NIST Cyber-Physical Systems Public Working Group (CPS PWG)

Kickoff Webinar
June 30, 2014
1pm EDT

National Institute of Standards and Technology
U.S. Department of Commerce

Purpose of the Webinar

This webinar will address 6 questions:

- Why is NIST convening the CPS-PWG?
- Who will participate?
- What is the goal of the CPS-PWG and what will it deliver?
- When will key milestones be reached?
- How will the CPS-PWG operate?
- How can you participate?

Agenda - CPS PWG Kickoff

- Introduction and Context – 20 minutes (Howard Harary, Chris Greer)
- CPS PWG Logistics Overview – 10 minutes (Dave Wollman)
- Overview of Subgroups – 40 minutes total
  - Ref Arch (Abdella Battou, co-chair)
  - Use Cases (Eric Simmon, co-chair)
  - Cybersecurity (Vicky Pillitteri, co-chair)
  - Timing (Marc Weiss, co-chair)
- Q&A and Concluding Remarks – 20 minutes (Chris Greer)

Q: Why is NIST convening the PWG?

A: By working together we can accelerate progress in cyber-physical systems across all domains.

Currently, however, we lack a unified technical foundation for broad collaboration. Missing are a consensus definition and taxonomy, reference architecture, and a shared understanding of the essential roles of timing and cybersecurity.

- The CPS-PWG will address this need by developing a shared foundation for progress.
- NIST provides a neutral perspective, technical expertise, and convening capability.

Q: Why now?

A: Consider three fast-paced trends:

- Widespread deployment of cyber physical systems in sector-specific applications.
- Explosive growth of the Internet of Things without a broad foundation for interoperability.
- Increasing need for systems-of-systems solutions that integrate CPSs across domains and at multiple scales.

Widespread CPS deployment

Smart systems are being deployed in countries worldwide to meet sector-specific needs:

- Smart Grid
- Disaster Resilience
- Manufacturing
- Health care
- Transportation
- Smart buildings
- <Your sector goes here!>

But these deployments are not designed for interoperability across sectors or between communities, countries or regions

Growth in the Internet of Things

Devices connected to the Web:

- 1970 = 13
- 1980 = 188
- 1990 = 313,000
- 2000 = 93,000,000
- 2010 = 5,000,000,000
- 2020 = 31,000,000,000

Source: Intel

Where these trends collide

Examples:

- Individual communities adopting unique smart systems may be unable to coordinate with neighbors, for example for regional traffic management systems that work across borders and share a common interface for all smart vehicles.
- Isolation of design, supply chain, assembly floor, and product delivery systems inhibit the emergence of end-to-end capabilities for 21st century advanced manufacturing.
- Separation of home care, primary care, pharmacy, and hospital systems prevent the emergence of patient-centric smart medical systems.

Q: Who Will Participate?

A: Anyone with an interest in cyber-physical systems

- The PWG is open and free for participation by anyone in industry, academia, or government anywhere in the world.
- Most of the sub-group work will be done in virtual meetings and using web collaboration tools allowing you to participate from anywhere.
- All of the products of the PWG will be openly available online to anyone.

Q: What is the goal of the CPS-PWG and what will it deliver?

A: The output of the PWG will be documents of three different types developed in sequential phases:

- Initial report from each of the four subgroups – Reference Architecture, Use Cases, Cybersecurity, and Timing
- CPS framework created by integrating the subgroup reports
- CPS Technology Roadmap identifying opportunities for a coordinated effort on key technical challenges

Key Characteristics of PWG Outputs

PWG outputs are:

- Intended for open use by all in the private and public sectors and will be freely available online
- Technology-neutral and business-model neutral
- Representative of the consensus, but not necessarily unanimous, technical perspective of the group

Examples of Other PWG Outputs

In progress:

- Big Data Public Working Group:

  Bigdatawg.nist.gov

NIST publication resulting from PWG effort:

- Cloud Computing – NIST SP500-292

  www.nist.gov/itl/cloud/index.cfm

Q: When will key milestones be reached?

- June 30, 2014: Kick-off webinar
- August 11-12, 2014: First face-to-face workshop at NIST
- November 1, 2014: Initial Sub-group reports complete
- Winter, 2015: Second workshop to complete integration and launch Technology Roadmap effort
- Spring, 2015: Integrated CPS framework complete
- Summer, 2015: Technology Roadmap complete

Q: How will the PWG be organized?

Co-Chairs	Reference Architecture	Use Cases	Cyber Security	Timing
NIST	Abdella Battou	Eric Simmon	Vicky Pillitteri	Marc Weiss
Academia	Janos Sztipanovits	John Baras	William Sanders	Hugh Melvin
Industry	Stephen Mellor	Stephen Mellor	Ron Perez, Claire Vishik	Sundeep Chandhoke

CPS PWG Logistics overview
David Wollman, NIST

- Subgroup co-chairs leadership and coordination
- Energetics – contracted support
- NIST and CPS PWG collaboration websites
- CPS PWG Meeting schedule
  - Virtual subgroup meetings will begin in the upcoming weeks
  - Face to face meeting August 11-12, 2014 at NIST in Gaithersburg, Maryland

