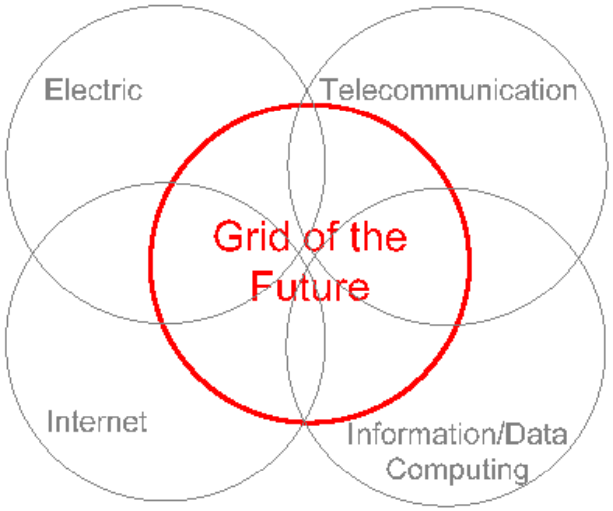
Smart grid - An Energy Internet

Real Time Systems & Smart grid (RTSSG)
CDAC-KP, Bangalore

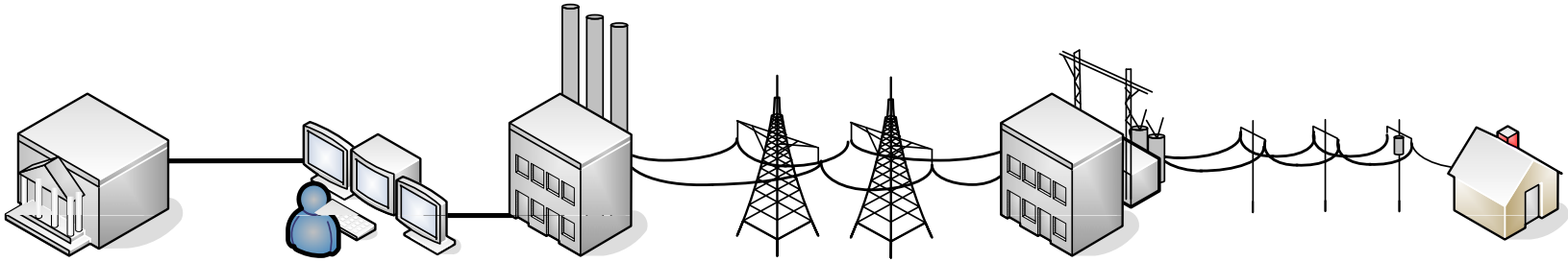
Smart Grid

"SMART GRID"

The "Smart Grid" is enabled by advanced technologies from several industries

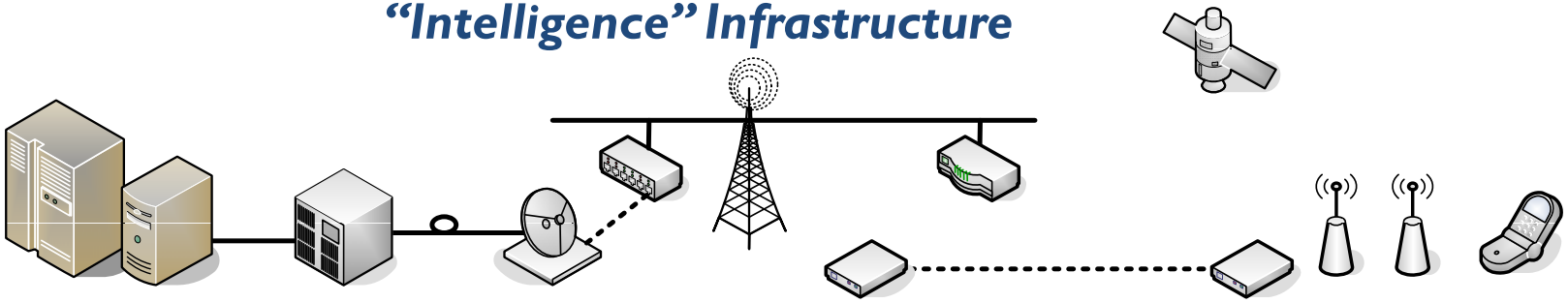


What does the concept of Smart Grid look like?



Electrical Infrastructure

"Intelligence" Infrastructure



Smart grid

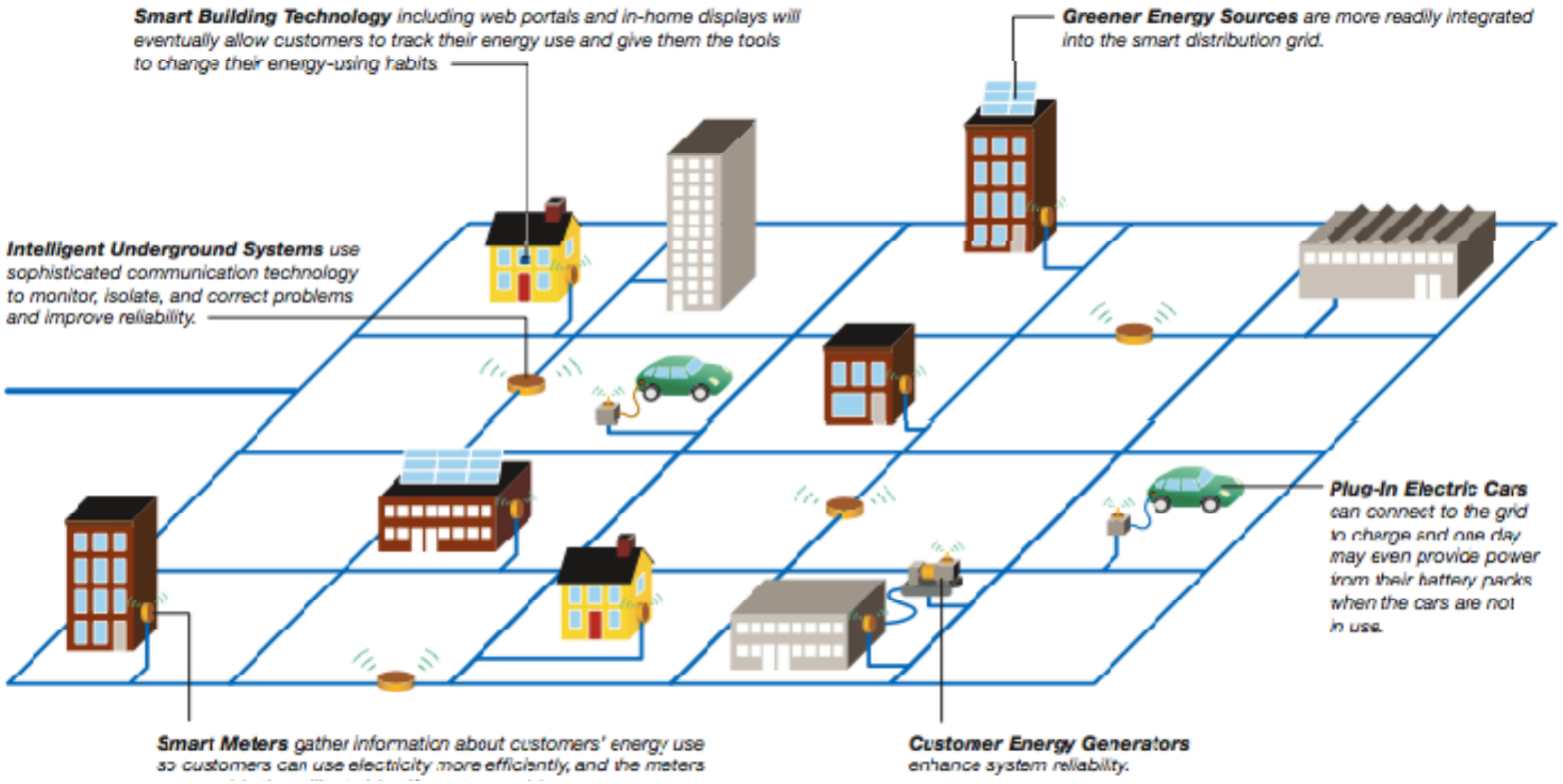
- **The smart grid marries information technology with our current electrical infrastructure, helping us support the energy needs of our 21st Century society. The smart grid is, in essence, an “energy Internet,” delivering real-time energy information and knowledge—empowering smarter energy choices.**

