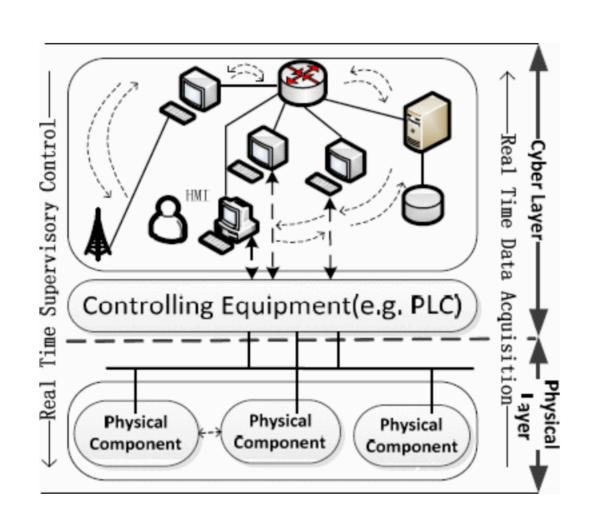
Typical CPS Framework



Smart-Grid Drivers for India

Customers:

- 1. Expand access to electricity
- "Power for All"
- 2. Improve reliability of supply to all customers
- No power cuts, no more DG sets and inverters!
- 3. Improve quality of supply
- No more voltage stabilizers!
- 4. User friendly and transparent interface with utilities
- 5. Ability to save money by reducing peak consumption
- 6. Increased consumer engagement, also as a producer ("Prosumer")

Utilities:

- 1. Reduction of T&D losses in all utilities to 15% or below
- 2. Peak load management
- Multiple options
- 3. Reduction in power purchase costs
- 4. Better asset management
- 5. Increased grid visibility
- 6. Self healing grid
- 7. Renewable integration

Government & Regulators:

- 1. Satisfied customers
- 2. Financially sound utilities
- 3. Tariff neutral system upgrade and modernization
- 4. Reduction in emission intensity

Smart-Grid Activities

Advanced Meter Infrastructure
Peak Load Management
Power Quality Management
Outage Management
Micro-grids
Distributed Generation

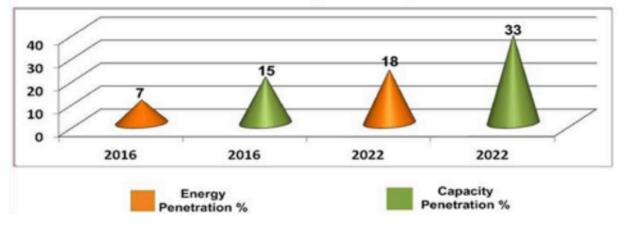
SAMAST

- Intra-state balancing, accounting, settlement
 - Scheduling,
 - Accounting,
 - Metering,
 - Settlement of Transactions

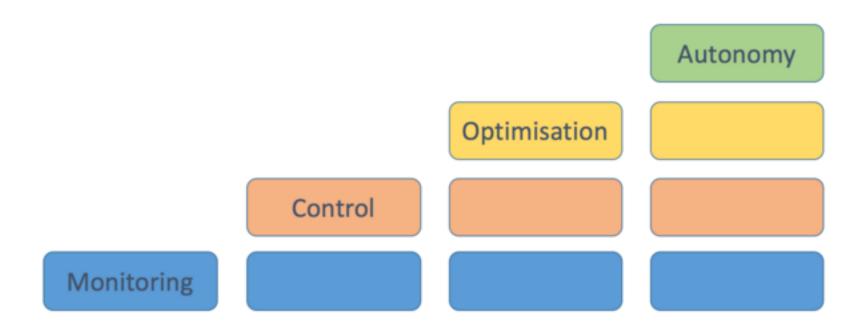
Data will play a key role

Renewable Addition Plan

- Plan to add 1,00,000 MW Solar, 60,000 MW Wind, 10,000 MW Biomass and 5,000 MW small hydro by the end of 13th plan (2022)
 - About 20,000 MW through Solar Power Parks.
 - About 40,000 MW through Distributed Solar Generation.
 - About 40,000 MW through Roof Top Solar Generation.



Role of Data in CPS



CPS Characteristics from Security Viewpoint

Modularity

Heterogeneity.

Combination of information and physical components

Decentralization.

Great number of control centers

Interoperability.

Interaction of modules and optimization of the structure to maintain functionality

Fault tolerance tending to cognitive behavior

Extended class of information threats. Strong dependence on information components

Orientation for the rapid introduction of new branches of technology

Control automation by integrating computation and physical components to achieve autonomy

Synchronization of actions to achieve the goal

Common protocols connecting information and physical components

No single point of failure and self-regulation, interchangeability of modules

Attacks from the Internet.
Effect of physical modules
on vulnerabilities. Integration
of software into physical modules.
Hardware trojan. Leaks

