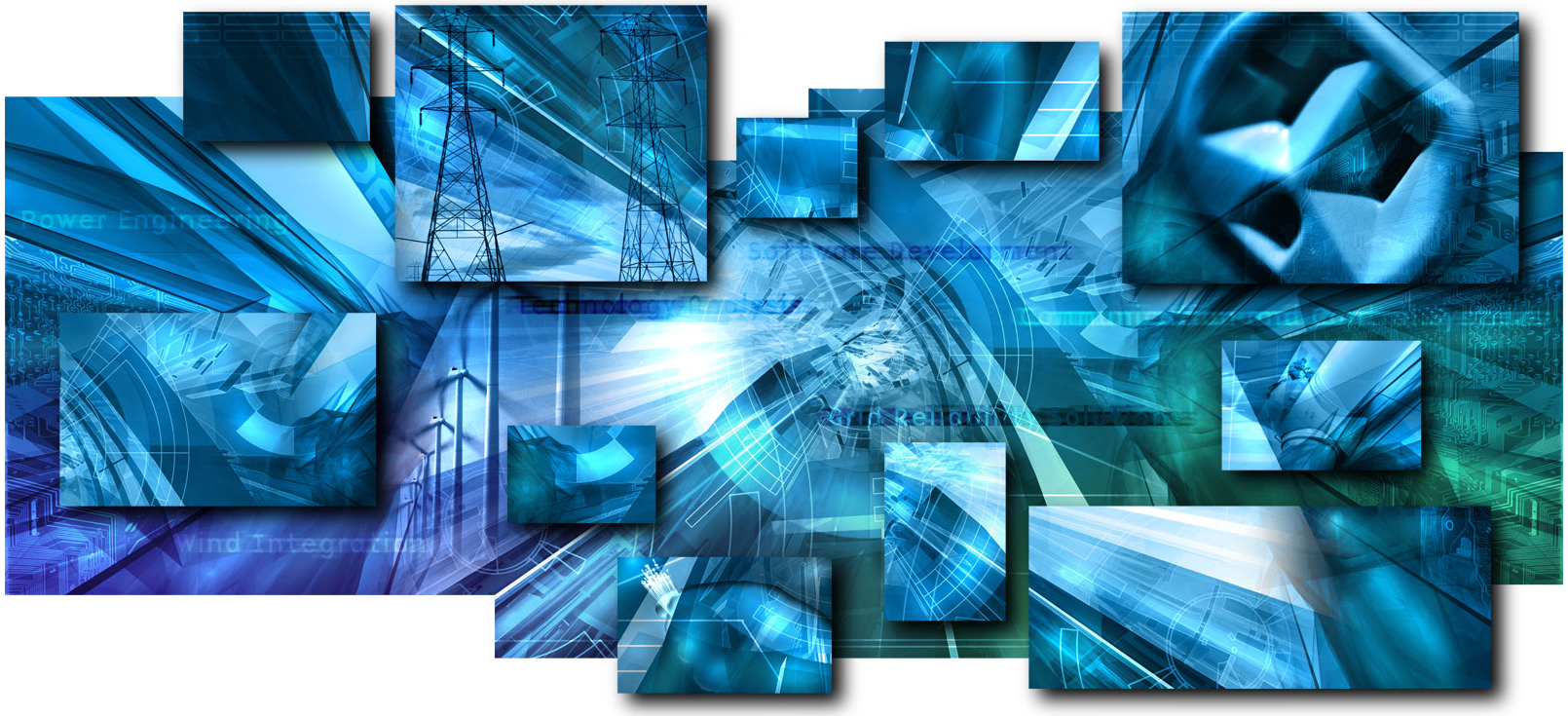
EnerNex CORPORATION

Electric Power Research, Engineering, and Consulting



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MODERN GRID
INITIATIVE

Modernizing the Grid Southeast Regional Summit

Overview of Interoperability

Erich W. Gunther
Chairman and CTO – EnerNex Corporation
August 11, 2006

EnerNex
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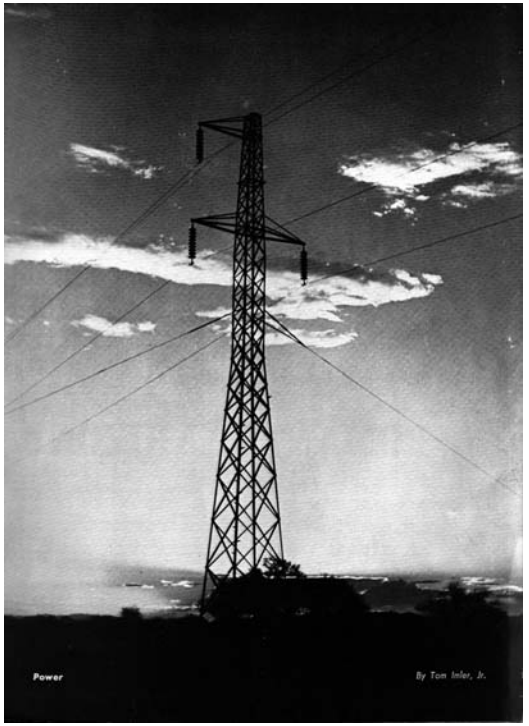
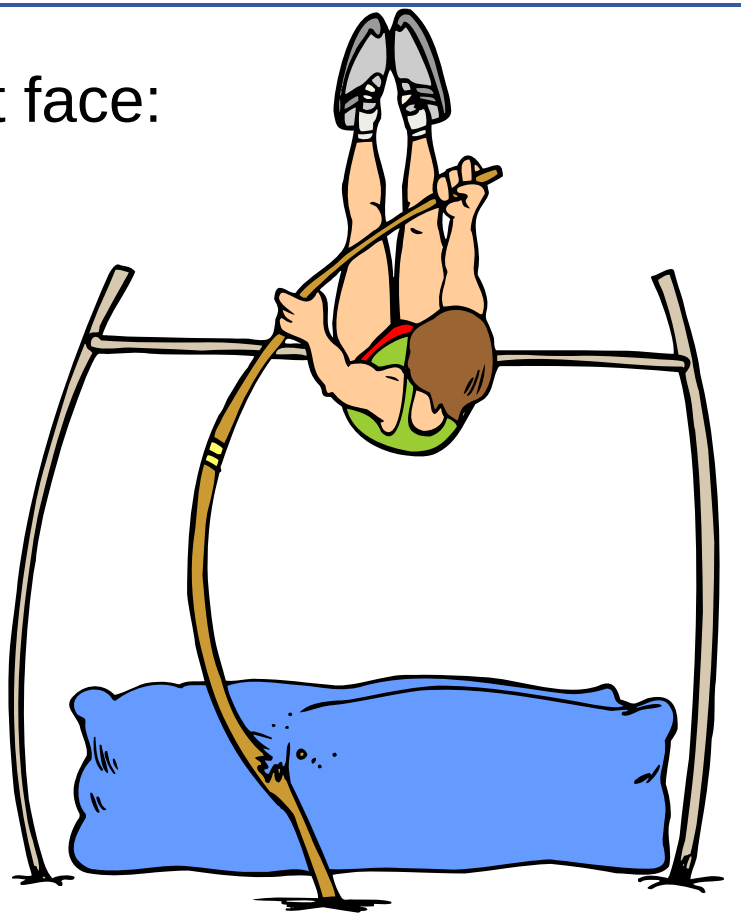
Today's Automation Projects

- Currently deployed in the industry (among others)
  - Volt/VAR control
  - Auto-sectionalization