What is Smart grid?

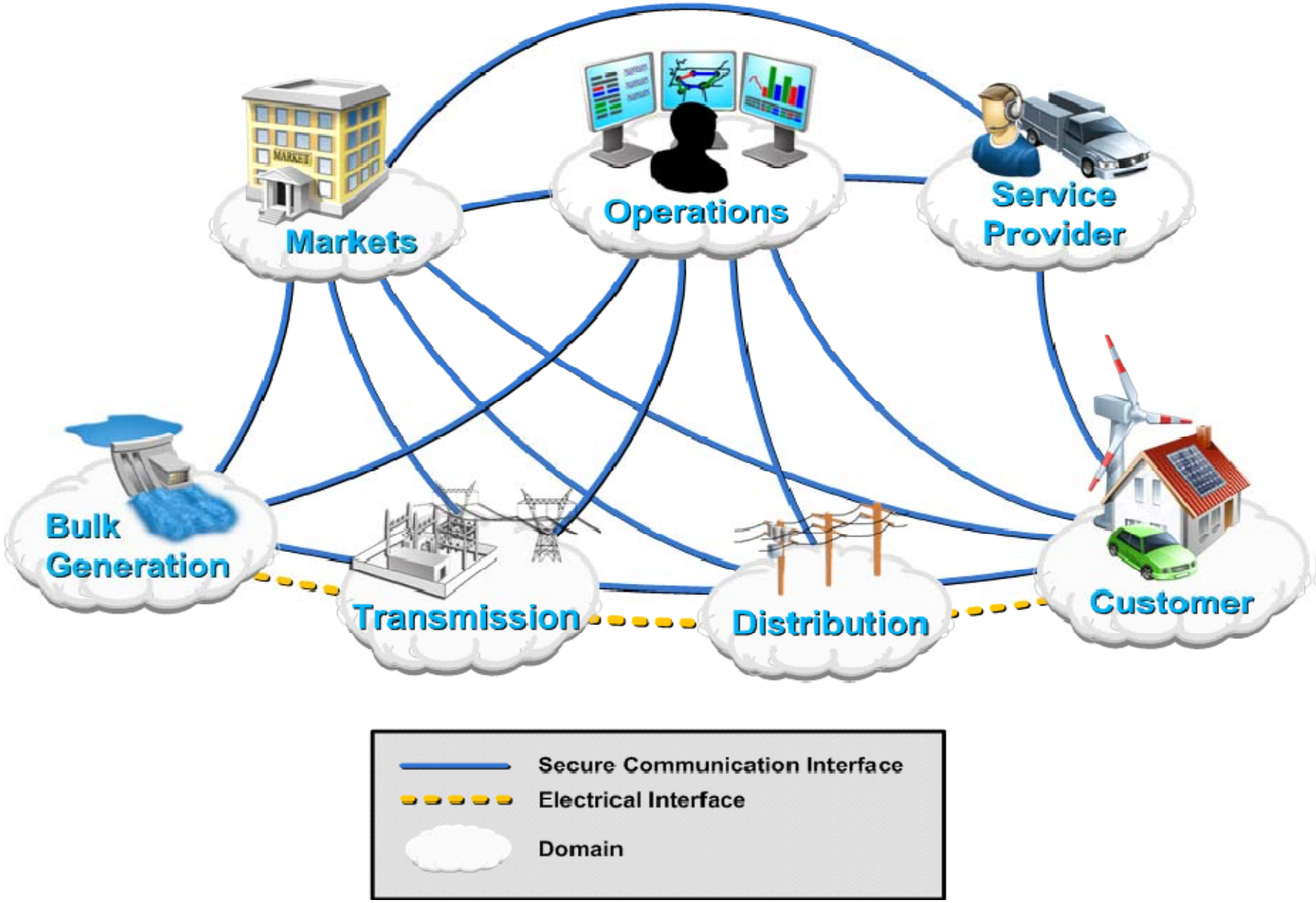
A smart grid puts information and communication technology into electricity generation, delivery, and consumption, making systems cleaner, safer, and more reliable and efficient.

U.S. Department of Energy Definition:

A smart grid integrates advanced sensing technologies, control methods, and integrated communications into the current electricity grid.



