Grid Architecture: Wide-Angle View of the Grid

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Grid Architecture Definition

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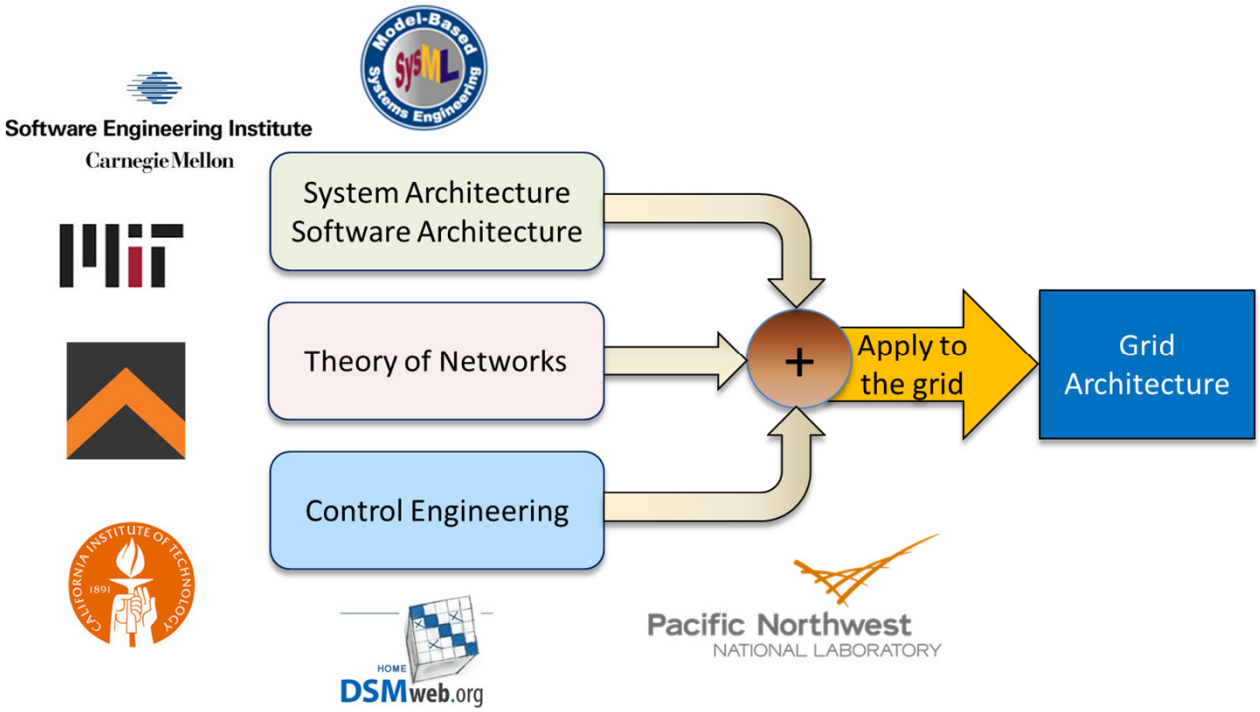
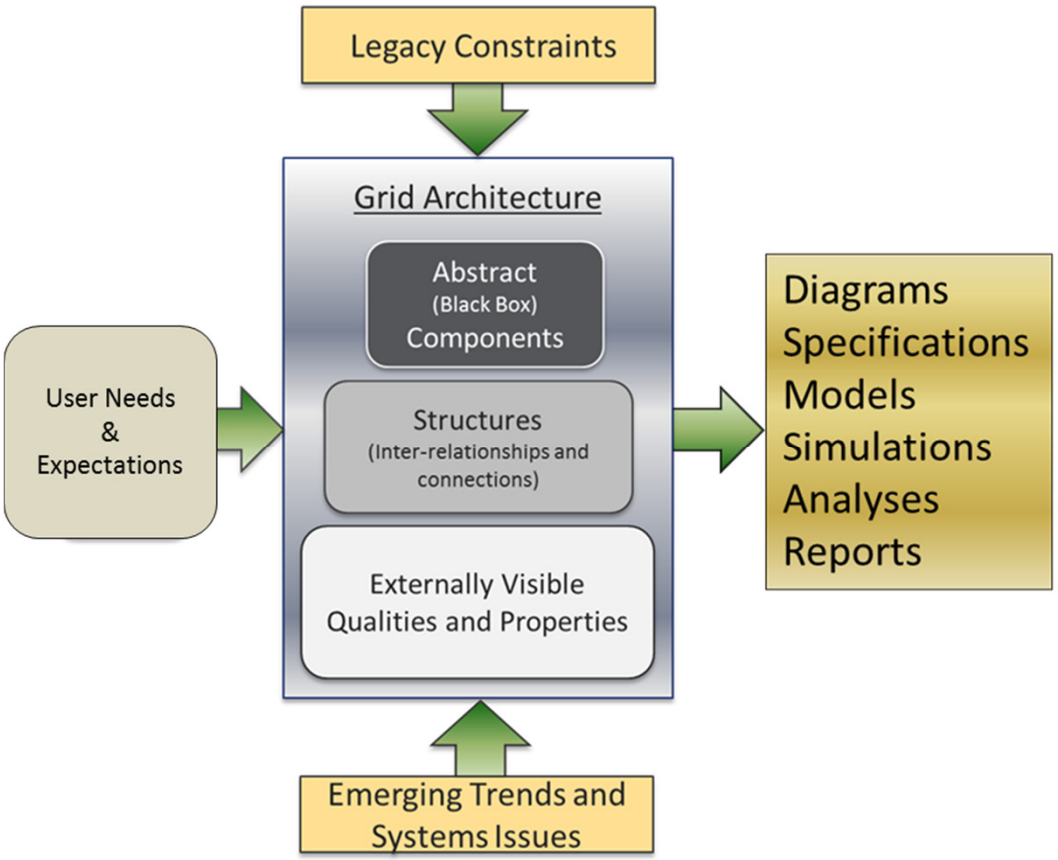
System Architecture