  - Substation and feeder protection
  - Automatic meter reading
  - SCADA
  - Transformer monitoring
  - State estimation
  - Workforce dispatch
  - Fault recording and analysis
- These are **INTELLIGENT SYSTEMS**
  - They have objectives
  - They gather data
  - They sense and react to their environment



New Challenges Faced by Today's Intelligent Systems

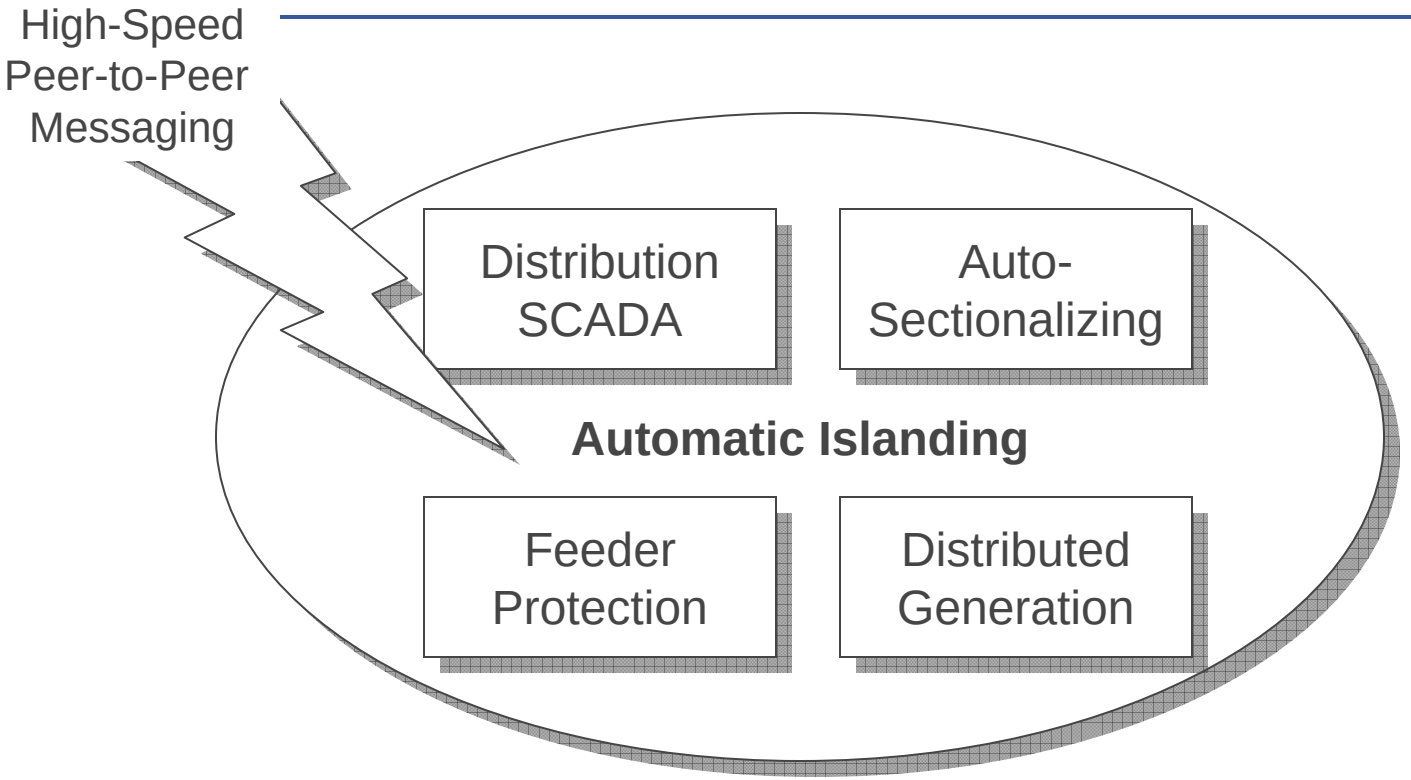
- These Intelligent Systems must face:
  - Deregulation
  - Security concerns
  - Wide-area reliability
  - Energy markets
  - Distributed generation
  - New energy sources
  - Reduced budgets
- Were never designed for this
- Don't have the scope