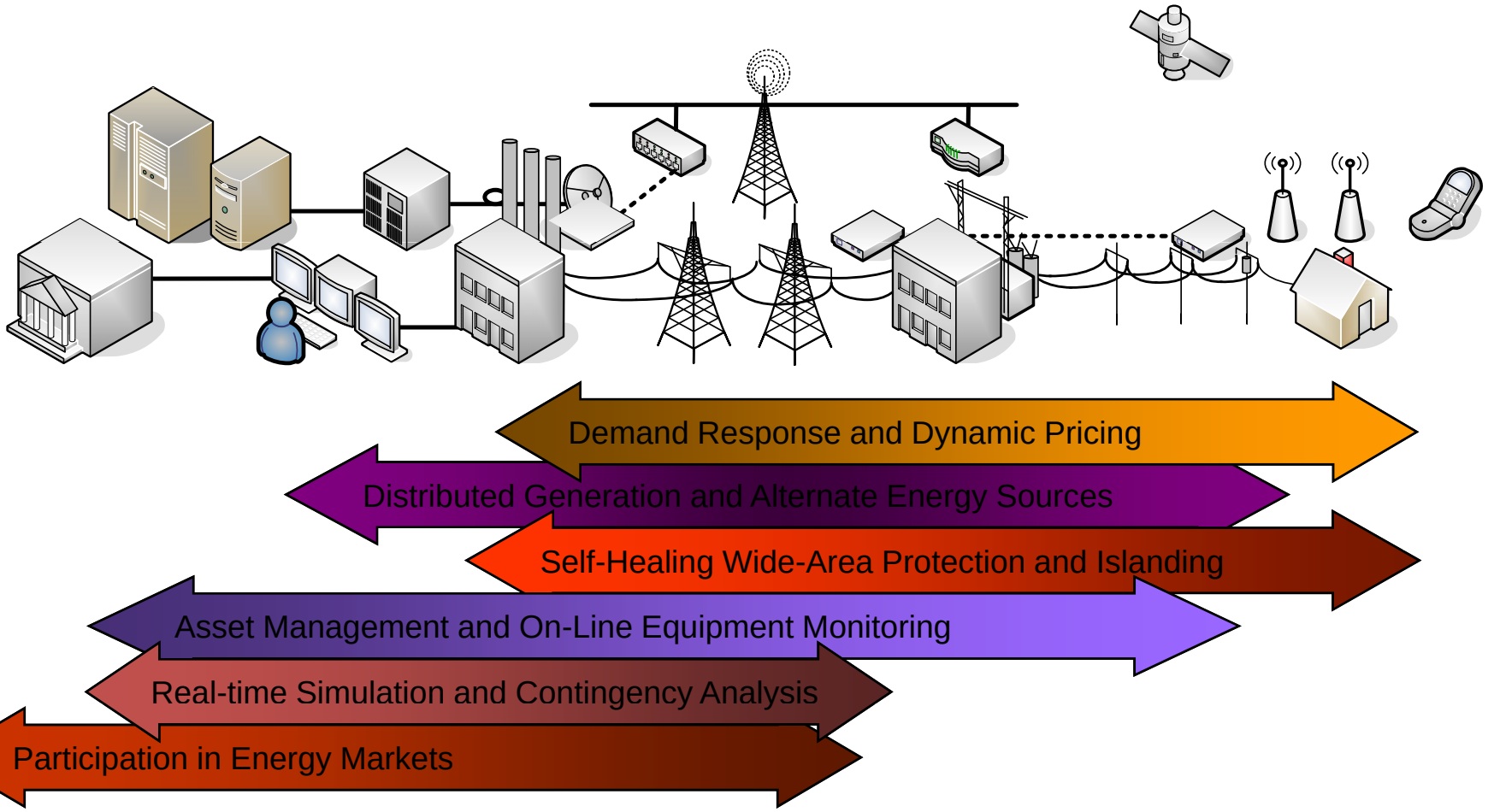
Conceptual Model



Smart grid Attributes

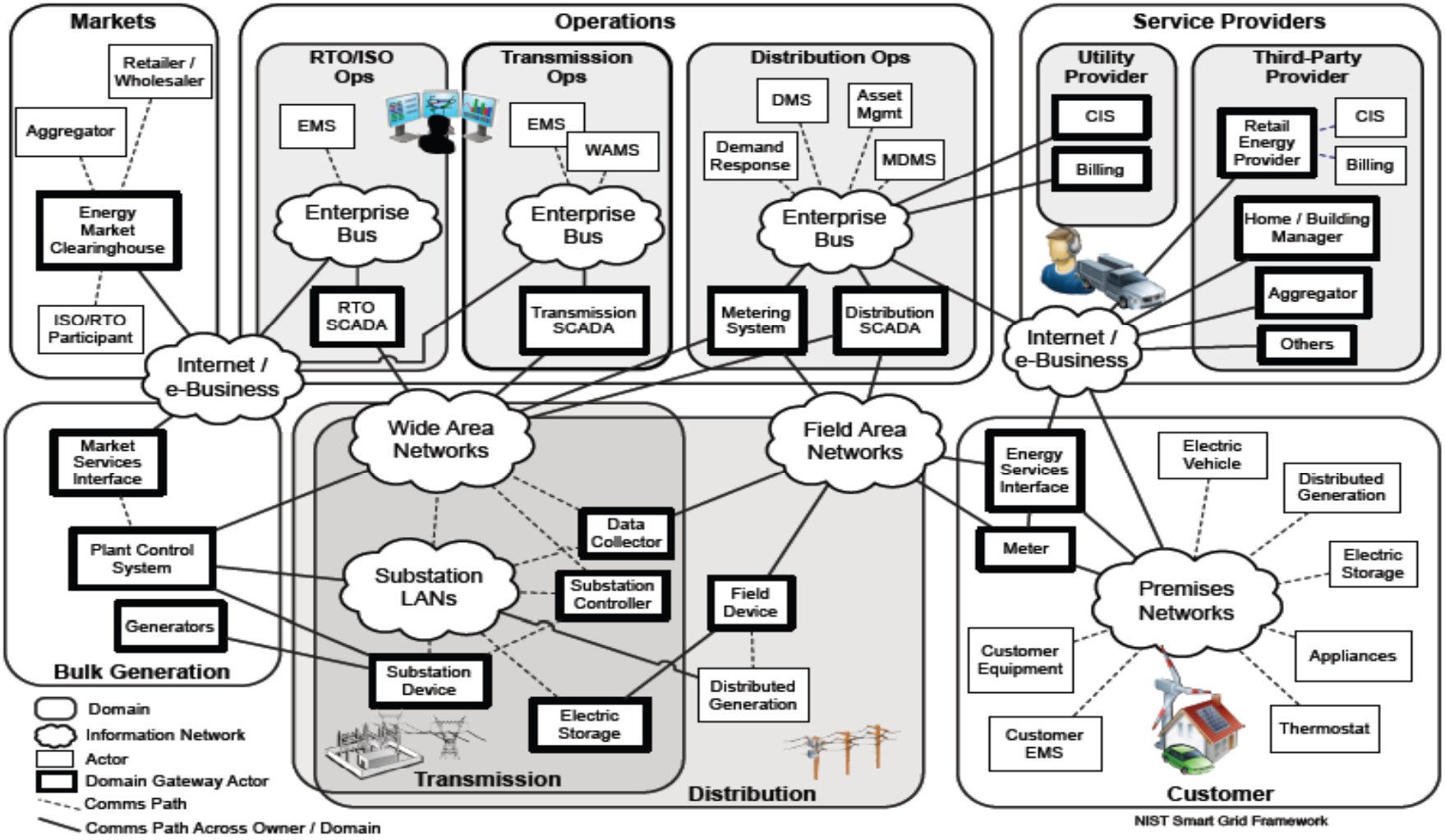
- Information-based
- Communicating
- Secure
- Self-healing
- Reliable
- Flexible
- Cost-effective
- Dynamically controllable