Contracted support - Energetics

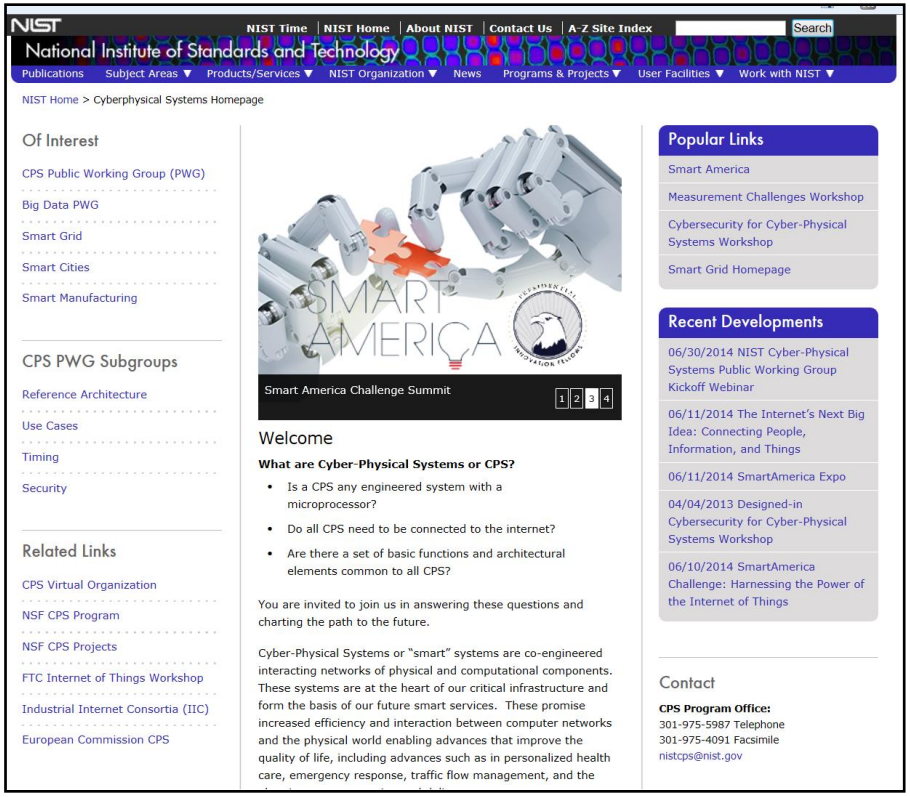
- NIST and Energetics have recently signed and are now implementing a contract for Energetics to provide support for the NIST CPS PWG and its subgroups.
  - Collaboration/document website and management – NIST CPS PWG website will have link to collaboration site, when available
  - F2F and virtual meeting facilitation and support

CPS PWG mailing lists, signups

- NIST CPS PWG email lists
  - Cps_pwgcomprehensive@nist.gov for general announcements
  - You can request to add your name via https://email.nist.gov/mailman/listinfo/cps_pwgcomprehensive for this list, or if you are having issues contact david.wollman@nist.gov
- CPS PWG subgroups email lists
  - For an interim period, you can request to add your name to subgroup lists via https://email.nist.gov/mailman/listinfo/cps_(name) where (name) = arch, usecase, sync, cyber
  - Alternatively, send an email to cps_(name)-join@nist.gov
  - if you are having issues joining, you can contact the NIST subgroup co-chairs to be added to subgroup mailing lists
- We will work with Energetics on mailing lists and subgroup admin going forward.

Initial Websites

- New main page NIST CPS: www.nist.gov/cps/
- NIST CPS PWG: http://www.nist.gov/cps/cpspwg.cfm



Initial Websites

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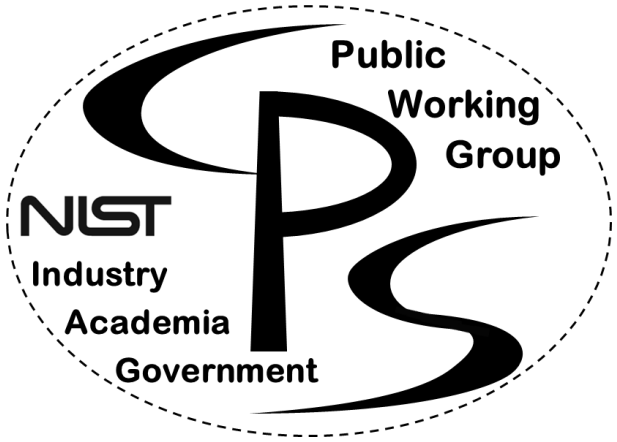
- **Logo Challenge:** For our more creative CPS experts, can you do better than Dave/Chris's attempts? Email (freely available) suggestions to david.wollman@nist.gov ….



CPS PWG Face to Face meeting August 11-12, 2014 at NIST Gaithersburg, Maryland

Draft agenda:

Monday August 11, 2014

9:00 AM Keynote Speaker - Chris Greer (NIST)

9:30 AM David Wollman - Schedule and beyond

Note: Sub-group co-chair presentations would include status of organizational documents and efforts to date.

10:00 AM Co-Chair Reference Architecture

10:15 AM Co-Chair Use Case

10:30 AM Break

10:45 AM Co-Chair Timing

11:15 AM Co-Chair Cybersecurity

11:45 AM Lunch

1:00 PM Subgroup breakout sessions

4:00 PM Adjourn

(4:15 PM Co-chairs only coordination meeting)

Draft agenda (Day 2):

Tuesday August 12, 2014

Breakout session reports. Note: Report outs should cover key issues, work plan and anticipated coordination and dependencies with other sub-groups

9:00 AM Co-Chair Reference Architecture

9:30 AM Co-Chair Use Case

10:00 AM Co-Chair Timing

10:30 AM Break

10:45 AM Co-Chair Cybersecurity

11:15 AM Concluding Remarks (Greer)

11:30 AM Workshop ends

Subgroup: Reference Architecture

CPS PWG Subgroup: Definition, Taxonomy and Reference Architecture
Purpose: Abstract the application sectors and address the more common, foundational principles of CPS

Co-Chairs

Janos Sztipanovits, *Vanderbilt University*

Stephen Mellor, *Industrial Internet Consortium (IIC)*

Abdella Battou

NIST

Deliverables: CPS Definition

1. **US NSF**: Systems in which physical processes are tightly intertwined with networked computing.