Systems Integration: Reacting to the Challenge

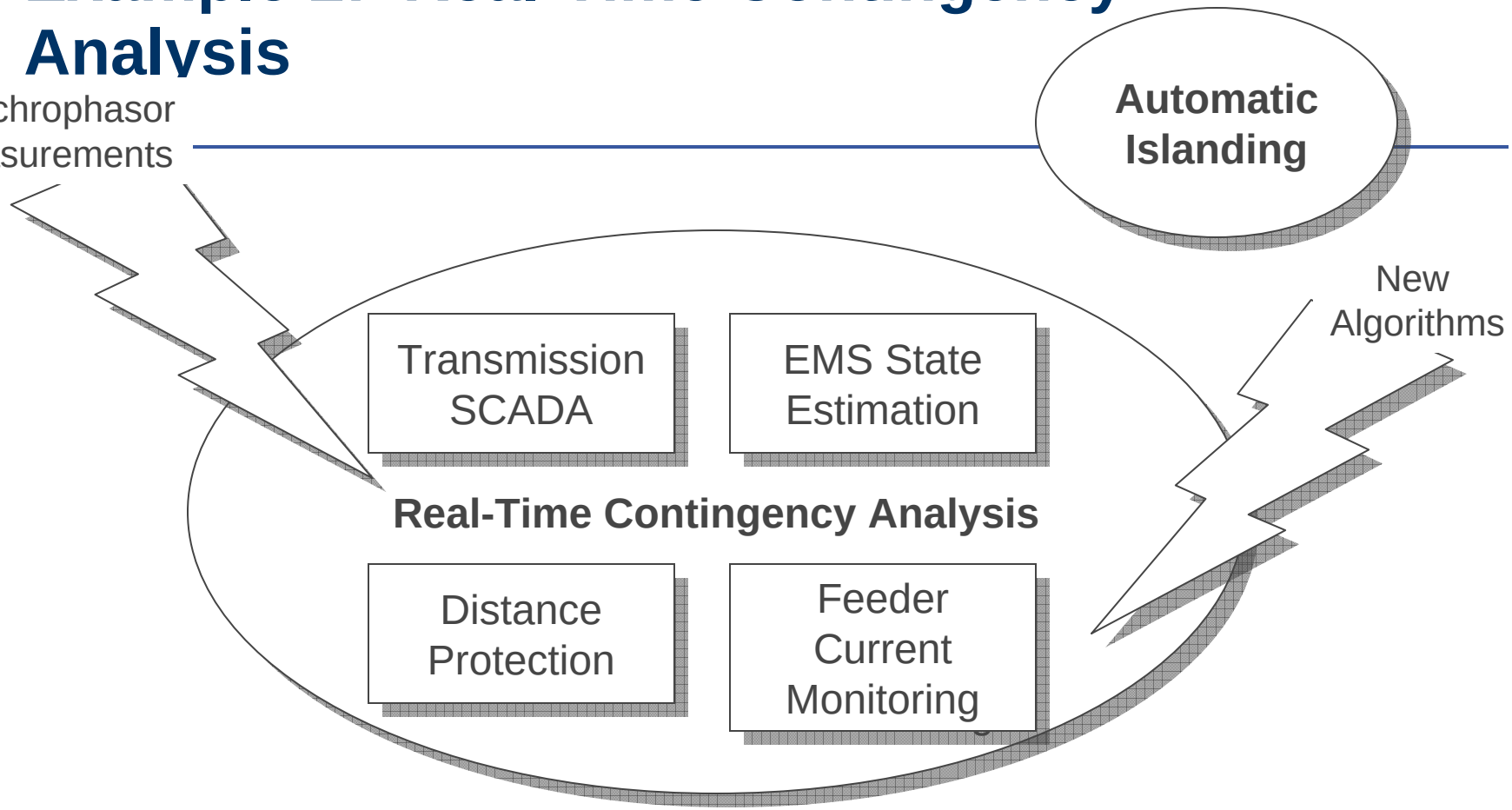
- Start with existing intelligent systems
- Progressively link them together
- Add new knowledge and technologies:
  - New standardized interfaces
  - Ideas for new power system applications
  - New intelligent algorithms
- Thus, create NEW intelligent systems with
  - Wider scope
  - Greater ability to adapt
  - Interaction with consumers and markets
- For example…