- An abstract depiction of a system, consisting of black box components, structure, and externally visible properties
- Purposes of architecture:
  - Support reasoning about a system's structure, behavior, and essential limits
  - Facilitate prediction of system qualities and properties
  - Manifest earliest design decisions/constraints
  - Enable (or inhibit) a system's possible capabilities
  - Identify gaps in theory or technology



Grid Architecture gives you an orderly, understandable, systematic view of a very complicated thing: the power grid.

Grid Architecture Has Multiple Purposes



- Support early stage modernization processes
- Help manage complexity (and therefore risk)
- Assist communication among stakeholders
- Re-shape the grid
- Identify and remove barriers; re-define essential limits
- Identify/define interfaces and platforms

It helps you think about changes to the grid and their implications before a lot of money has to be spent.

How to Build A House

What do you pick up first:

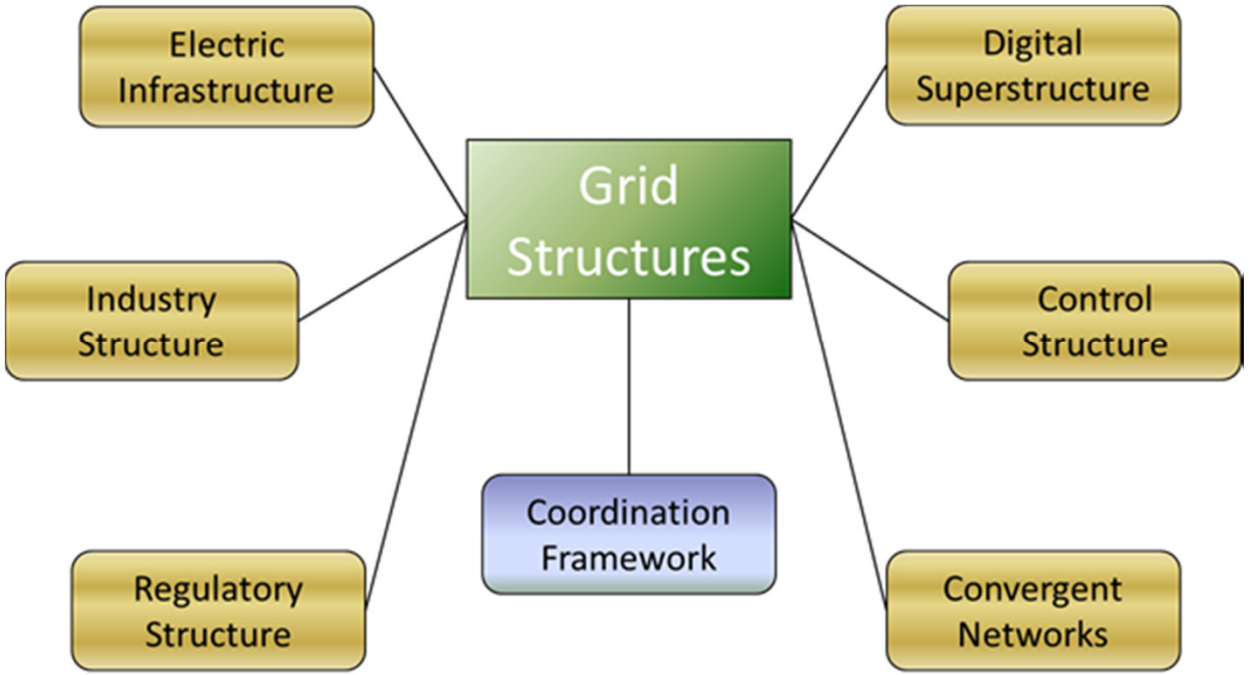
a shovel

or a pencil?

The same thing is true if you are modifying the house.

