# NIST Cyber-Physical Systems Program

Through new measurement science, advanced testbed capabilities, and community-based efforts, enable the scalable design and reproducible performance measurement of advanced cyber-physical systems, including smart grid systems, that are reliable, resilient, effective, safe, sustainable, secure, and privacy-enhancing.

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

CPS: Scalability and Compositionality
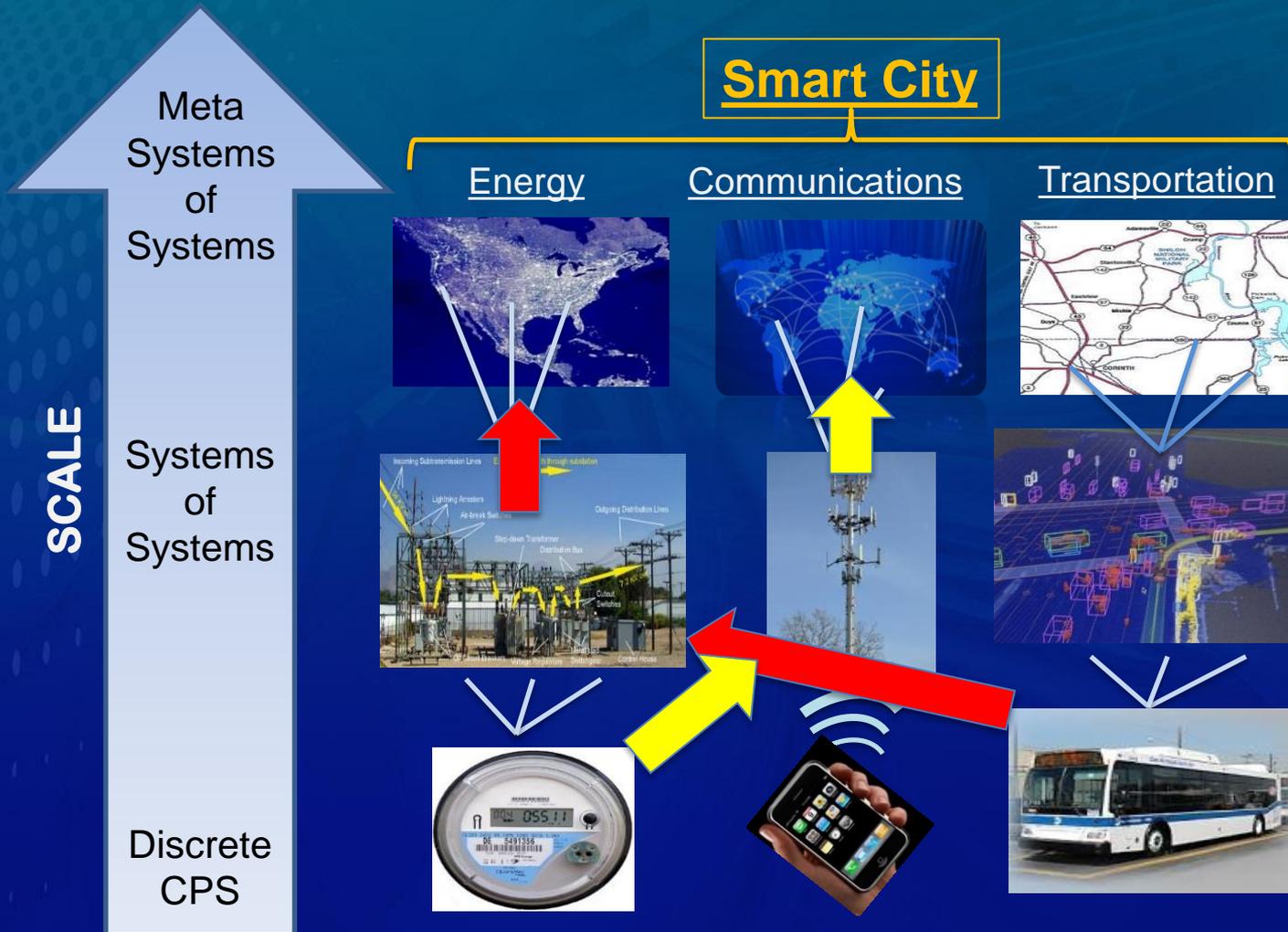
CPS Program Organization

	Project	Current Goal	Lead
Meta Systems of Systems	CPS at Scale	Smart City Architecture	Sokwoo Rhee
Systems of Systems	CPS Test Bed	Conceptual Design	Paul Boynton
Discrete CPS	CPS Public Working Group	Intellectual Framework	Dave Wollman