Example 1: Islanding



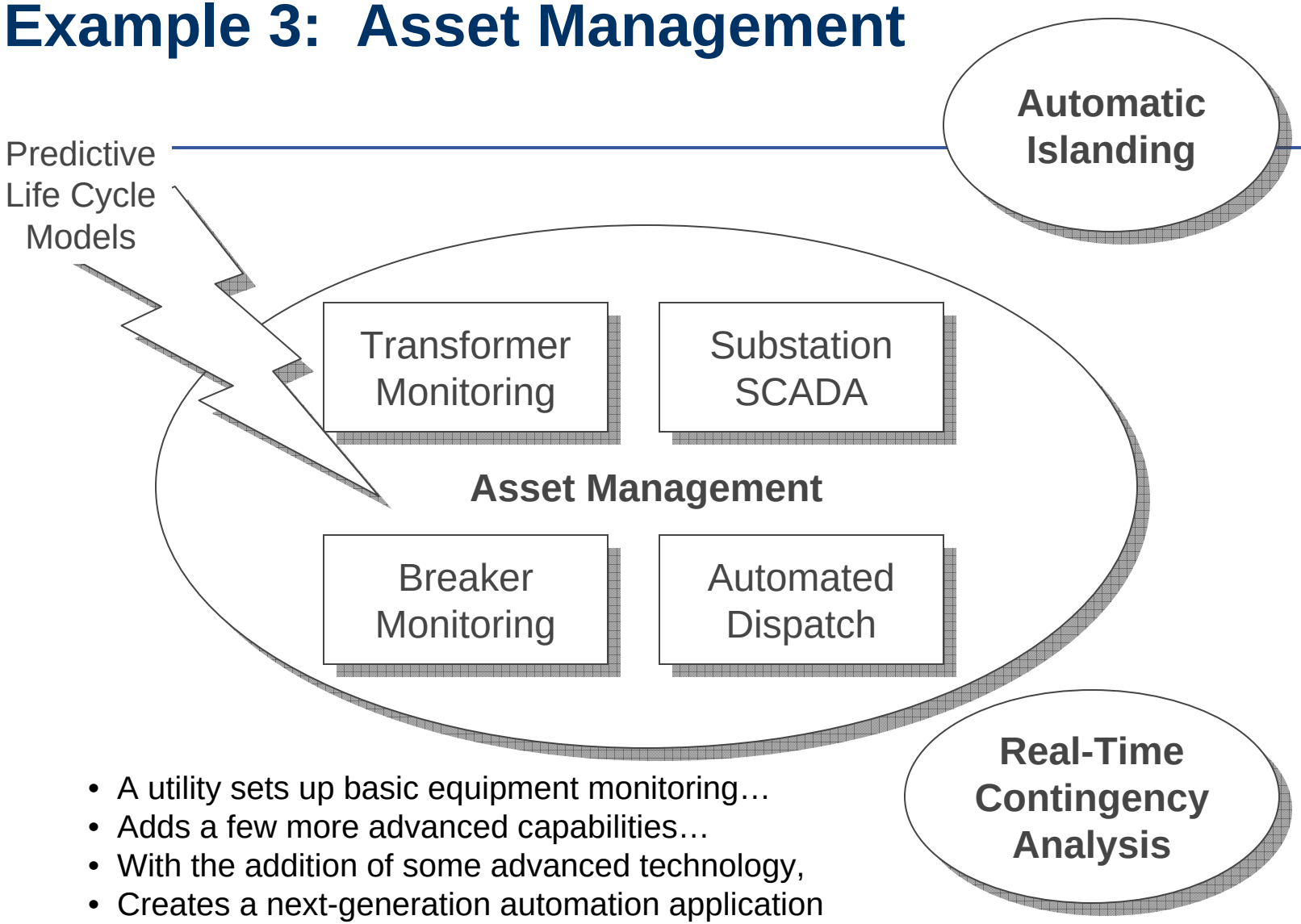
- A utility sets up basic distribution automation…
- Adds a few more advanced capabilities…
- With the addition of some advanced technology,
- Creates a next-generation automation application