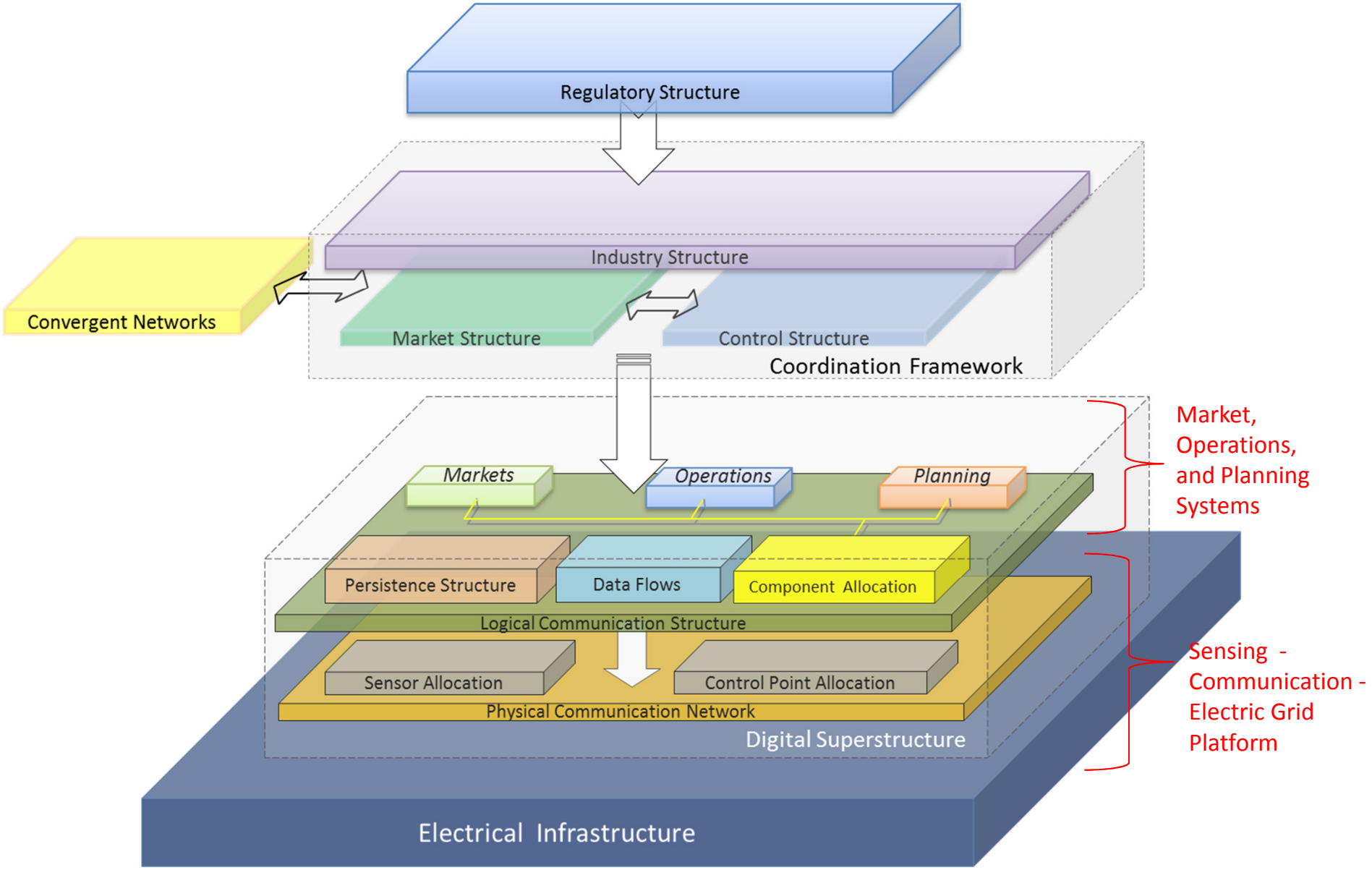
Structure and Structure Modification

- Grid Architecture treats the grid as a network of structures
- Grid structure is changing
- Some legacy structures need to be changed to relieve constraints