Smart Grid Applications

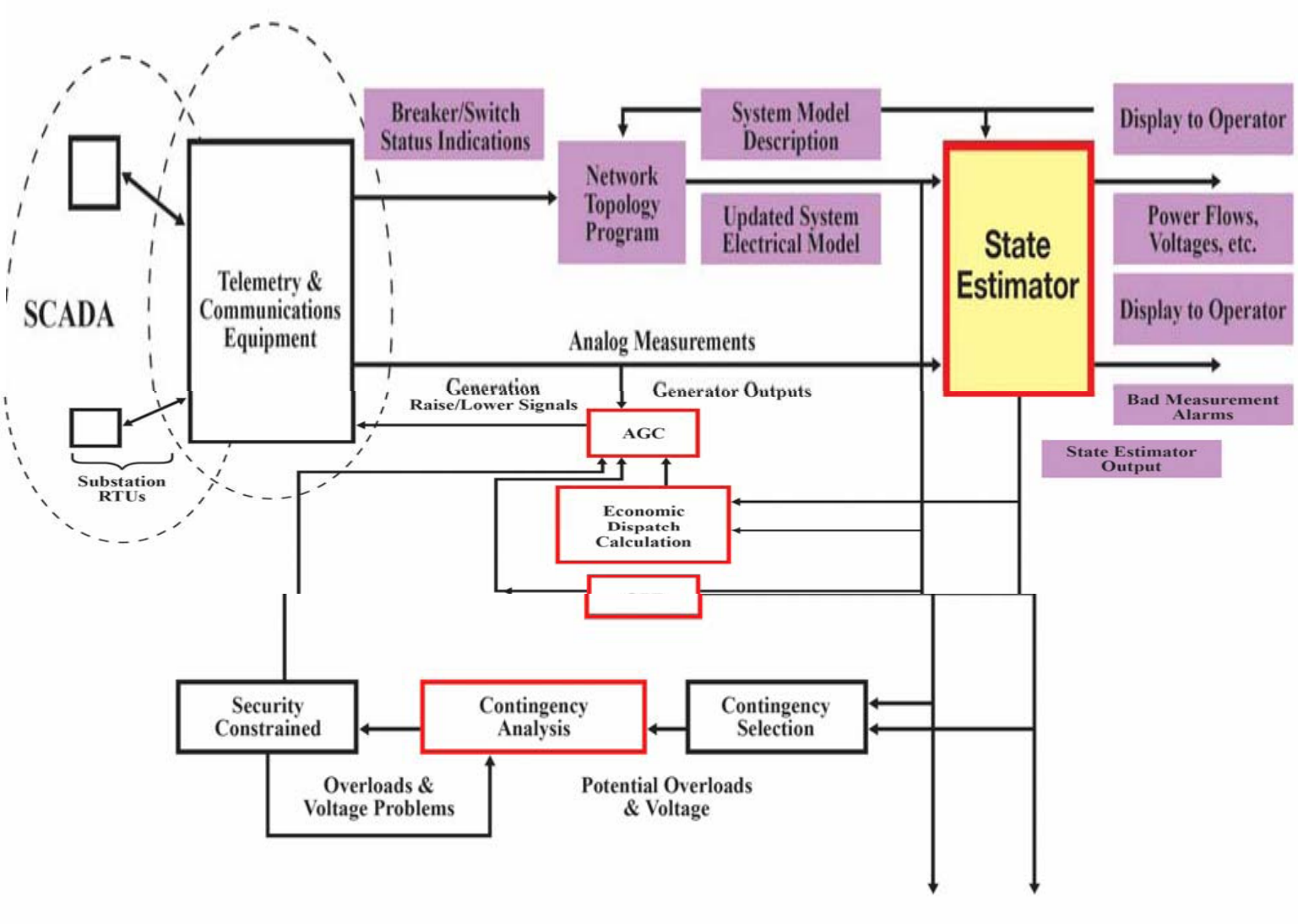


Shared Information – Continuously Optimizing – Intelligent Responses!