Example 2: Real-Time Contingency Analysis



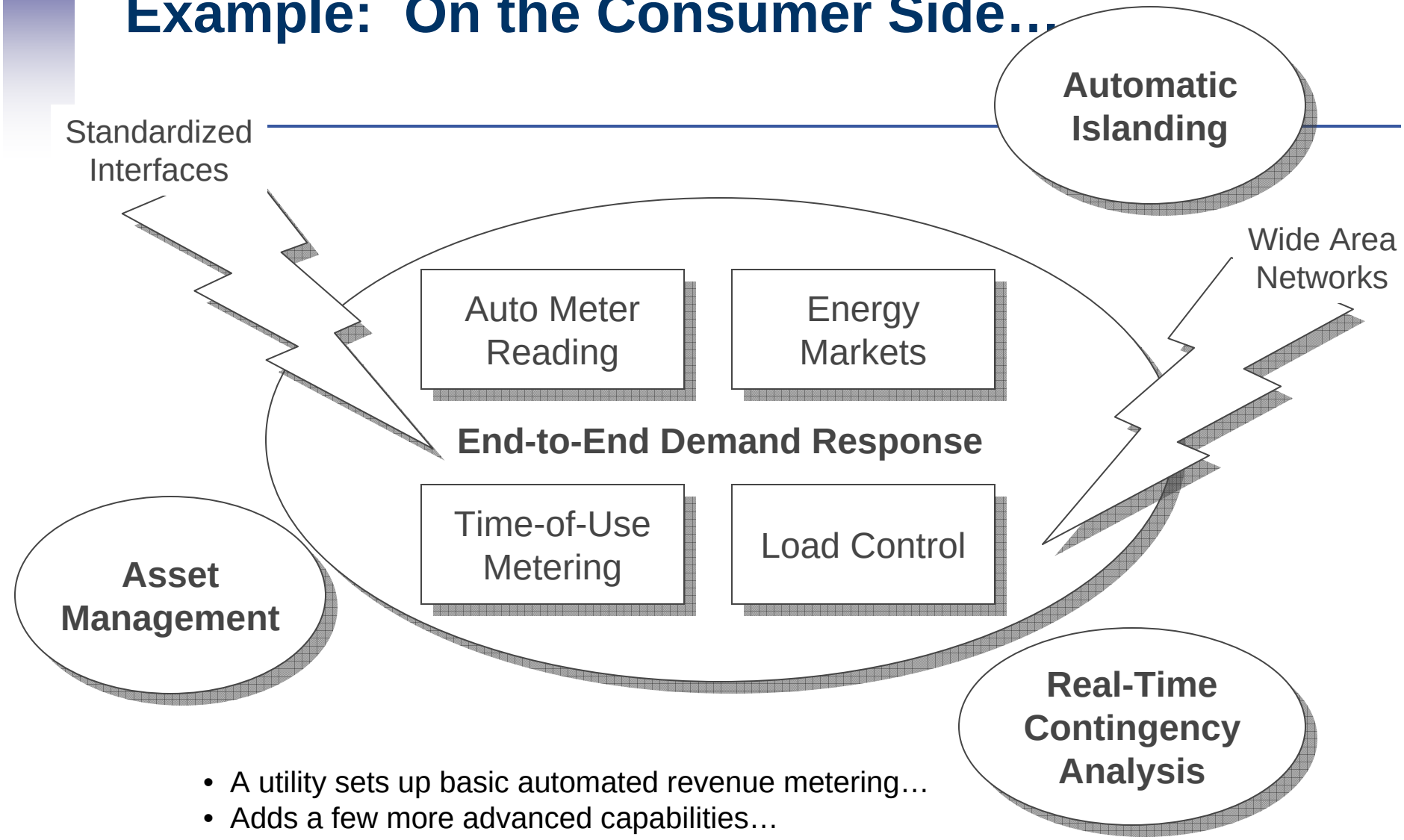
- A utility sets up basic substation automation…
- Adds a few more advanced capabilities…
- With the addition of some advanced technology,
- Creates a next-generation automation application

Example 3: Asset Management



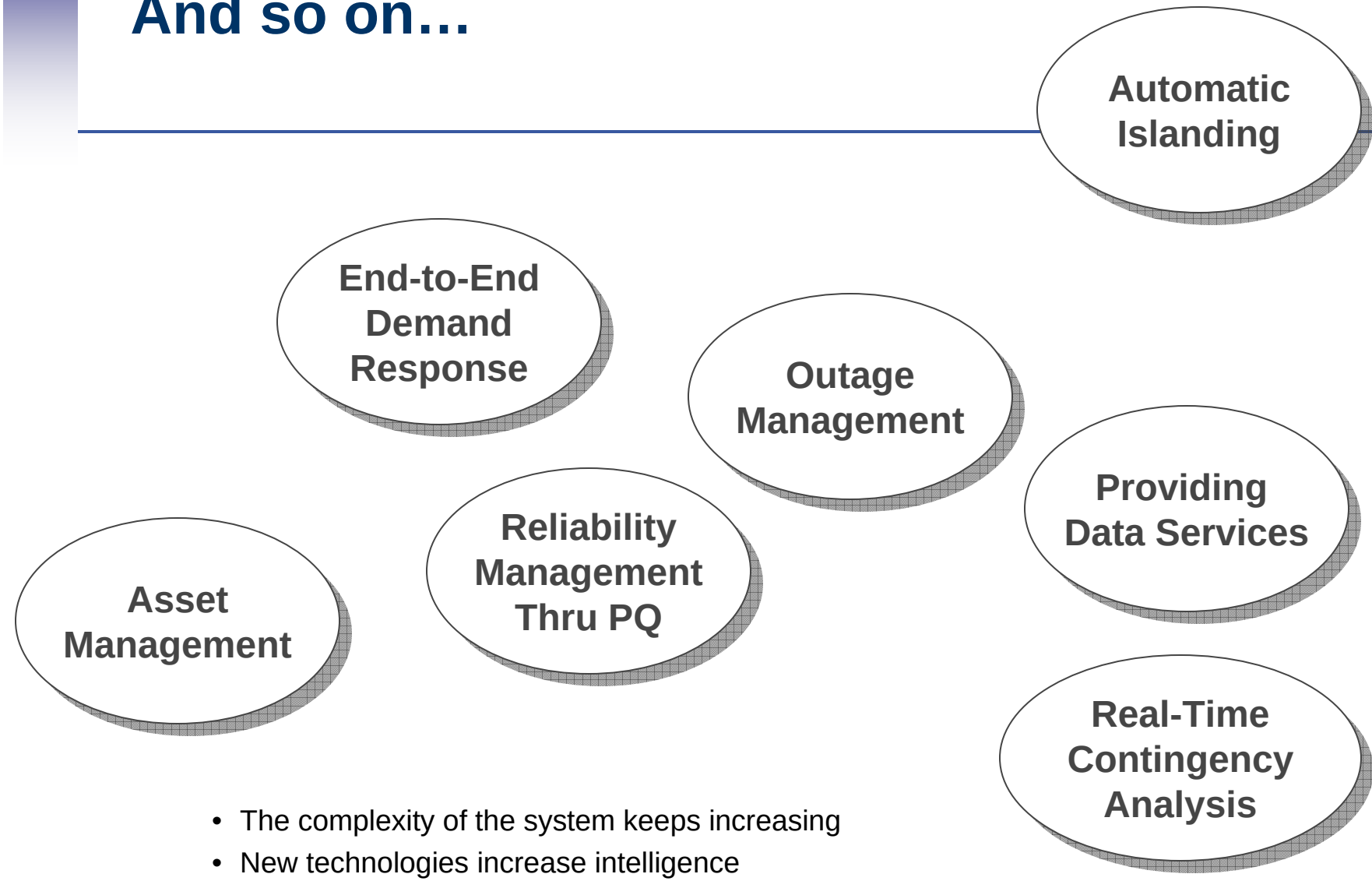
- A utility sets up basic equipment monitoring…
- Adds a few more advanced capabilities…
- With the addition of some advanced technology,
- Creates a next-generation automation application