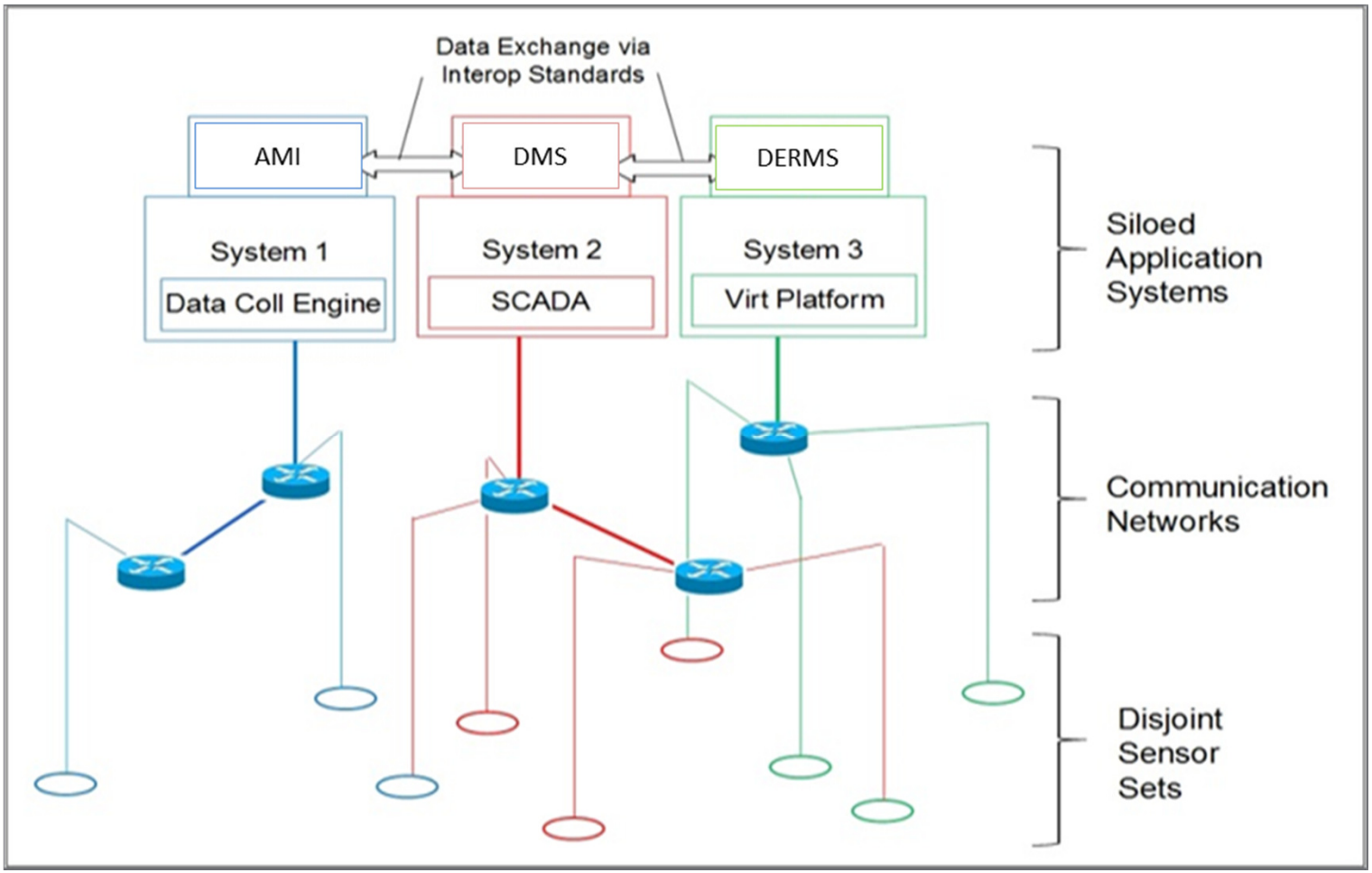


Getting structure right simplifies the downstream decisions.