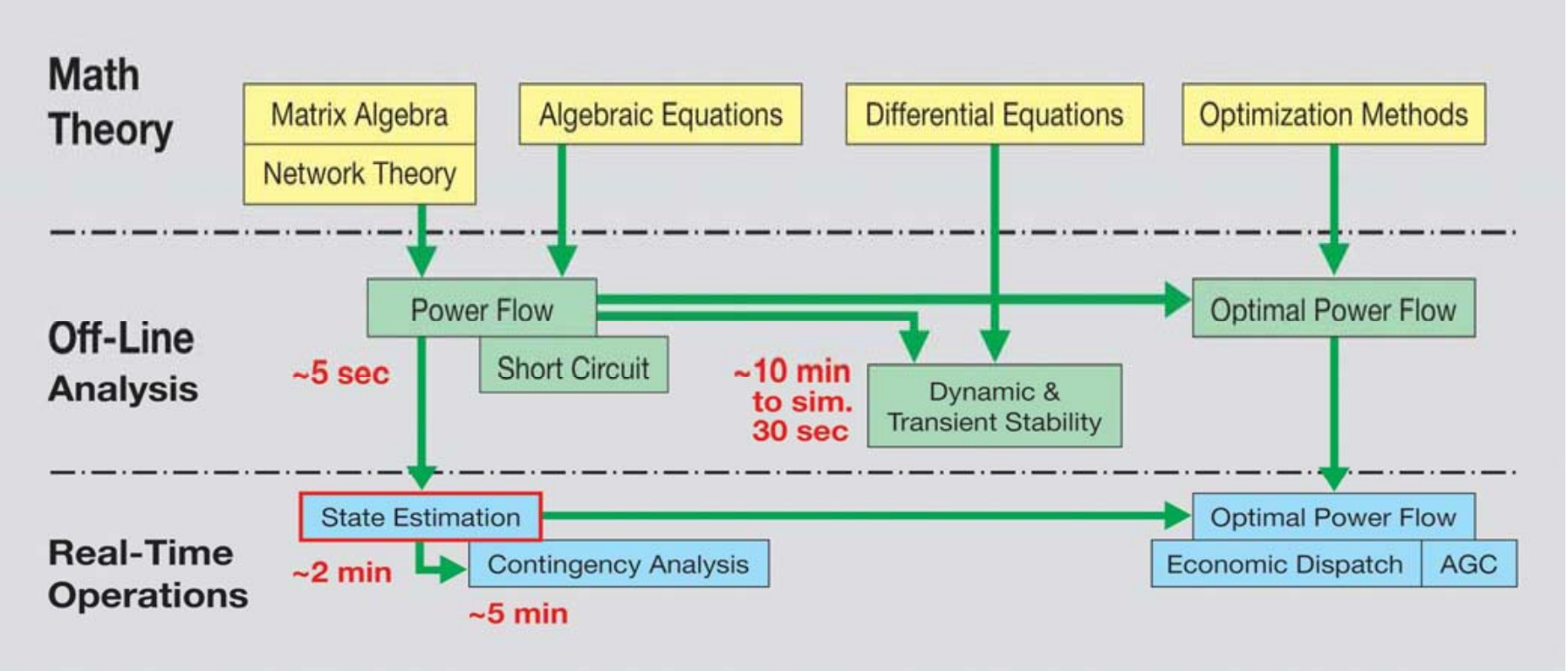
Inter-operable Clouds



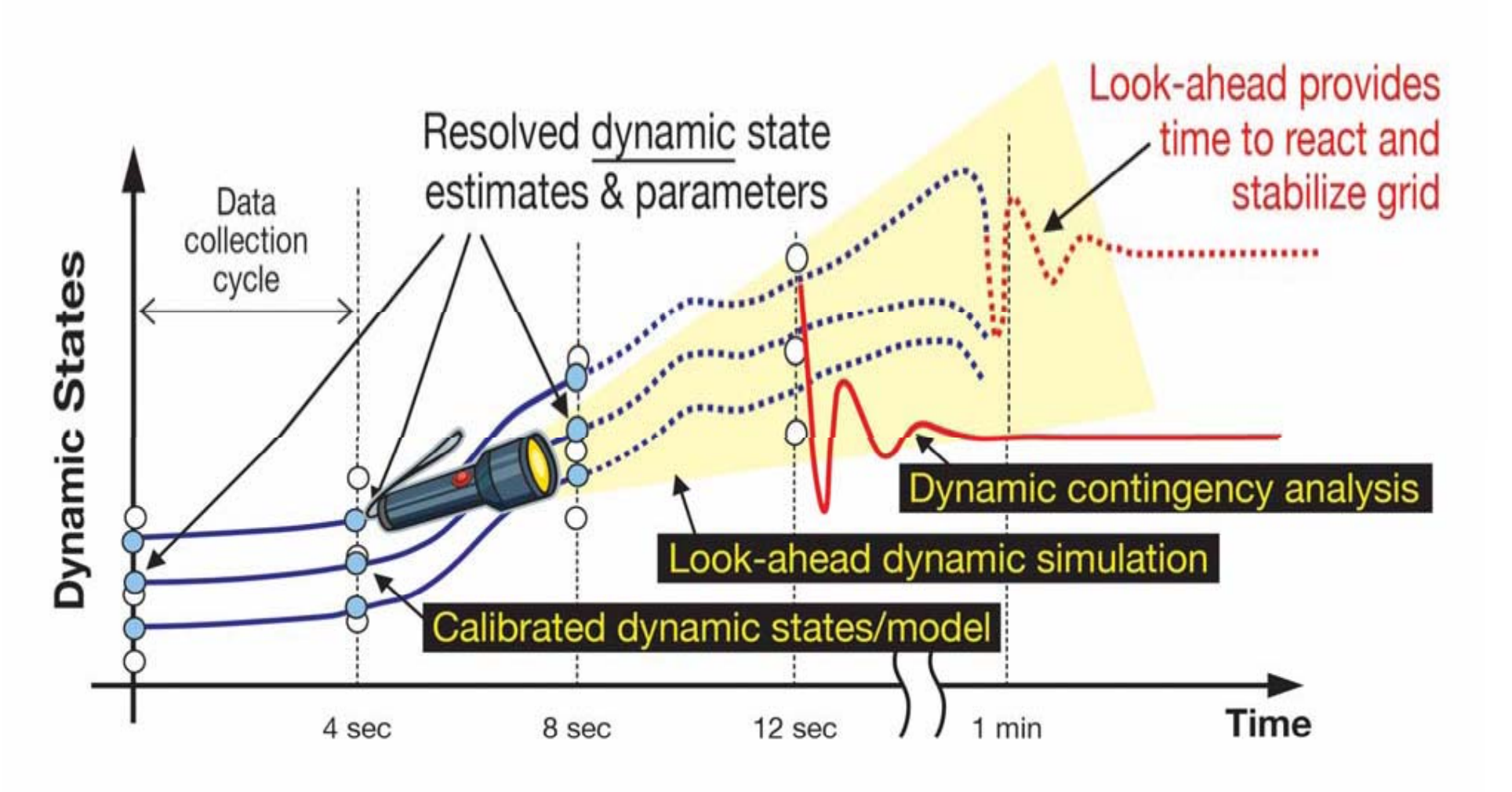
Functional Structure of real- time power systems operations