2. **UC Berkeley**: Cyber-Physical Systems (CPS) are integrations of computation, networking, and physical processes. Embedded computers and networks monitor and control the physical processes, with feedback loops where physical processes affect computations and vice versa.

3**.IEEE Control Systems Society**: The term cyber-physical systems (CPS) refers to a new generation of systems with integrated computational and physical capabilities that can interact with humans through many new modalities. The ability to interact with, and expand the capabilities of, the physical world through computation, communication, and control is a key enabler for future technology developments.

4. **CMU**: Cyber-Physical Systems (CPS) represent a bold new generation of systems that integrate computing and communication capabilities with the dynamics of physical and engineered systems. Just like the Internet transformed how we interact with information systems, cyber-physical systems will transform how we interact with and manipulate the physical world.

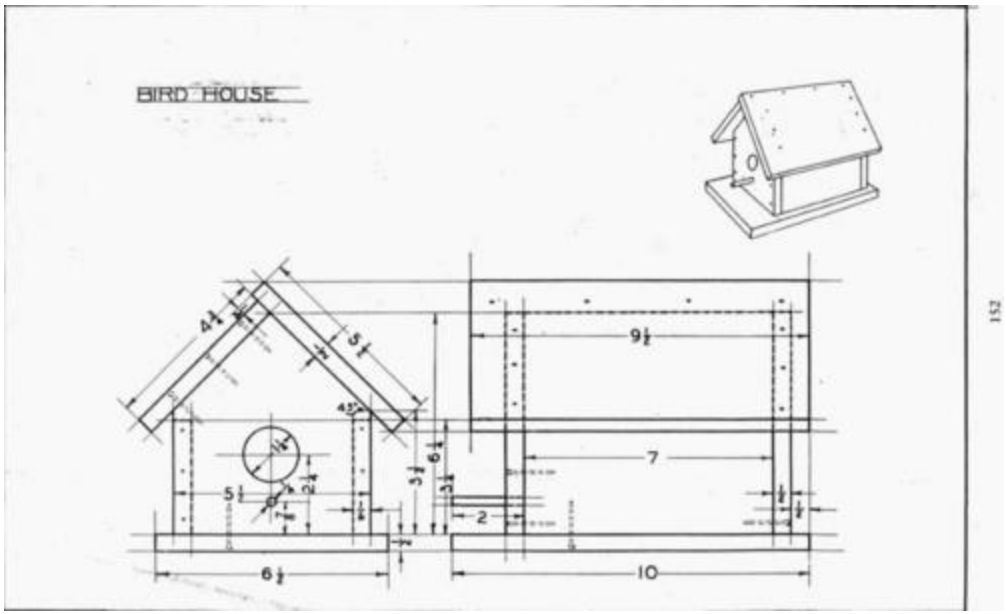
5. **Vanderbilt:** Engineered systems where functionalities and salient properties emerge from the networked interaction of physical and computational processes.

Adopt, Modify, or Develop a definition

Deliverables: Reference Architecture

Framework

Architecture



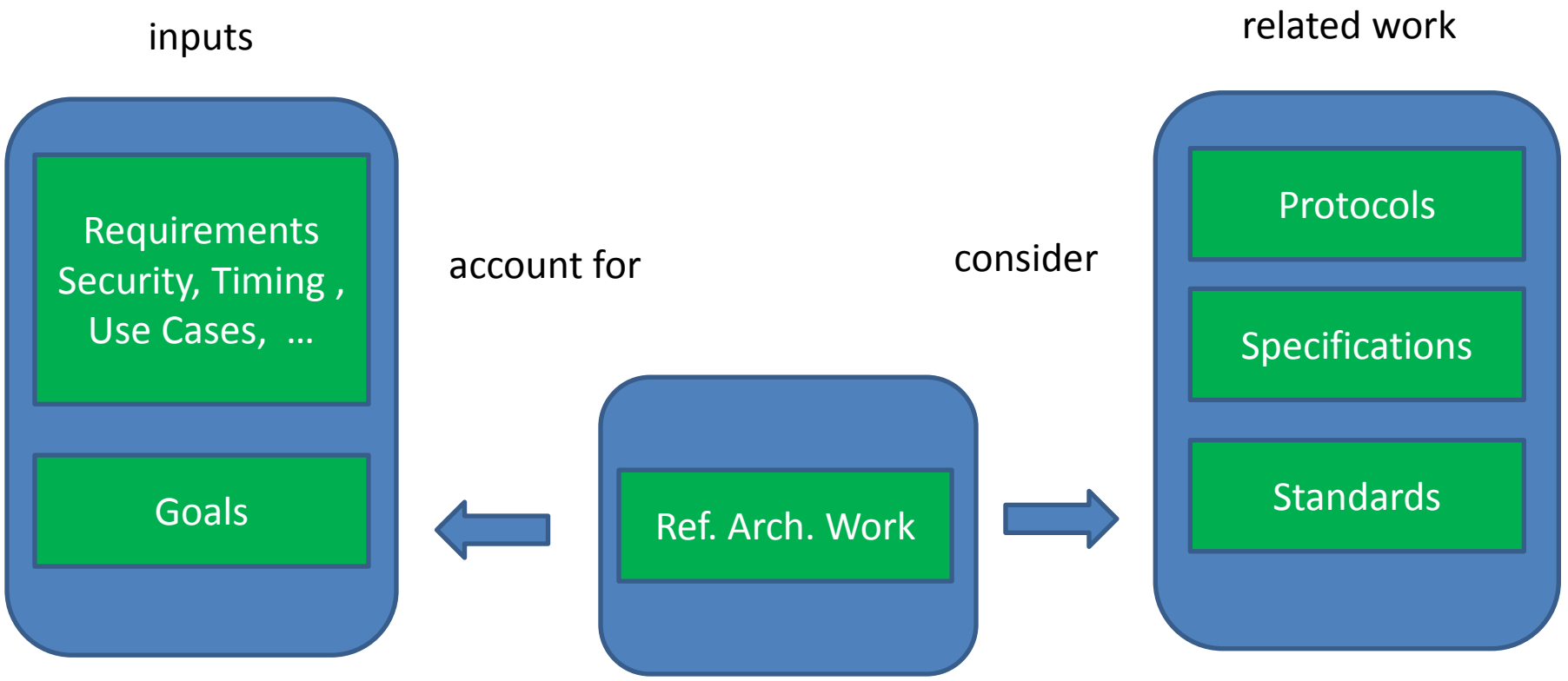
We expect the industry to develop many of these –as they promise high productivity and shorter time to market