Example: Layering and Platform Definition

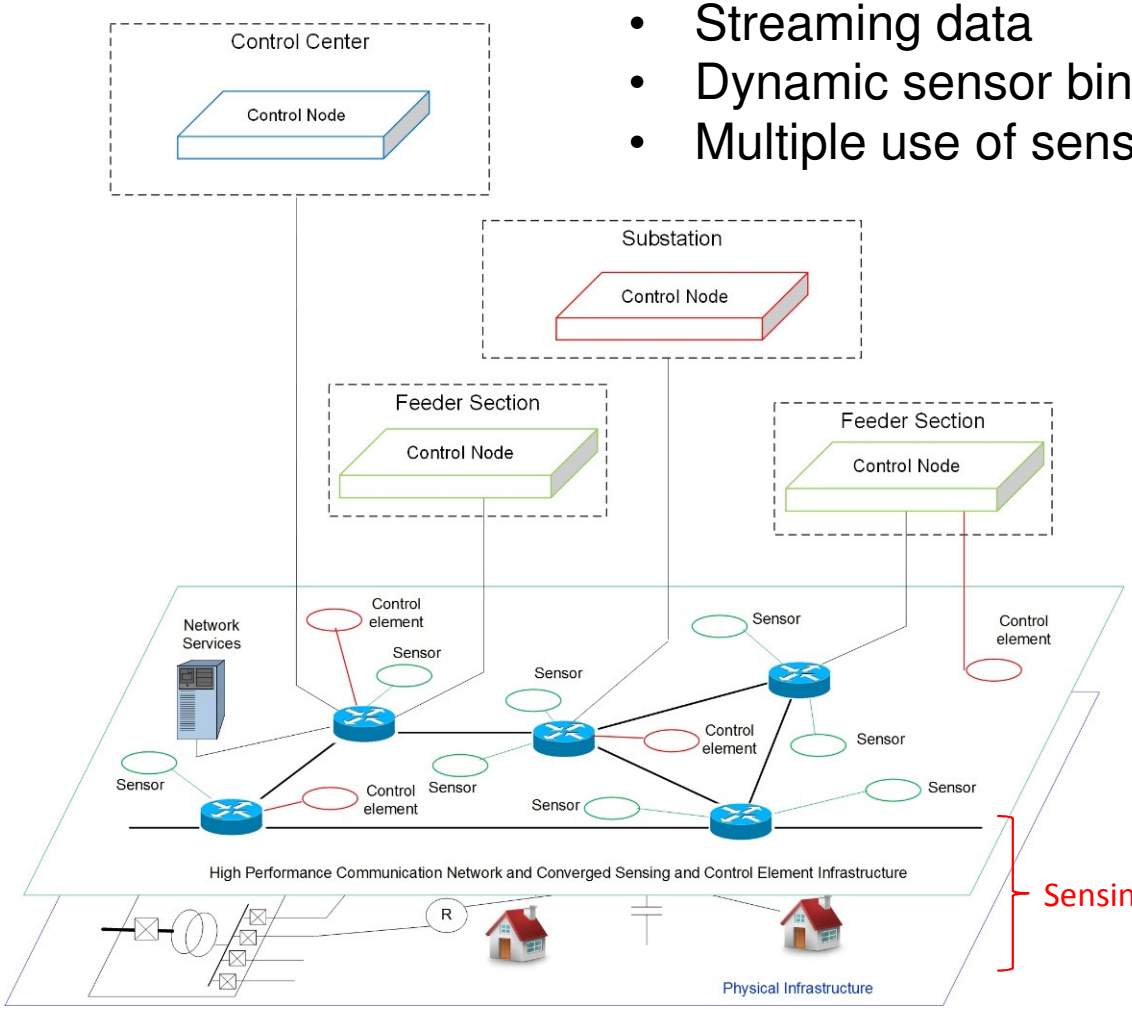


Practical Application: Distribution Network Structure



- Siloed, coupled apps
- Long latency
- Poor flexibility
- Expensive integration

Sensing and Measurement/Grid Platform