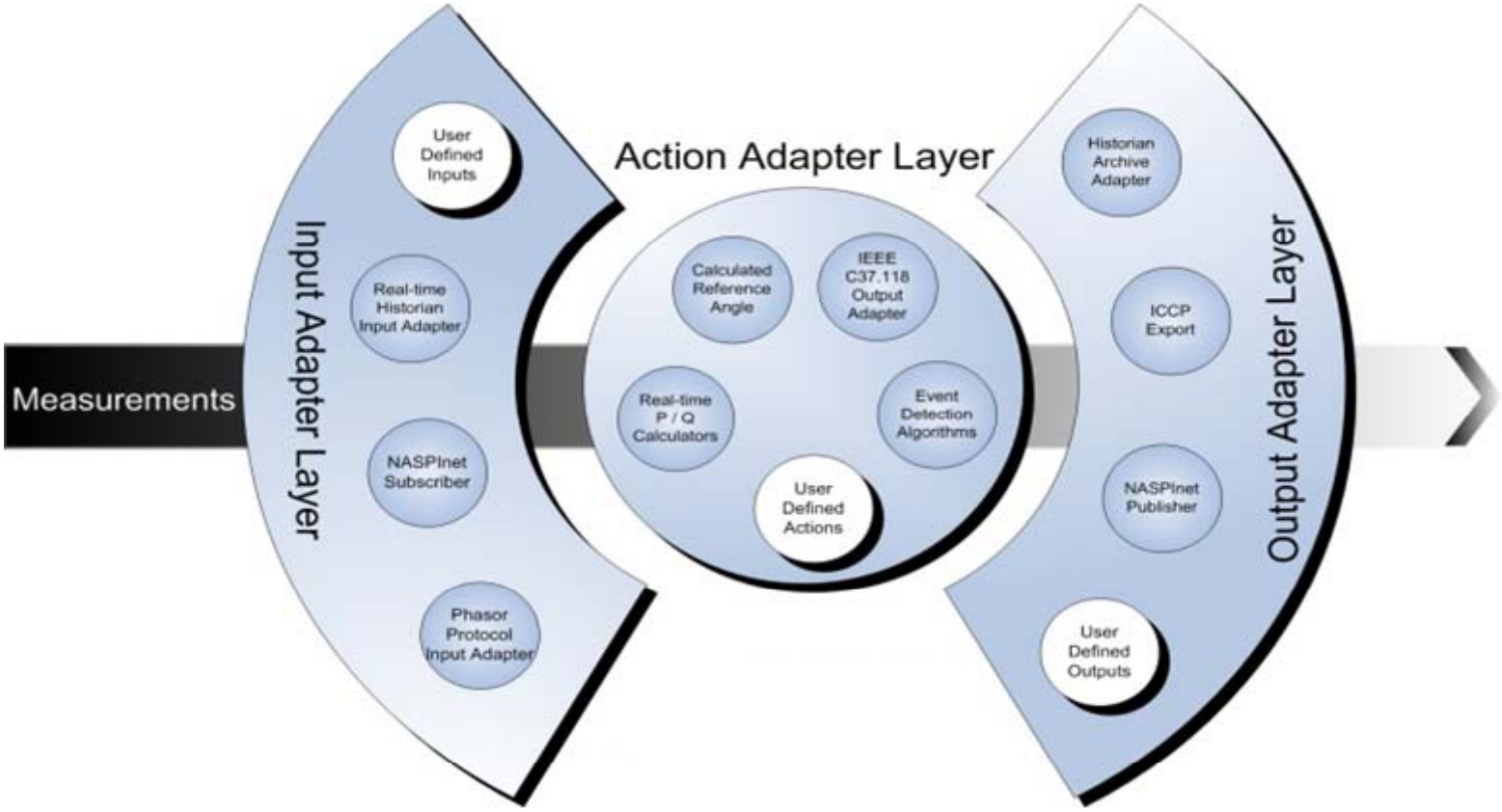
Timing requirements



Look-ahead simulation



Wide Area Measurement Layers



WAMCP-Research needs

Wide Area Situational Awareness framework for system stability coordination will be developed.

Wide-Area monitoring

Synchronized phasors for stability, protection and control.

Monitoring and Instrumentation (Interface modules).

State Estimation periodicity.

Wide-Area state estimation.

Substation state estimation.

WAMCP-Research needs

Development Heuristics based Online Energy Management Models integrating PMU & SCADA data cover the following models ;

* Network topology
* Observability
* Load flow Analysis
* Steady State & dynamic stability (small signal) Analysis
* Contingency Analysis

Wide-Area Control (Exploring novel algorithms/methods)

* Development of On-line dynamic analysis (predictive) & simulation.
* Dynamic analysis triggers.

WAMCP – Research needs

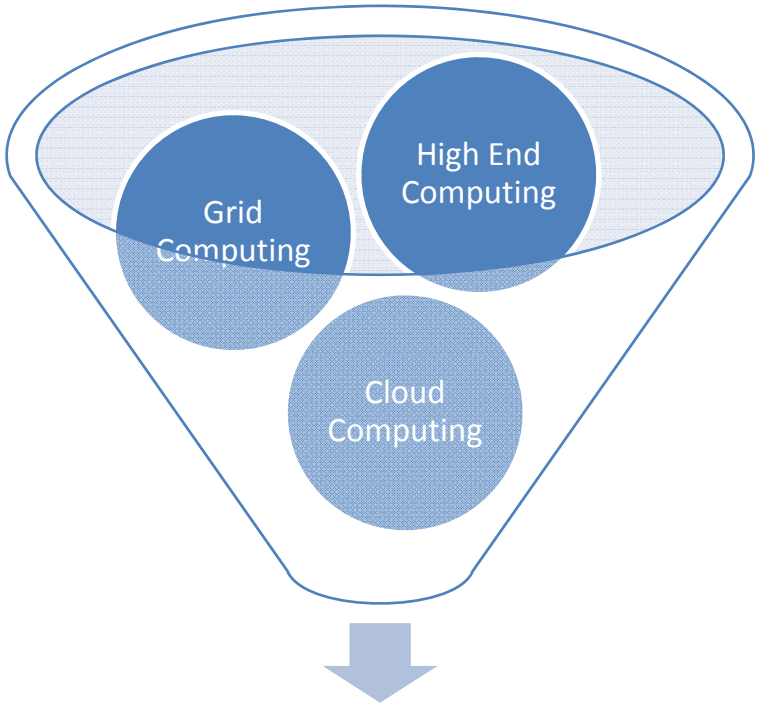
Wide-Area Control (Exploring novel algorithms/methods)

* Adaptive Islanding models.
* System State prediction (look-ahead).
* Automatic System Recovery.
* Closed-loop control.

Wide-Area Protection

* System security analysis models.

Computing Components



Smart grid (Energy Internet)

