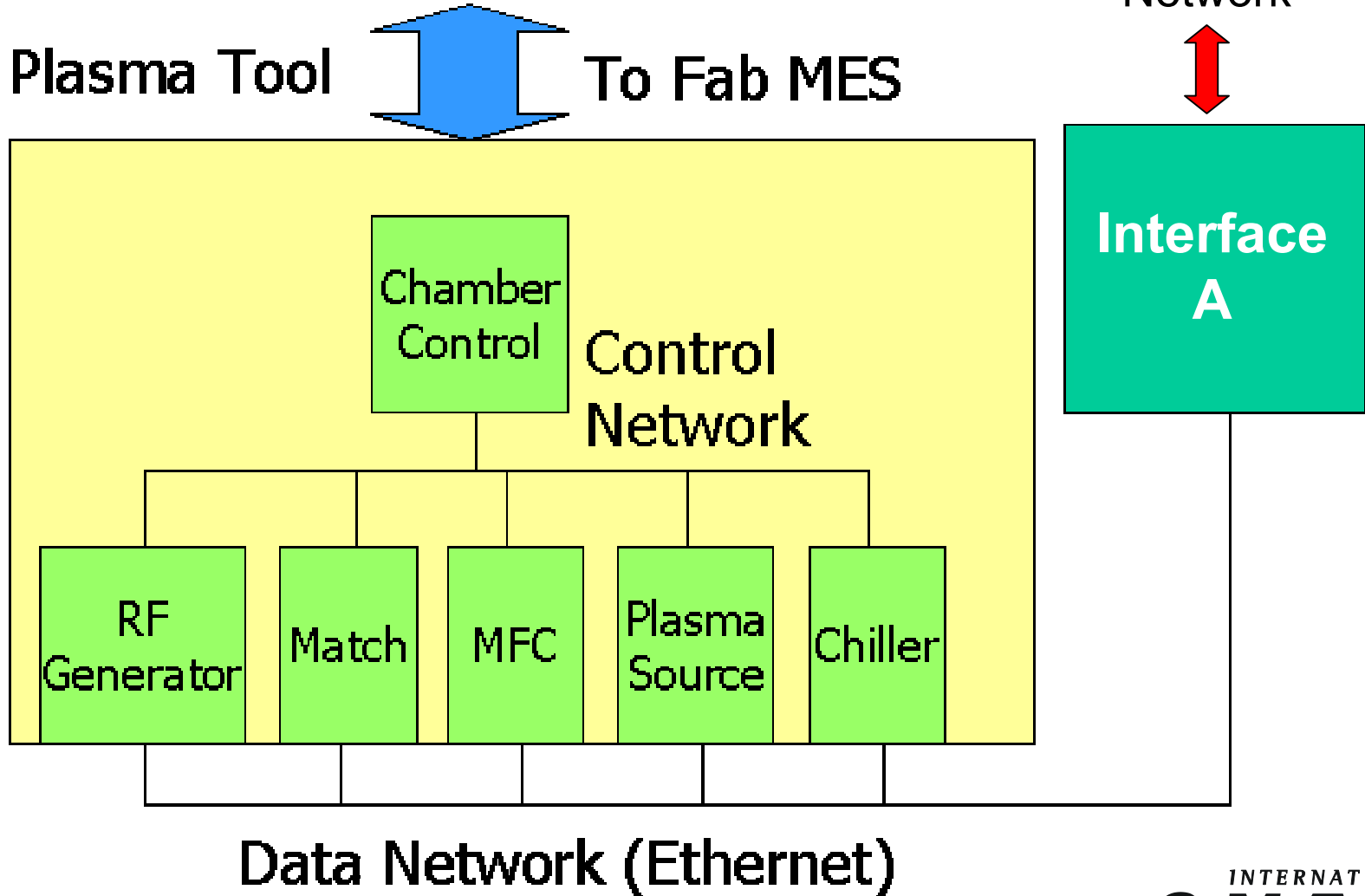
# Current State-of-Art Subsystem Available Data

| RF Generator                      | RF Match                      |
|-----------------------------------|-------------------------------|
| <b>Over-temperature</b>           | <b>Over-temperature</b>       |
| <b>AC Line Faults</b>             | <b>Interlock (Safety)</b>     |
| <b>Out of Setpoint</b>            | <b>NV Ram Failure</b>         |
| <b>Output at Limit</b>            | <b>Input DC power failure</b> |
| <b>Interlock (Safety) Faults</b>  | <b>Over-voltage</b>           |
| <b>AC on and RF output timers</b> |                               |

# Current Intra-Tool Capabilities: 300mm plasma tools

- **Semi SensorBus (DeviceNet, LonWorks, Profibus...) standards now in place for several equipment types**
  - But are not utilized for most equipment types
  - Subject to customization
  - Multiple standards and OEM-specific customizations are creating inefficiencies and reliability problems at the subsystem supplier level
- **Many tools continue to use analog, discrete digital**
  - Information access remains a problem
- **Encouraging efforts to access more information from on-tool sensors and actuators are underway for new generation tools**
  - But will not make a difference in the near term

# Future Intra-Tool Networks



# Conclusion

- **Proposed standards appear viable**
  - Bandwidth expectations must be within reason
    - **Easily supported**
      - Large block data transfer
      - Small data transfers at low sample rates
    - **Unlikely to support**
      - Individual measurements sampled at medium-to-high rates (> 10Hz)
  - Considerable implementation freedom exists
    - **Especially surrounding DCP implementation**
  - Some clarification and cleanup recommended
- **Tool and subsystem capability needs to be considered**
  - Availability of data from subsystems/sensors
    - **Modifications required to support e-diagnostic needs**
  - Intra-tool connectivity practices must consolidate to reliably and cost-effectively handle load
    - **Move to a common platform (e.g., Ethernet)**
    - **Reduced customization of approved standards**