Example: On the Consumer Side…



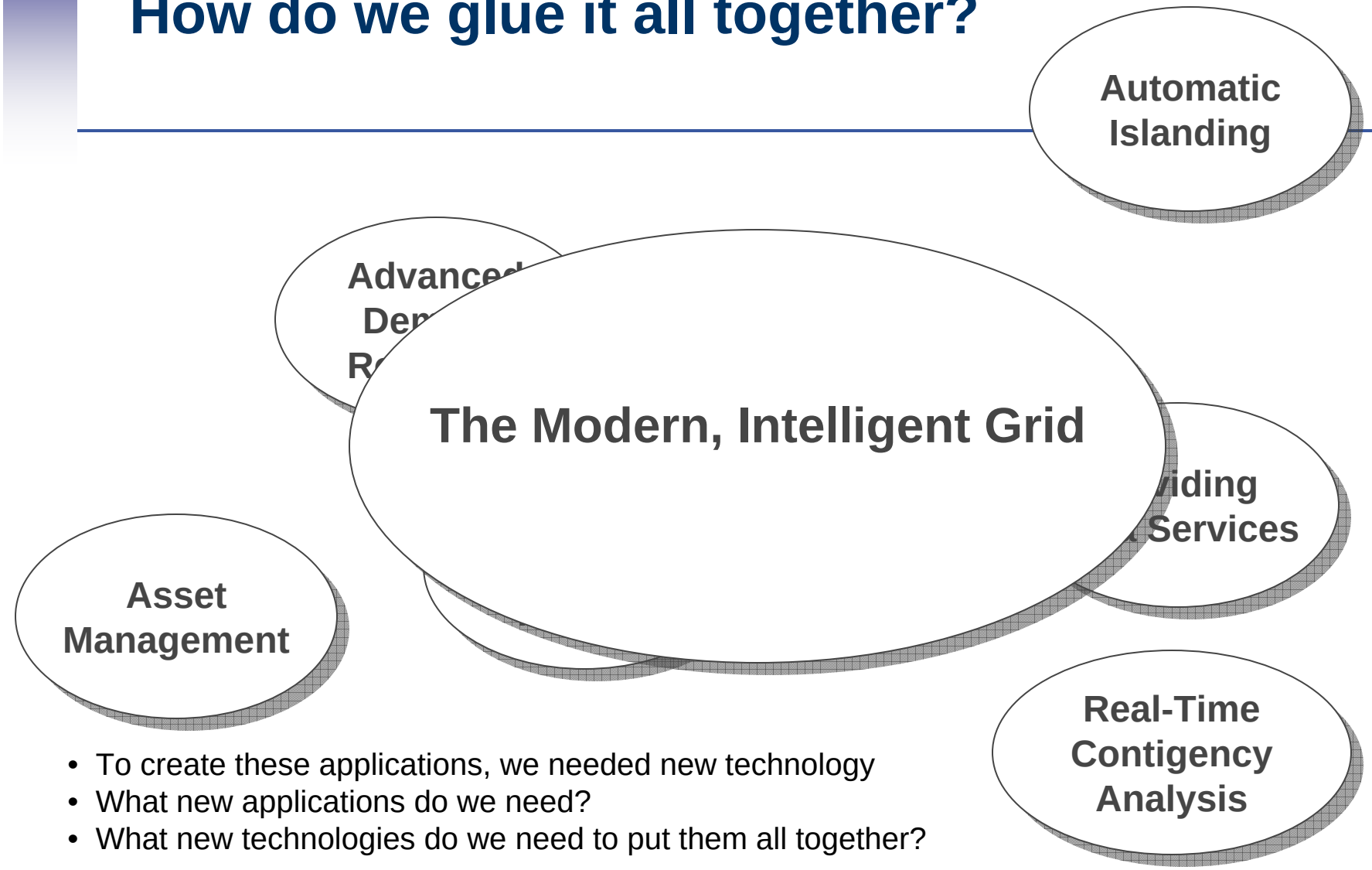
- A utility sets up basic automated revenue metering…
- Adds a few more advanced capabilities…
- With the addition of some advanced technology,
- Creates a next-generation automation application

And so on…



- The complexity of the system keeps increasing
- New technologies increase intelligence
- Utilities will deploy these systems individually