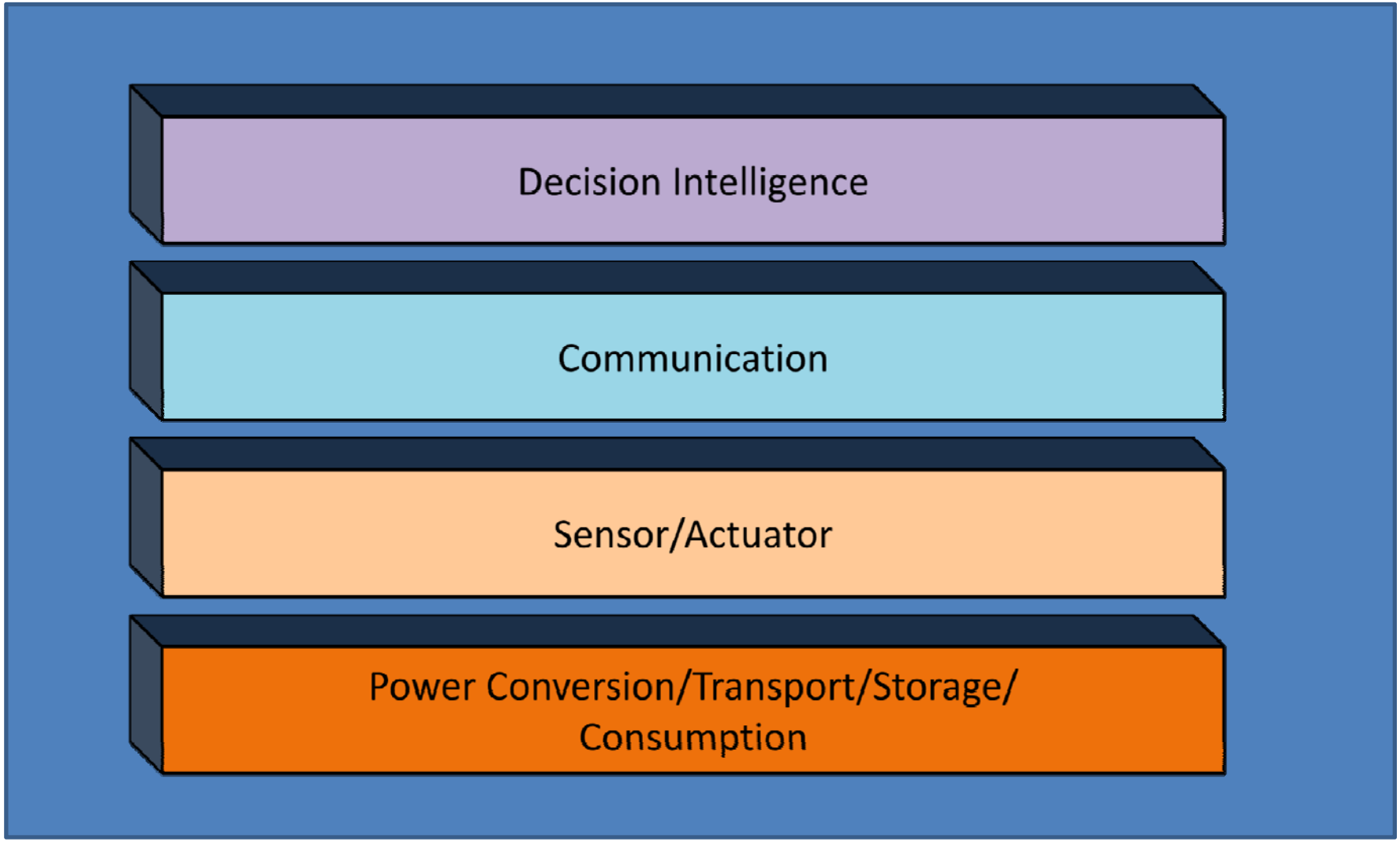
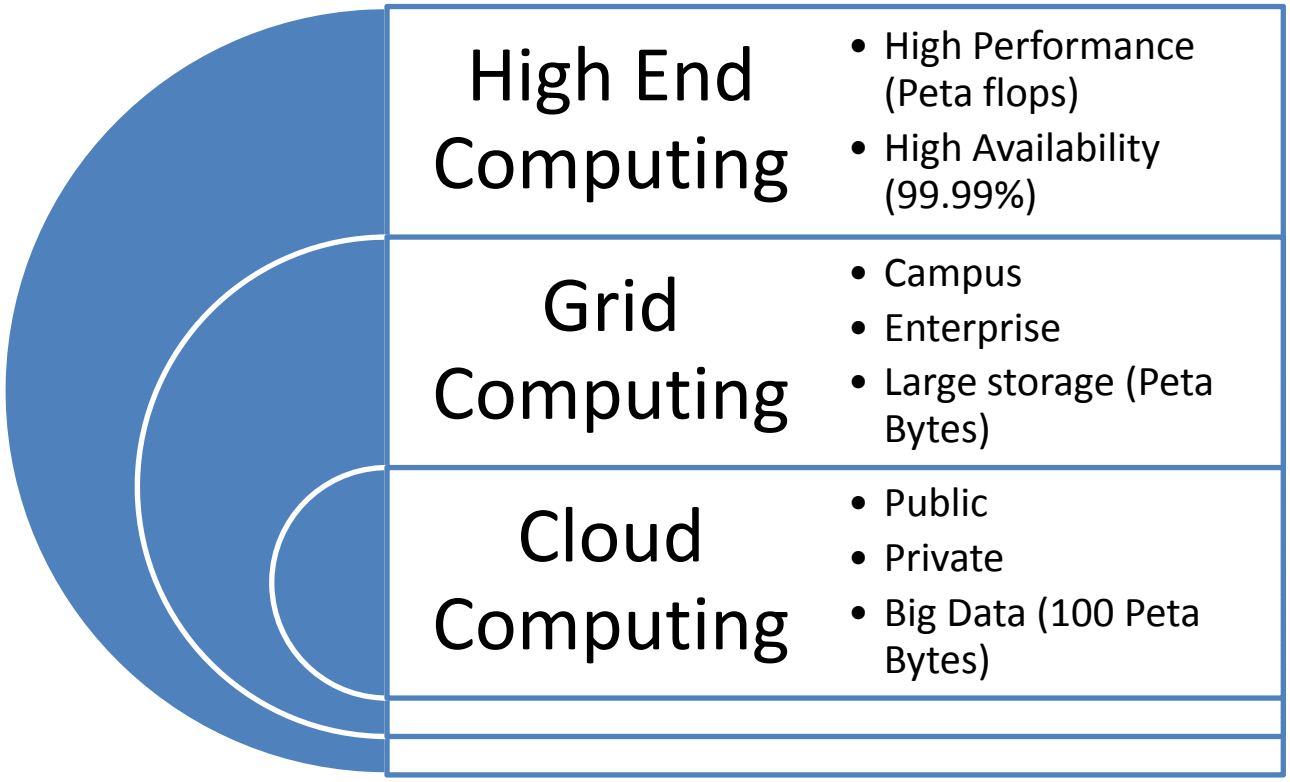
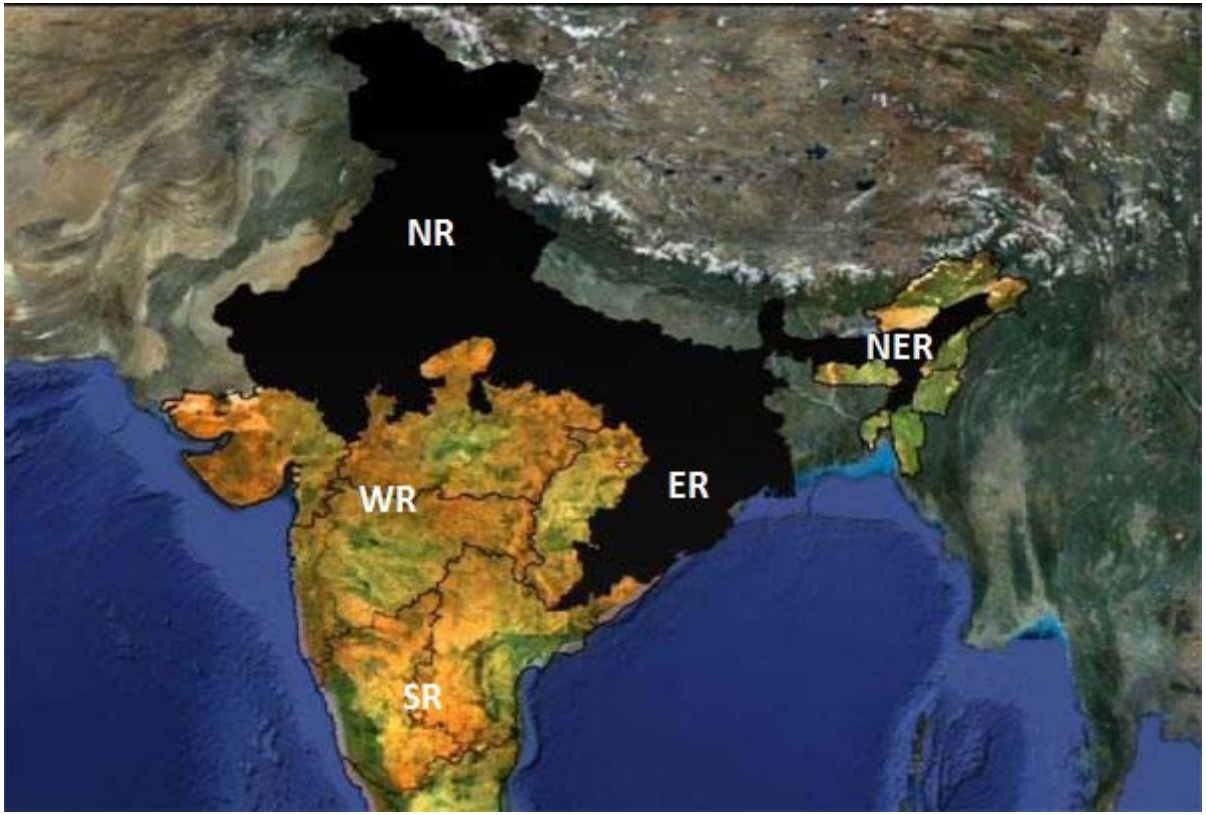