Expandability of the system due to the distributed structure

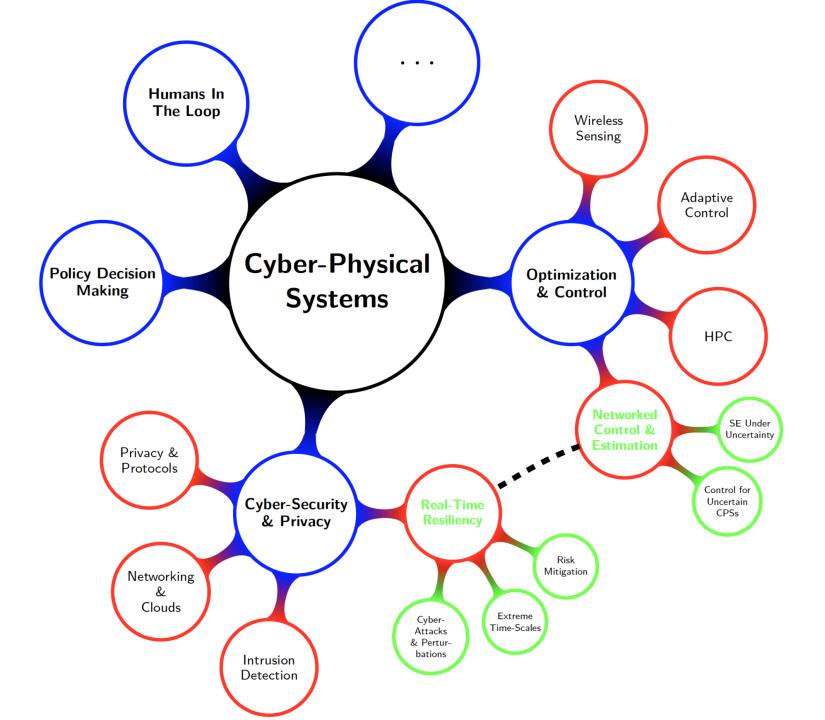
Several types of flows: data flow, information-control flows, and physical flows

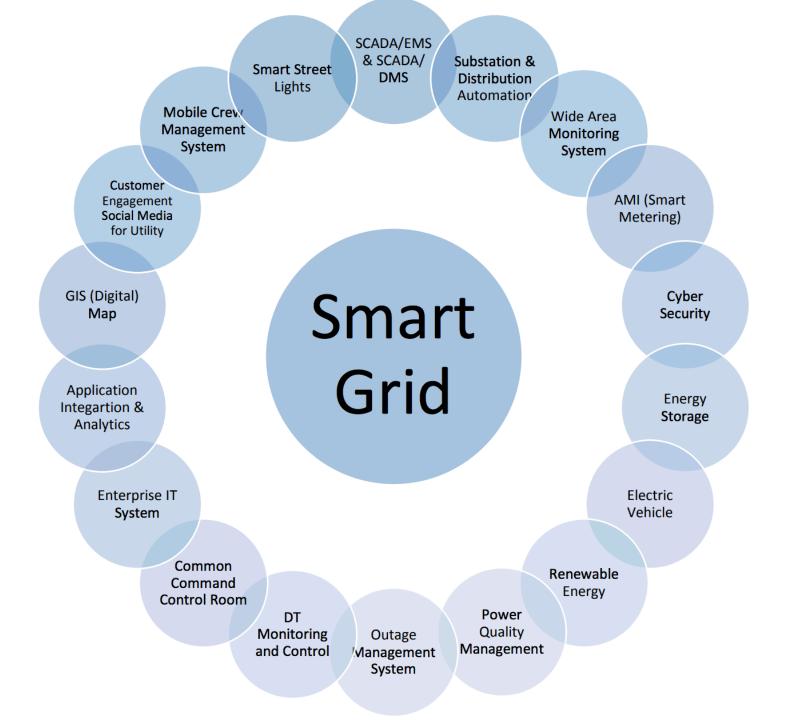
System of devices that seek autonomy

Interfaces between heterogeneous devices for maintaining operation

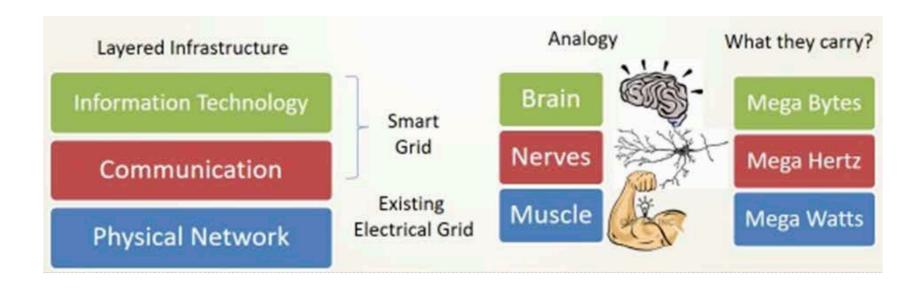
Errors detection, redundancy, adaptability, and control flexibility

Attackers threat to intercept control. Interdependence of the security of information and physical subsystems





An Analogy



Event-driven Data Ecosystem

- In real-time
- Authenticity & integrity
- Reliability of actions
- Incentives & Penalty enforcement

- ✓ Compliance
- ✓ Audit & Regulation

Blockchain & Smart Contracts

- Immutable, reliable, distributed database
- Acts as a shared data-bus across CPS

- A smart contract is a computer protocol intended to digitally facilitate, verify, or enforce the negotiation or performance of a contract.
- Smart contracts allow the performance of credible transactions without third parties. These transactions are trackable and irreversible.

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