Guiding principles for a CPS application

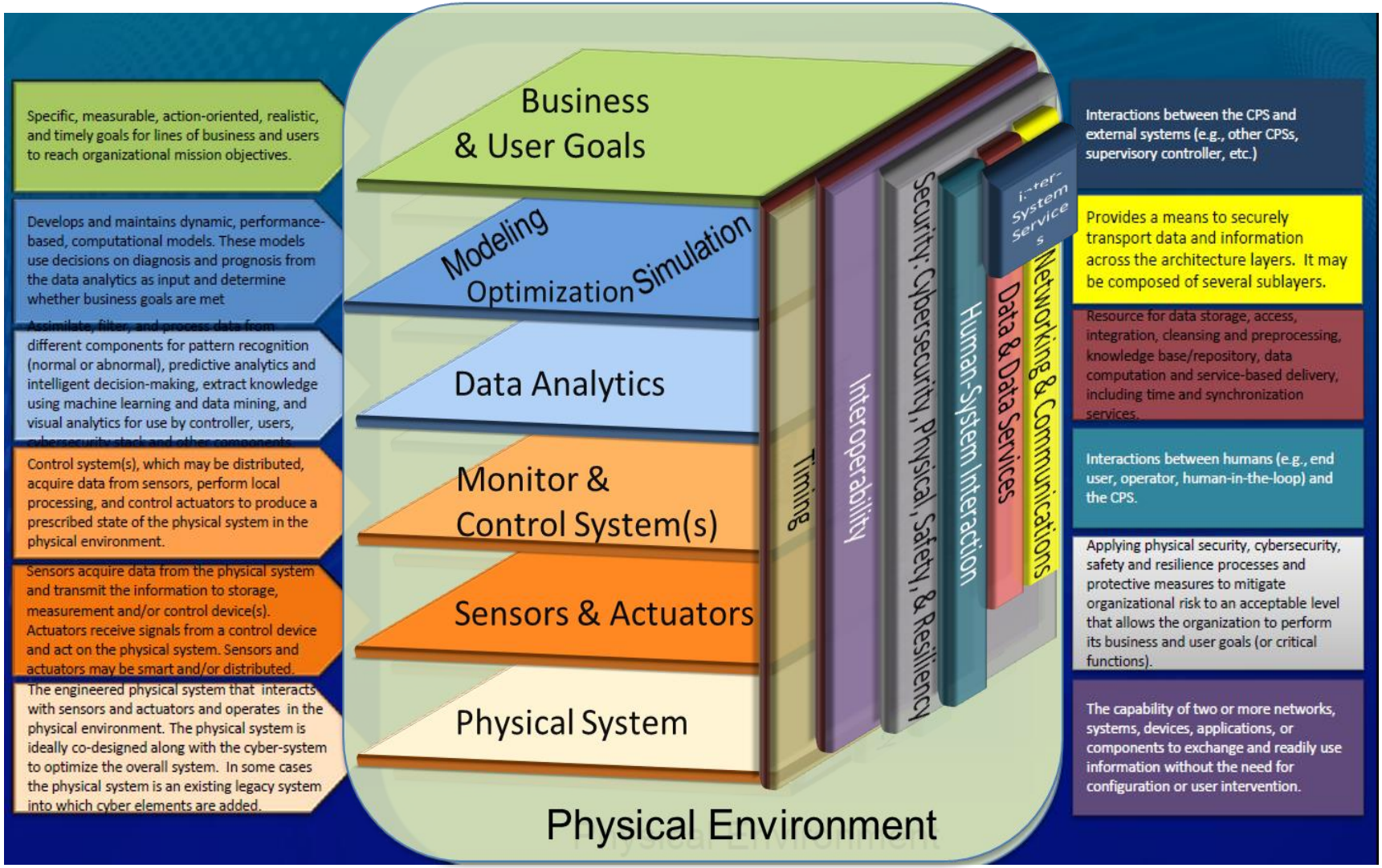
1. How a CPS Application is organized
2. What are the modules that compose it
3. What are the design principles

Do we need a Reference Model to help us define a Reference Architecture ?

Interdependencies



Input : NIST Notional Ref. Architecture



Reference Architecture – Subgroup logistics

- To join the CPS Ref. Architecture mailing list, cps_arch-join@nist.gov, or contact Abdella Battou (abdella.battou@nist.gov)
- A CPS Ref. Arch collaboration space will be announced for (links, docs, etc)
- Call-1 : 1pm EDT, July 15th
- Call-2 : 1pm EDT, July 29th
- Contact info for co-chairs
  - Abdella.Battou@nist.gov

Subgroup: Use Cases

- **Purpose:** Investigate the stakeholders, application areas, goals, and uses of CPS.