SCALE

NIST CPS Public Working Group

NIST CPS PWG leadership					
Co-Chairs	**Reference Arch**	**Use Cases**	**Security**	**Timing**	**Data Interop**
NIST	Abdella Battou	Eric Simmon	Vicky Pillitteri	Marc Weiss	Marty Burns
Academia	Janos Sztipanovits	John Baras	Bill Sanders	Hugh Melvin	Larry Lannom
Industry	Stephen Mellor, Shi-Wan Lin, Ed Griffor	Stephen Mellor	Claire Vishik	Sundeep Chandhoke	Peggy Irelan, Eve Schooler

DRAFT
Framework for Cyber-Physical Systems
Release 0.8
September 2015

Cyber Physical Systems Public Working Group

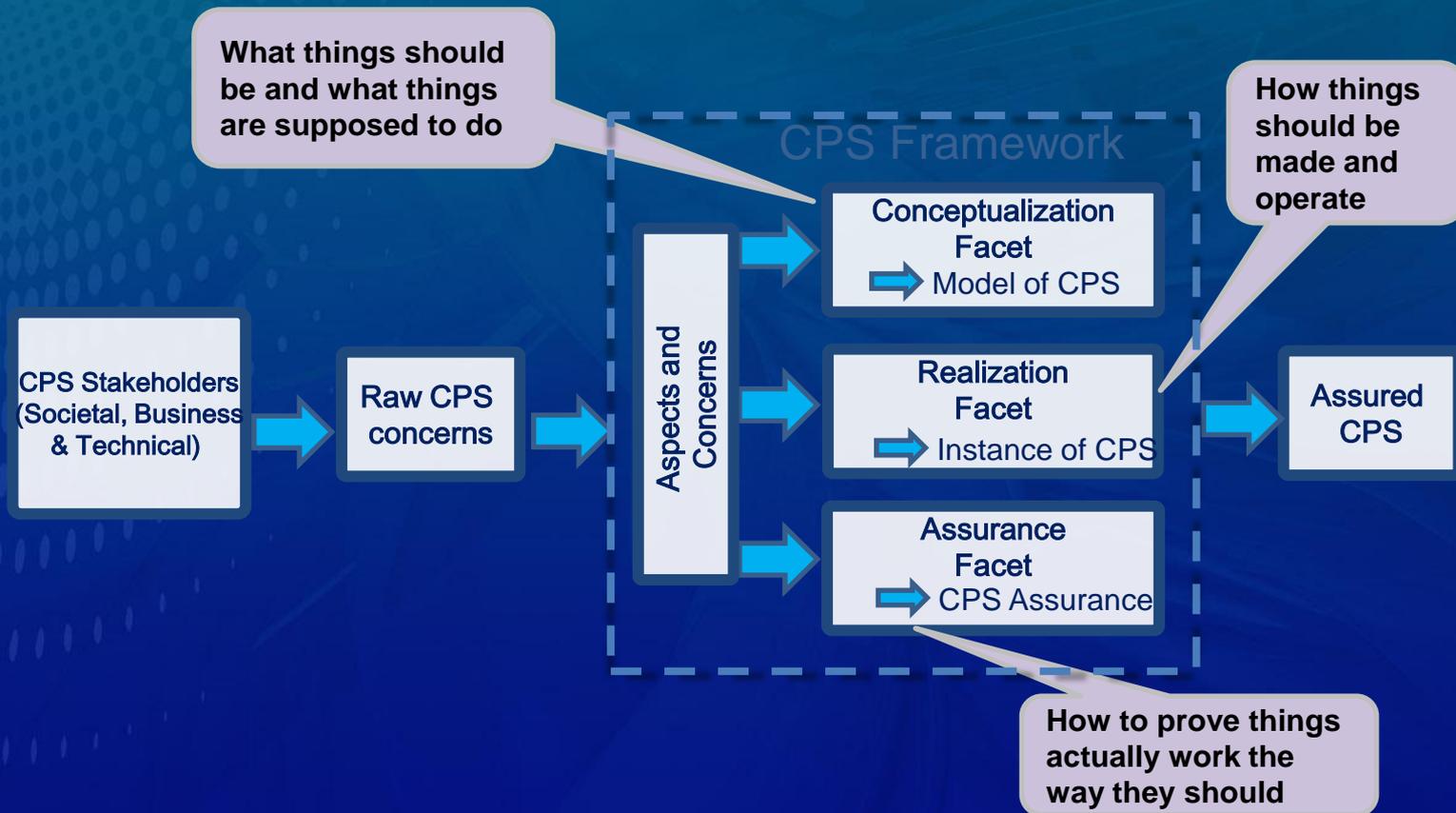**CPS Collaboration Platform:**
- www.cpspwg.org