Fig. Smart Grid Technology Layers

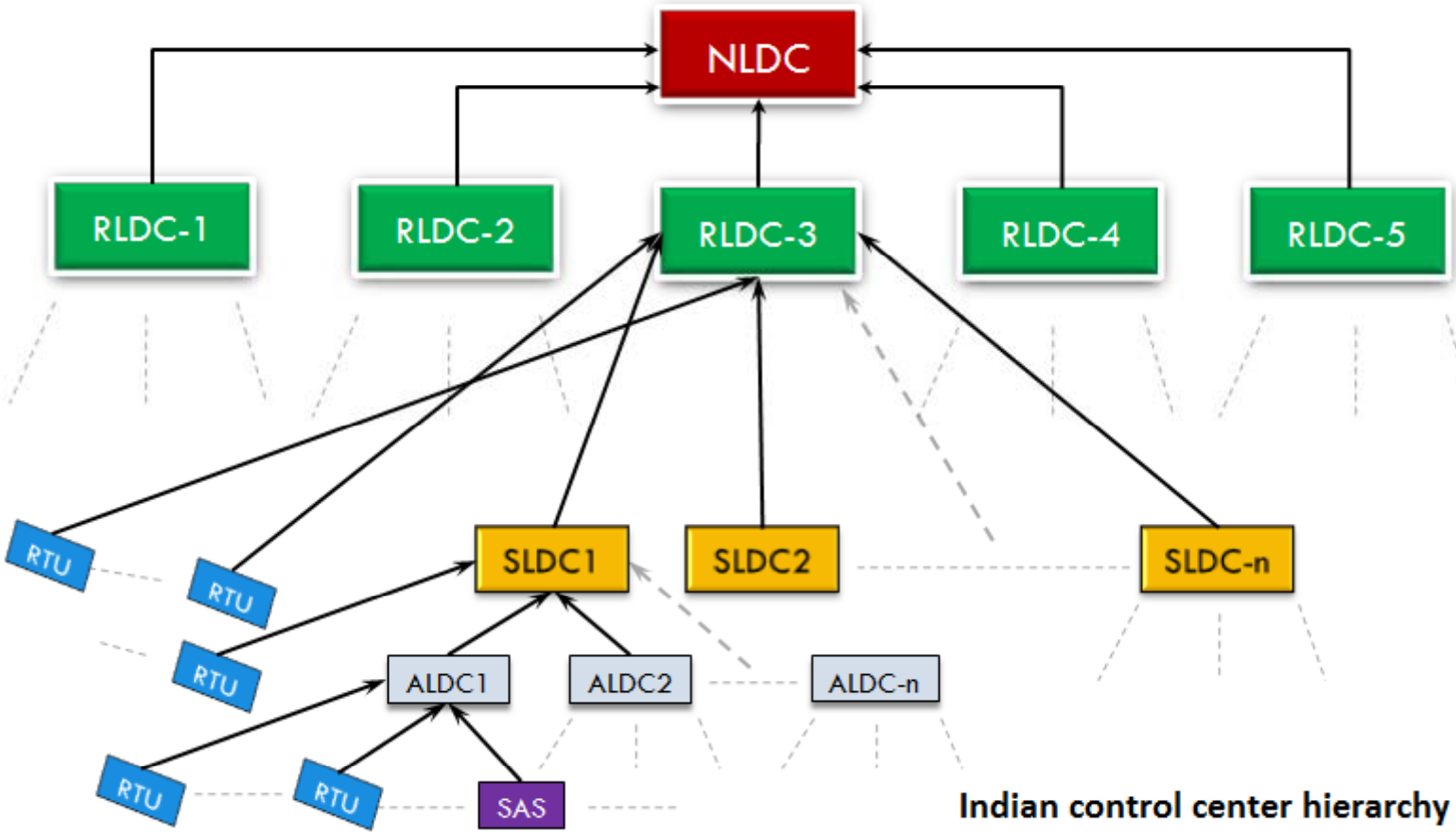
Computing Needs – Energy Internet



July 31 2012 Blackout



Indian Transmission Control Centre



Indian control center hierarchy

Areas of Collaborations

- Parallel Algorithms
- Management tools for Grid/Clouds
- Advanced Sensing /measurement technologies
- Self-aware Systems
- Self-healing Grids

References

- NIST documents
- Desi Smart grid report

THANK YOU

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