Co-Chairs

John Baras,
University of Maryland (UMD)

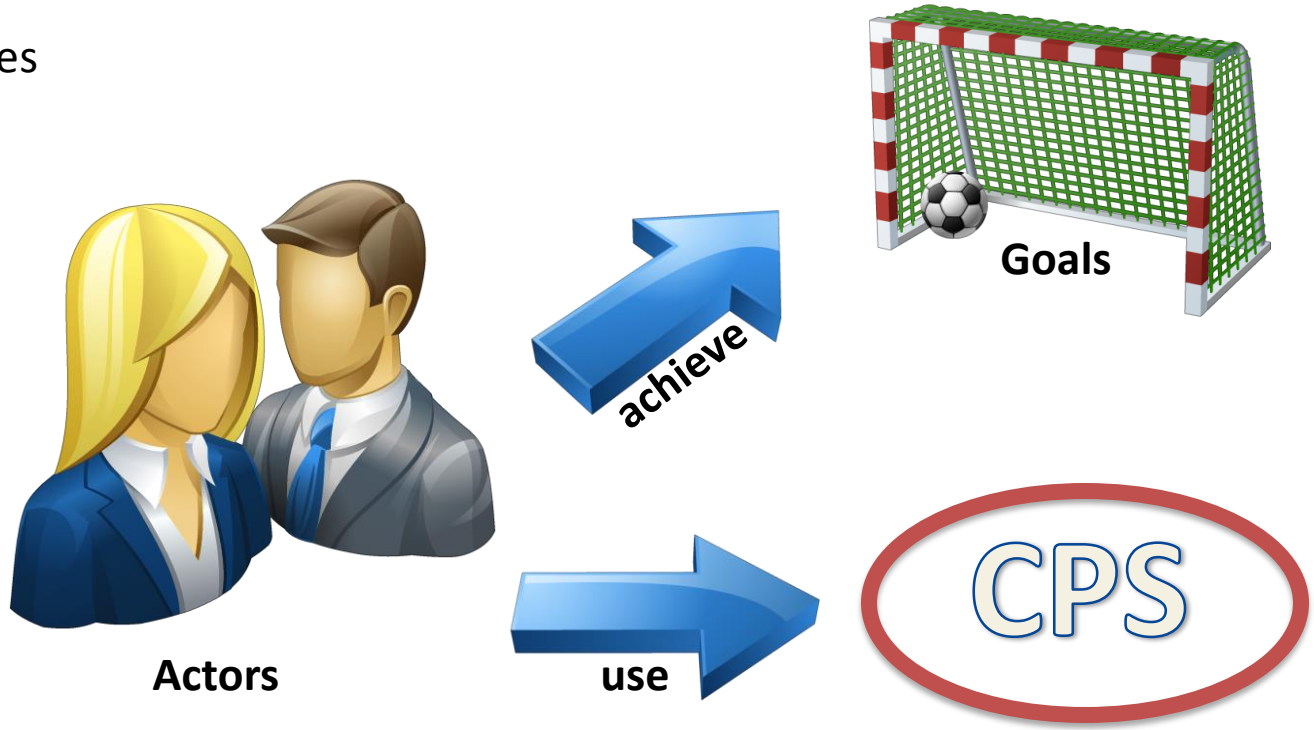
Stephen Mellor,
Industrial Internet Consortium (IIC)

Eric Simmon
National Institute of Standards and Technology (NIST)