CPS Working Group web site:
- www.nist.gov/cps/cpspwg.cfm

Framework released for public comments Sept. 2015

Derivation of CPS Framework

CPS Framework Structure

Domains

- Manufacturing
- Transportation
- Energy
- Healthcare
- others …

Aspects

- Functional
- Business
- Human
- Trustworthiness
- Timing
- Data
- Boundaries
- Composition
- Lifecycle

Facets

Conceptualization	Realization	Assurance
Use Case, Requirements, …	Design / Produce / Test / Operate	Argumentation, Claims, Evidence

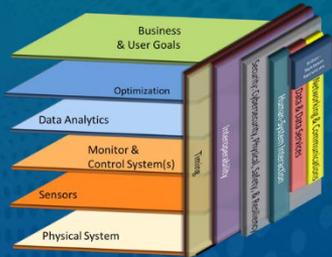### Activities and their Artifacts
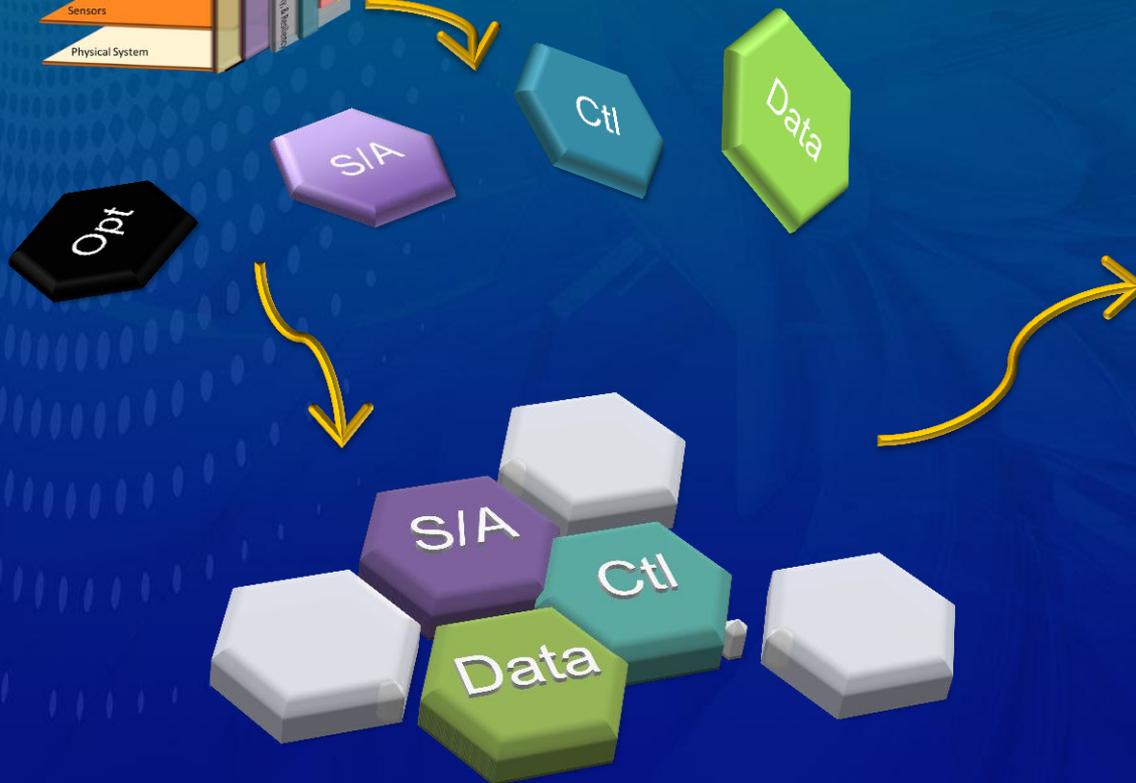
Model of a CPS	CPS	CPS Assurance