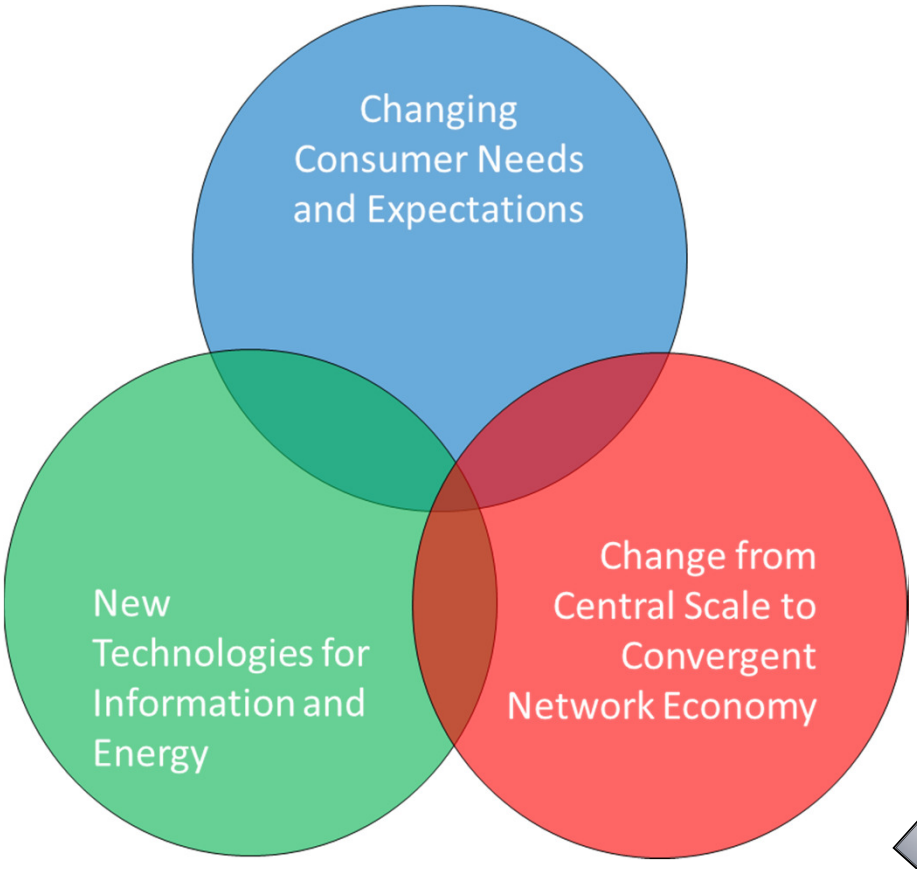


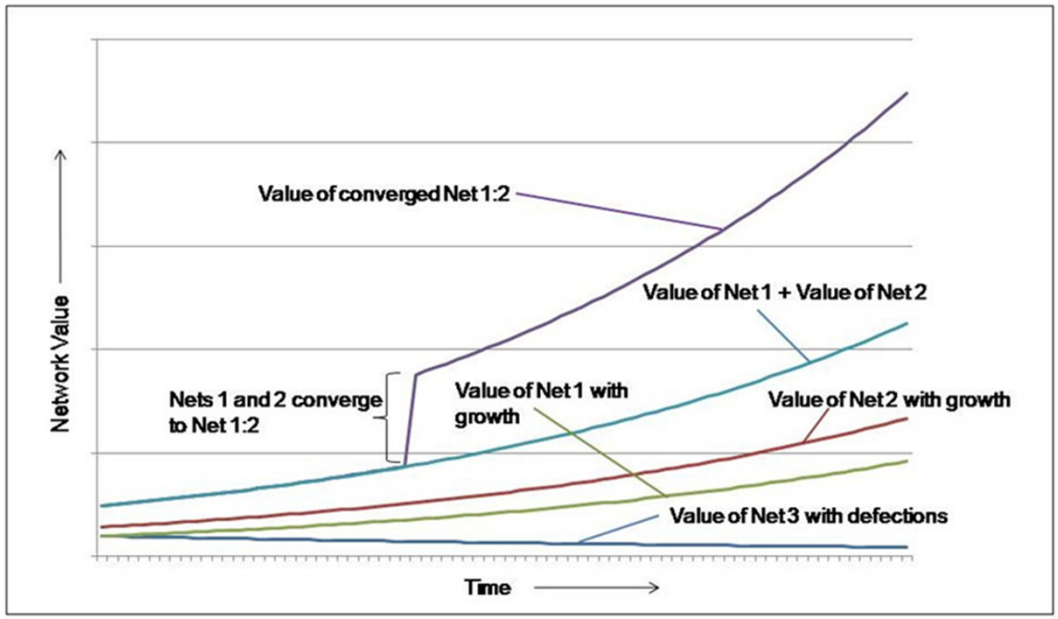
- Streaming data
- Dynamic sensor binding
- Multiple use of sensor data

- Independent apps
- Low latency
- High functional flexibility
- Low cost integration
- Future-proofed investment