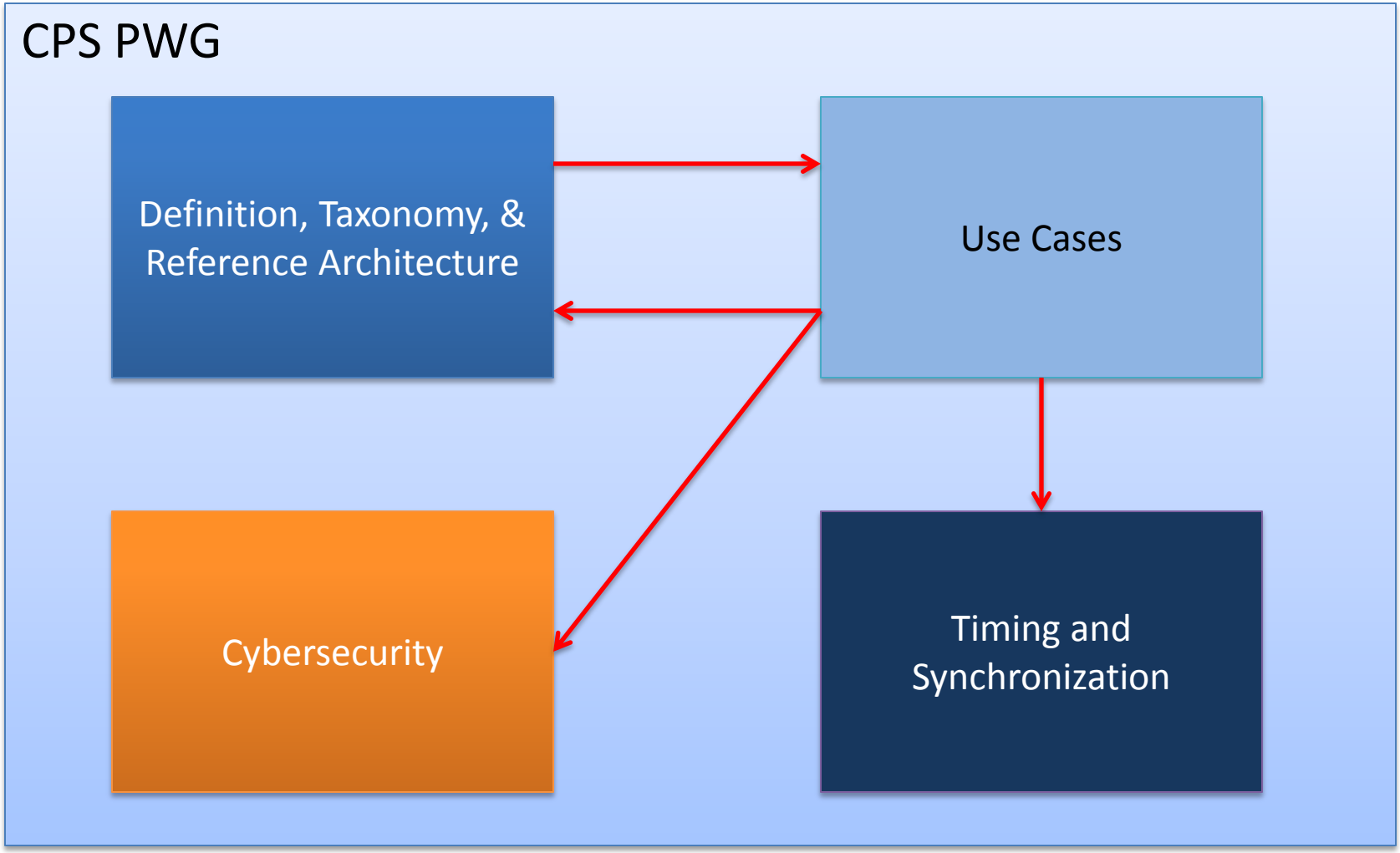
CPS Use Cases

An actor interacts with the system to achieve a goal

A use case describes the interaction between the actor and the system



CPS Subgroup Interdependencies



Proposed Objectives and Deliverables: Use Cases

1. A set of stakeholder categories for CPS
2. A set of CPS application areas
3. General goals CPS will be used to achieve
4. A set of use cases supporting the goals that can be used to validate the architecture and develop CPS requirements

Logistics: Use Cases

- Subgroup Meeting Logistics
  - Bi-weekly conference calls/webinars
  - First call: in mid-July, date TBD, calendar invite will be sent to to cps_usecase@nist.gov

- To join the CPS Use Case mailing list, send email to cps_usecase-join@nist.gov

Subgroup: Cybersecurity

CPS PWG Subgroup: Cybersecurity and Privacy

Purpose: Address the common cybersecurity and privacy elements of different CPS application domains and contexts.

Co-Chairs

William Sanders

Electrical and Computer Engineering Interim Dept. Head

University of Illinois at Urbana-Champaign

Claire Vishik

Security and Privacy Standards and Policy Manager

Intel Corporation

Ronald Perez

Senior Fellow and Senior Director of Security Architecture

Advanced Micro Devices

Vicky Yan Pillitteri

Advisor for Information Systems Security

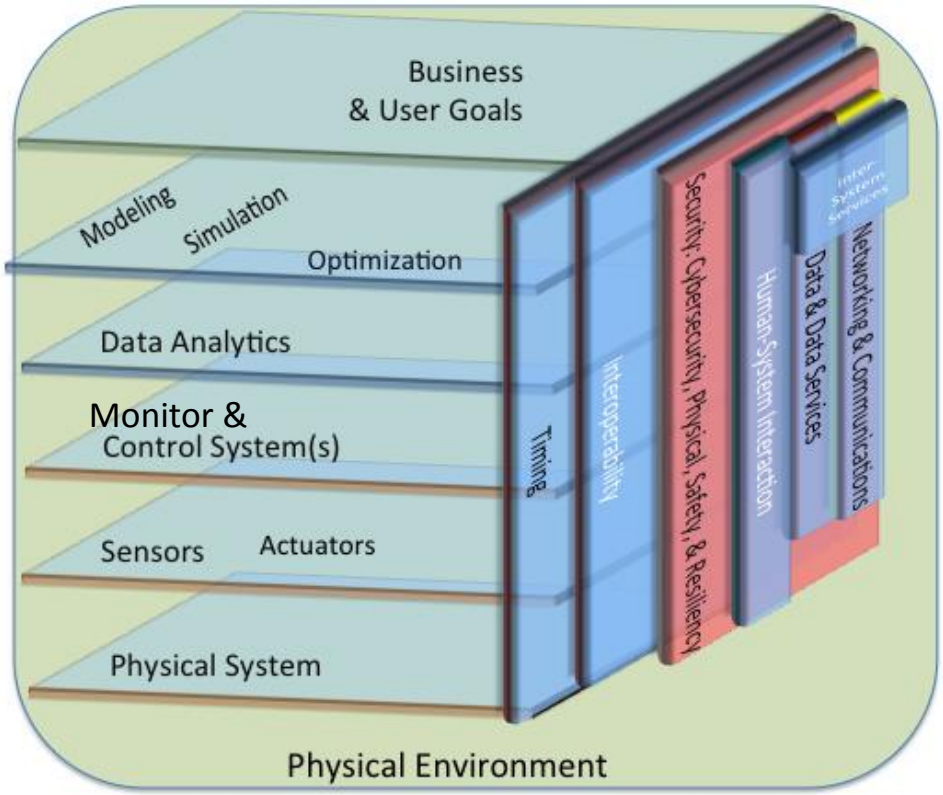
National Institute of Standards and Technology

Goal: Cybersecurity

Goal: Develop a cybersecurity and privacy strategy for the common elements of CPS that includes a focus on the the identification, security architecture, integrity and other cybersecurity activities and outcomes in the context of a risk management program.