CPS Testbed Initial Conceptual Design

Model Library based on Reference Architecture
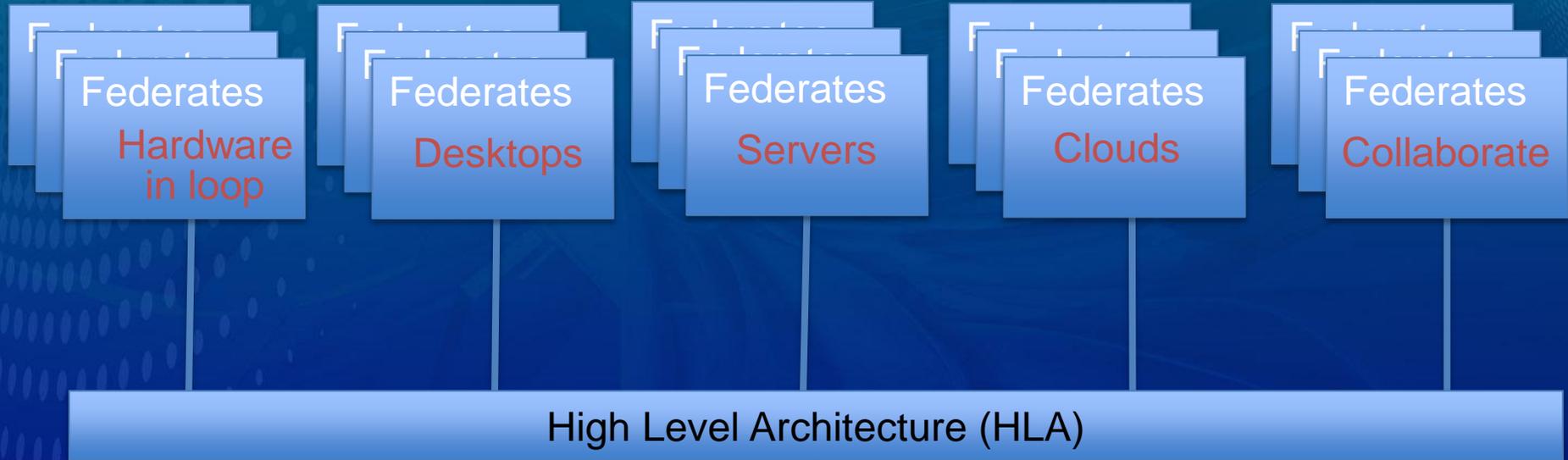
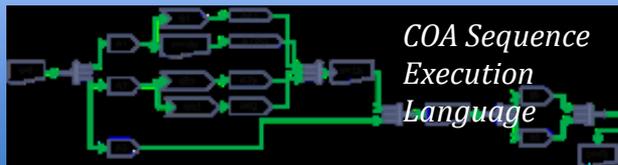Physical and Virtual Test Benches

Model Integration Platform

At-scale Validation

engineering laboratory

CPS Testbed Network Architecture

Within an enterprise

With external enterprise

Federates	Federates	Federates	Federates	Federates
Hardware in loop	Desktops	Servers	Clouds	Collaborate

High Level Architecture (HLA)

Federate

Experimental Orchestration

COA Sequence Execution Language

Global Cities Team Challenge: The Approach

Smart City Projects

U.S.
San Jose
Detroit
Austin
Washington DC
Montgomery County
Others …

Europe
City 1
City 2
City N

Africa
City 1
City 2
City N

Middle East, South America, Australia, etc.

Action Clusters (Teams)

Energy, Air quality, Traffic management

Renewable energy, Green Technologies, Microgrids

Emergency response, Disaster resilience

Building design and management, energy efficiency

Healthcare

Technology Innovators

Sensor Systems
Cyber Security
Infrastructure
Cloud Services
Medical Services
Visualization
Utilities
Robotics
Building Controls
Etc. …

Next Challenge: GCTC 2016

- Demonstrate <u>quantifiable/measurable</u> benefits to the cities and communities
  - Reduce commute times by 20%?
  - Reduce air pollution by 25%?
  - Reduce energy consumption by 30%?

- 20-month process (2 Phases)
  - 1st Phase by June 2016
  - 2nd Phase by June 2017

- Team solutions to be replicated and deployed in as many cities as possible.

Smart City Architecture

- Smart City technologies are being developed and deployed at a rapid pace.

- In many application domains architectural design efforts are independently pursued by self-selected groups of stakeholders.

- NIST and its partners are convening a public working group to distill from these architectural efforts and city stakeholders a common set of architectural features.

Goal: An architecture that supports incremental and composable function for Smart Cities

Additional Information

- NIST CPS Program website:

  www.nist.gov/cps

- NIST CPS Public Working Group website:

  www.nist.gov/cps

- NIST Global City Teams Challenge website:

  www.nist.gov/cps/sagc.cfm

- Contact:

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