Sensing-Communication-Electric Grid Platform

Re-Shaping of the Grid is Inevitable

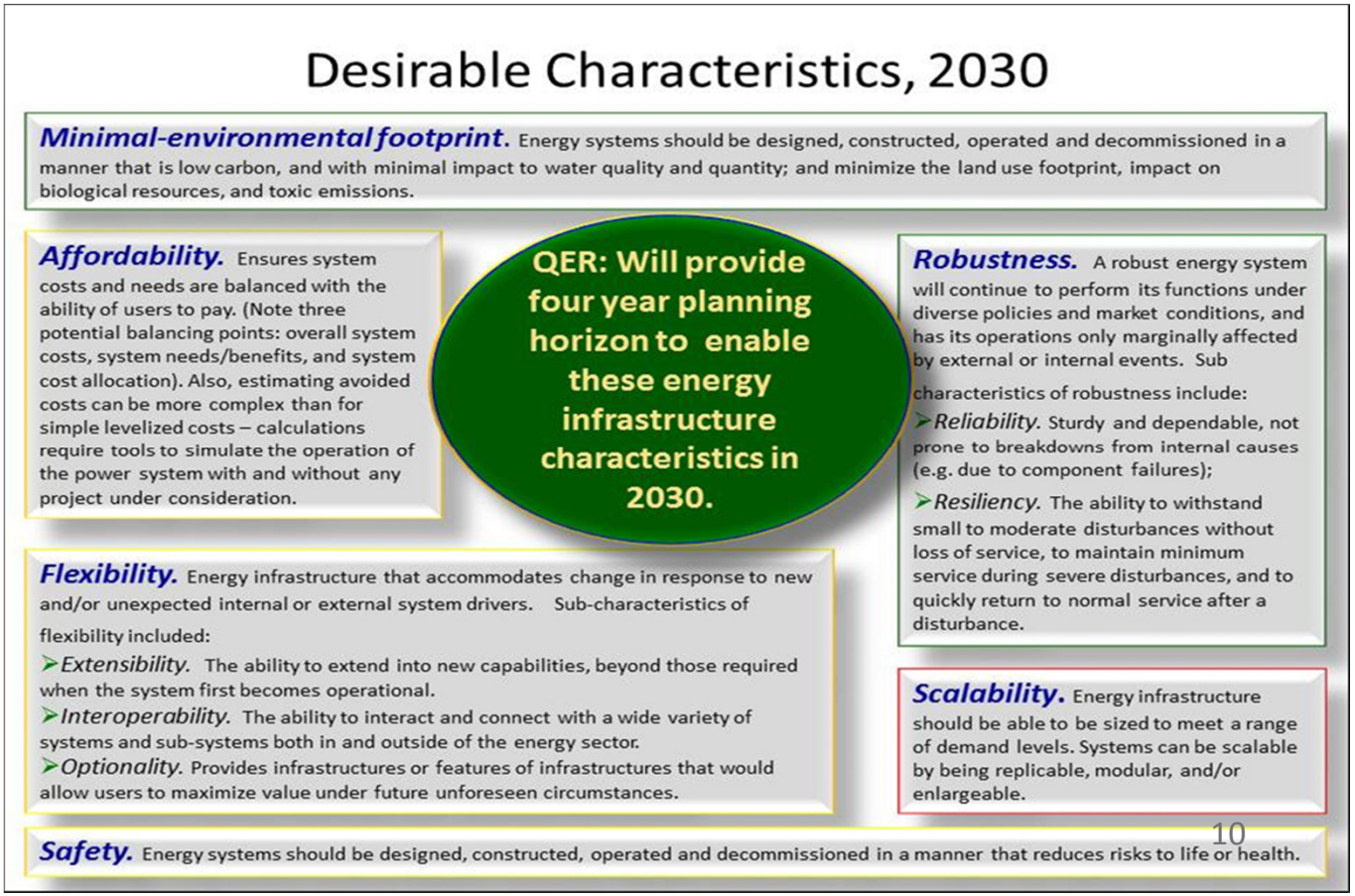




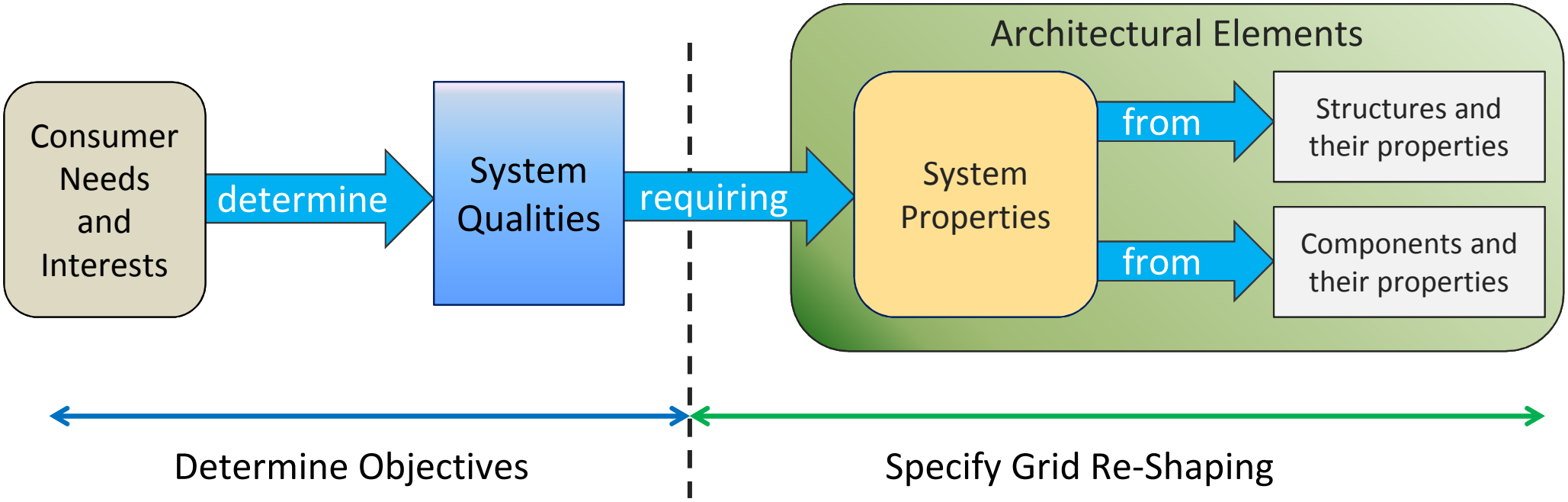
source: P De Martini

Defining the Modernized Grid

- Lots of definitions of "Smart Grid" in the previous decade
- Now, many definitions of the modernized grid
- "-ility" words used a lot
- DOE example from 2015:



Defining the Architecture



First Logical Steps

- Start with objectives
  - understand the forces: emerging trends
  - qualities->properties->architecture->designs
- Understand legacy constraints
  - structural or component-based ?
- Get the structure(s) right
  - reduce/eliminate constraints
  - identify structures/platforms to futureproof investments
- Don’t try to hang the windows first

Thank You

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http://gridarchitecture.pnnl.gov/

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