Example Foundational Work

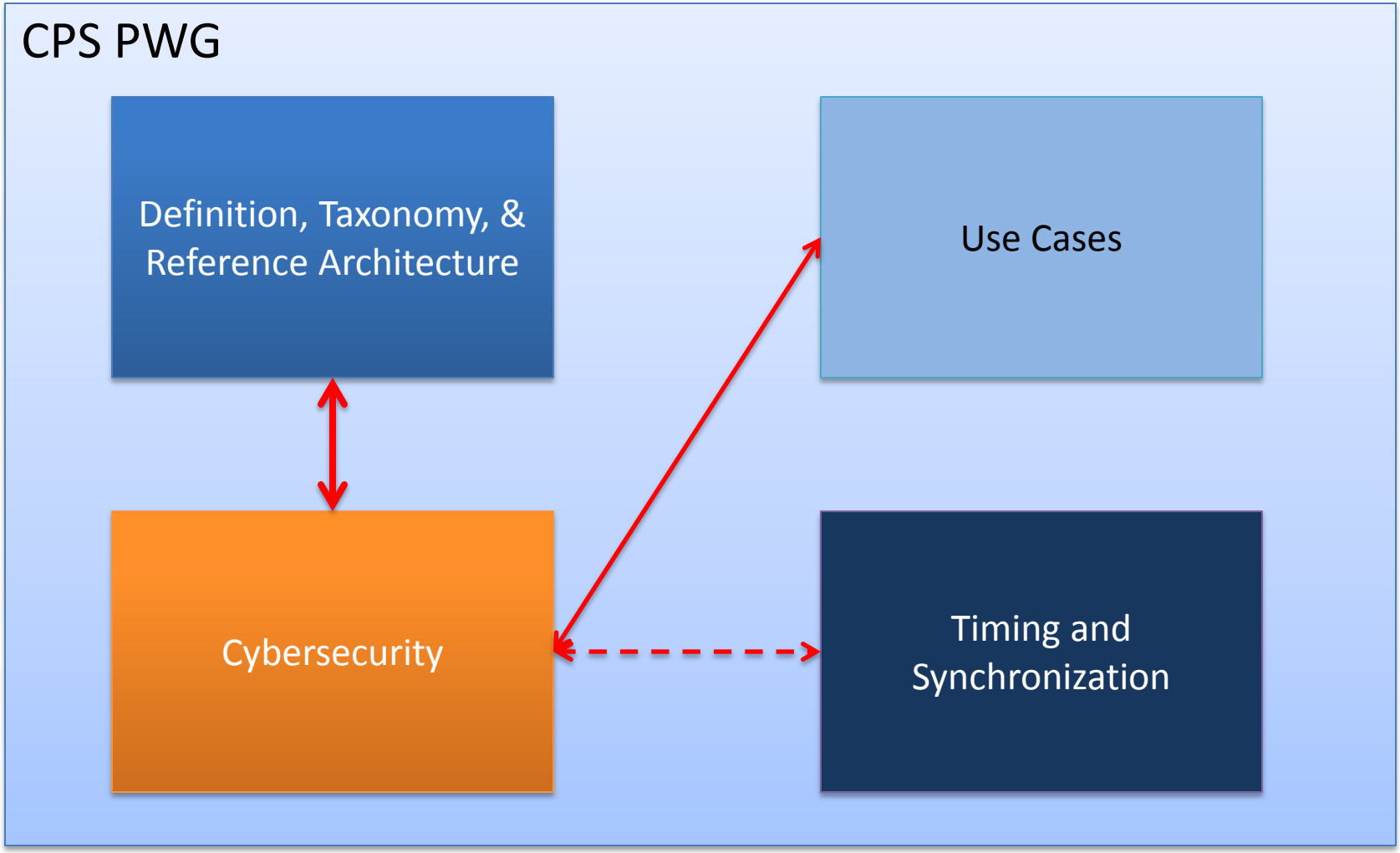
- NIST Notional CPS Reference Architecture
- NIST Interagency Report 7628, Guidelines for Smart Grid Cybersecurity
- Designed-In Cybersecurity for Cyber-Physical Systems (Workshop report by CSRA)
- Framework for Improving Critical Infrastructure Cybersecurity



Proposed Objectives and Deliverables: Cybersecurity

1. Develop appropriate security goals (or best practices) and metrics (confidentiality, integrity, and availability) for CPS
2. Develop a security reference architecture for CPS
3. Identify security and privacy requirements for the components of the security reference architecture
4. Establish a community of practice for CPS Cybersecurity

CPS Subgroup Interdependencies



Logistics: Cybersecurity

- Subgroup Meeting Logistics
  - Bi-weekly conference calls/webinars
  - First call: in mid-July, date and calendar invite will be sent to to cps_cyber@nist.gov
- To join the CPS Cybersecurity mailing list, cps_cyber-join@nist.gov or contact Vicky Yan Pillitteri (victoria.yan@nist.gov)

Subgroup: Timing

CPS PWG Subgroup: Timing and Synchronization

Purpose: Ensure that adequate timing is included in the common elements of CPS

Co-Chairs

Sundeep Chandhoke, Chief Architect, National Instruments

Hugh Melvin

Information Technology

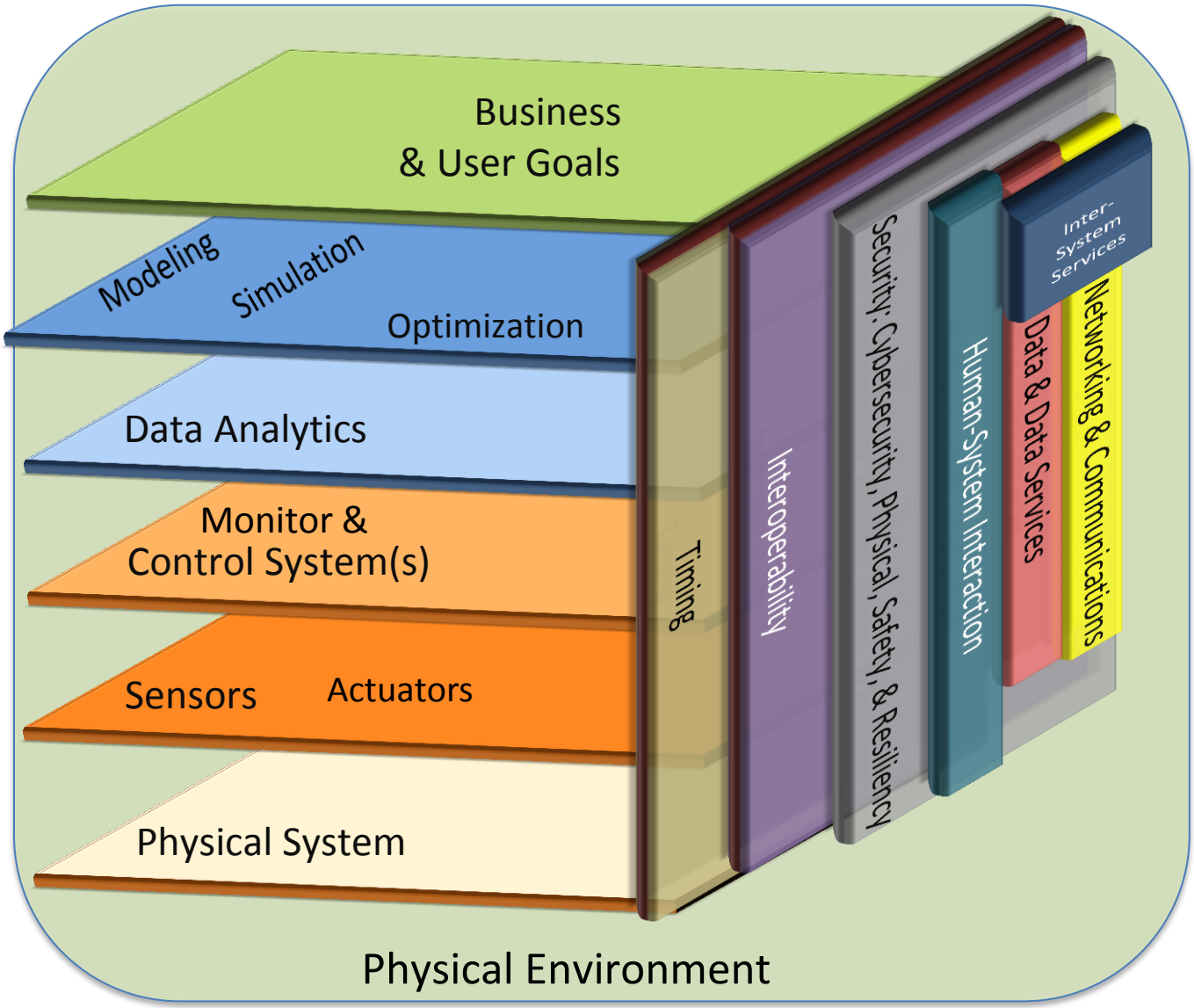
National University of Ireland, Galway

Marc Weiss

NIST Time and Frequency Division

Notional CPS Reference Architecture

Timing needs to be transferred in unique ways to support all layers



Goal: Include Appropriate Timing Design in CPS

Examples – different types of timing and different criteria:

- Time-synchronized medical devices and sensors
  - Time accuracy at ms to s
- Motors synchronized in velocity and position over a networked control system
  - Time accuracy at μs to ms
  - Frequency synchronization, syntonization
- Distributed search and rescue
  - Time stamps essential for combining I/O from multiple sensors, control systems
- Sensors on aircraft, wireless time transfer at ns-level to low size, weight, power devices
- Redundant, reliable, timing with integrity for life-critical systems

Proposed Deliverables of Timing Subgroup

- ***Originate*** paradigms from subgroup
  - Develop **Definitions** of timing, characterizations and measurements
  - Establish **Timing Use Cases** and **Timing Reference Architectures**
  - Highlight potential uses of timing, and methods to meet the challenges of integrating with data systems

- ***Collaborate*** with other subgroups
  - Work with the Definitions and Taxonomy subgroups
  - Review Use Cases and Reference Architectures for Timing issues
  - Collaborate with Cybersecurity on both the use of Timing for Cybersecurity issues, as well as issues for securing timing signals and data

Link with Other Groups

- Time-Aware systems research group
- NSF research group
- Industrial Internet Consortium
- Standards Bodies
  - ITU-T/IETF/IEEE/ETSI
- Academic conferences

Timing – Subgroup logistics

- To join the CPS Timing mailing list, cps_sync-join@nist.gov or contact Marc Weiss (marc.weiss@nist.gov)
- A CPS Timing collaboration space will be announced for (links, docs, etc.)
- Call-1 : Week of July 21
- Call-2 : Week of August 4
- Face-to-face meeting August 11-12

Q: How can I join?

- Reference Architecture:

  cps_arch-join@nist.gov
- Use Cases:

  cps_usecase-join@nist.gov
- Cybersecurity:

  cps_cyber-join@nist.gov
- Timing:

  cps_sync-join@nist.gov
- General CPS questions:

  nistcps@nist.gov

Questions and Answers and Concluding Remarks

Chris Greer

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