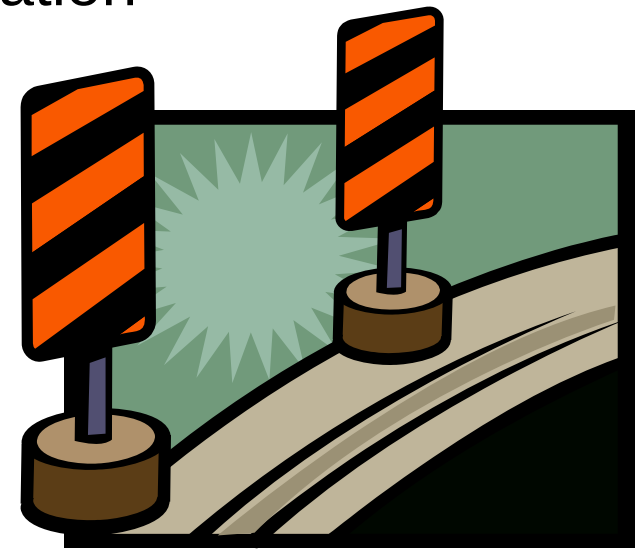
How do we glue it all together?



- To create these applications, we needed new technology
- What new applications do we need?
- What new technologies do we need to put them all together?

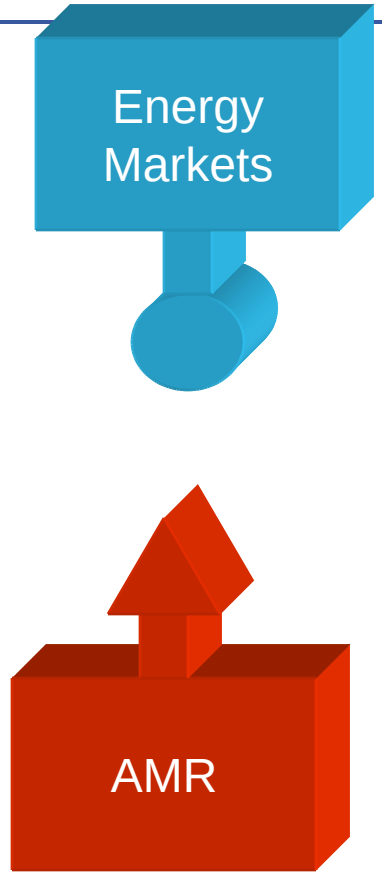
DANGER: Integration without Architecture

- It is not sufficient just to integrate systems haphazardly
- There must be an overarching plan, or blueprint
- Otherwise, vital systems integration may be prevented because of:
  - High costs
  - Missing technology



CHALLENGES OF INTEGRATION:

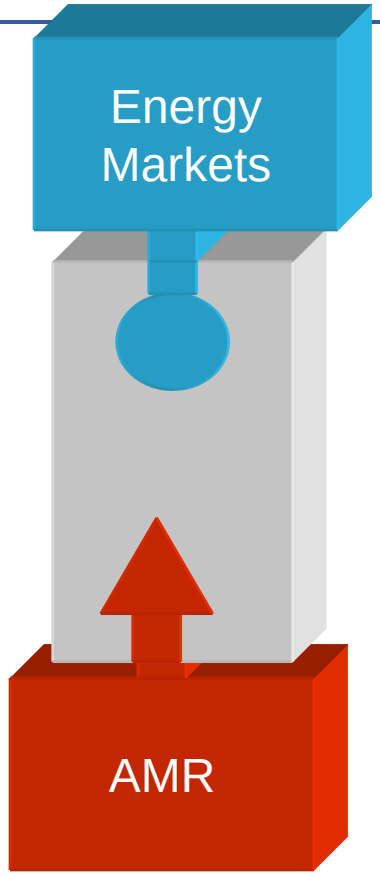
Building Isolated Systems



- Utilities tend to develop intelligent systems in isolation
- For example, AMR and participation in energy markets
- Neither project is typically developed with the other in mind.

CHALLENGES OF INTEGRATION:

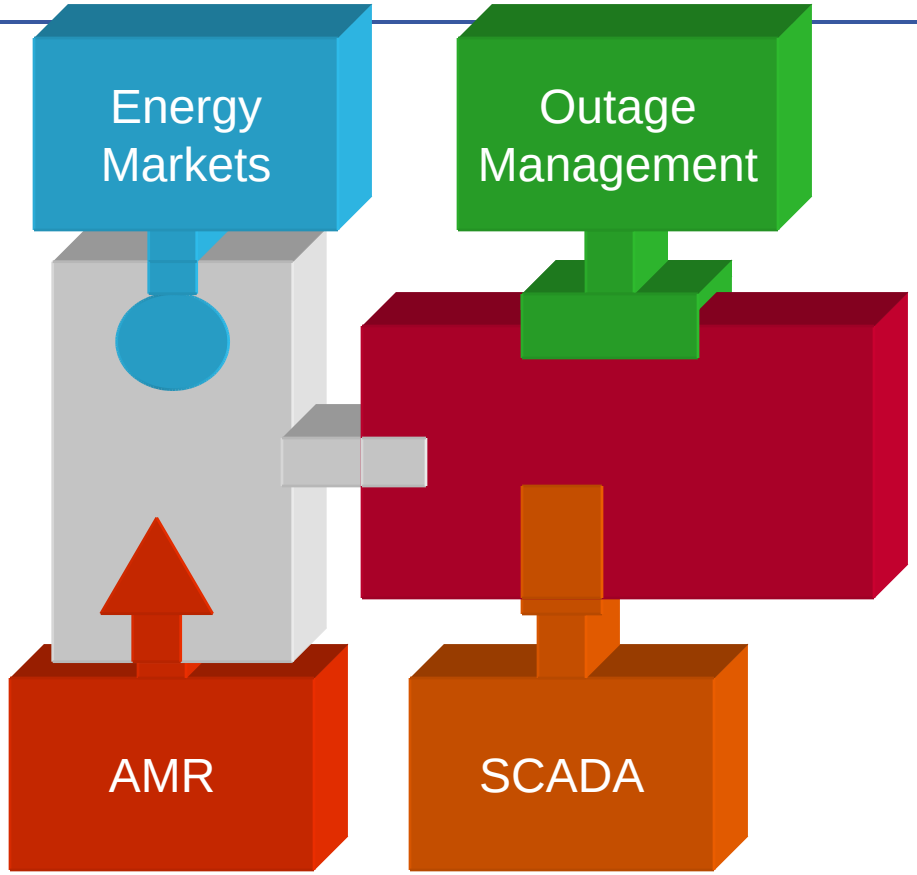
One-Off Integration



- Integration is typically done after the fact
- Cost is significant

CHALLENGES OF INTEGRATION:

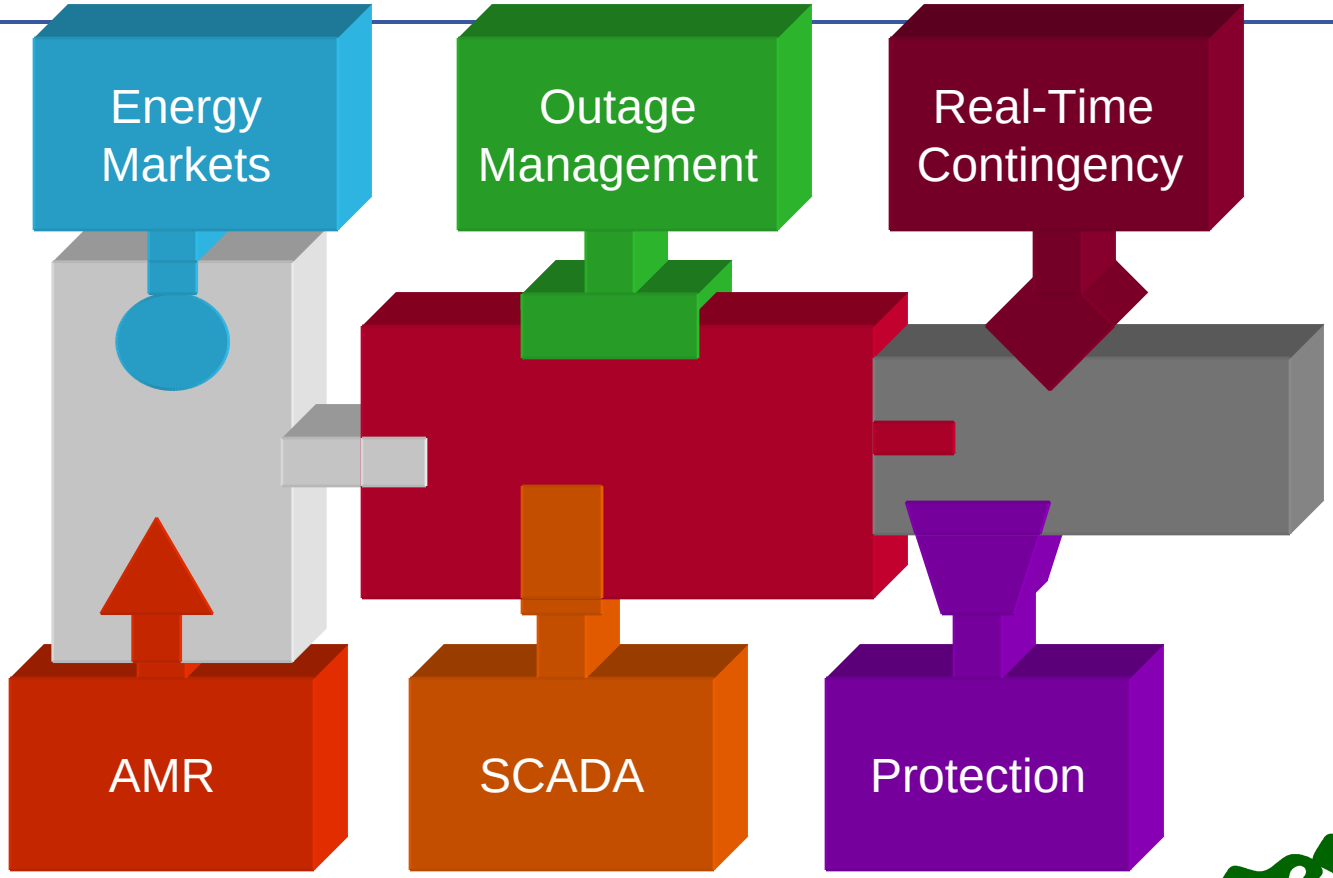
Doing it the Next Time



- Now want to link in new systems
- Must first make the old system expandable
- Then must do another "one-off" integration

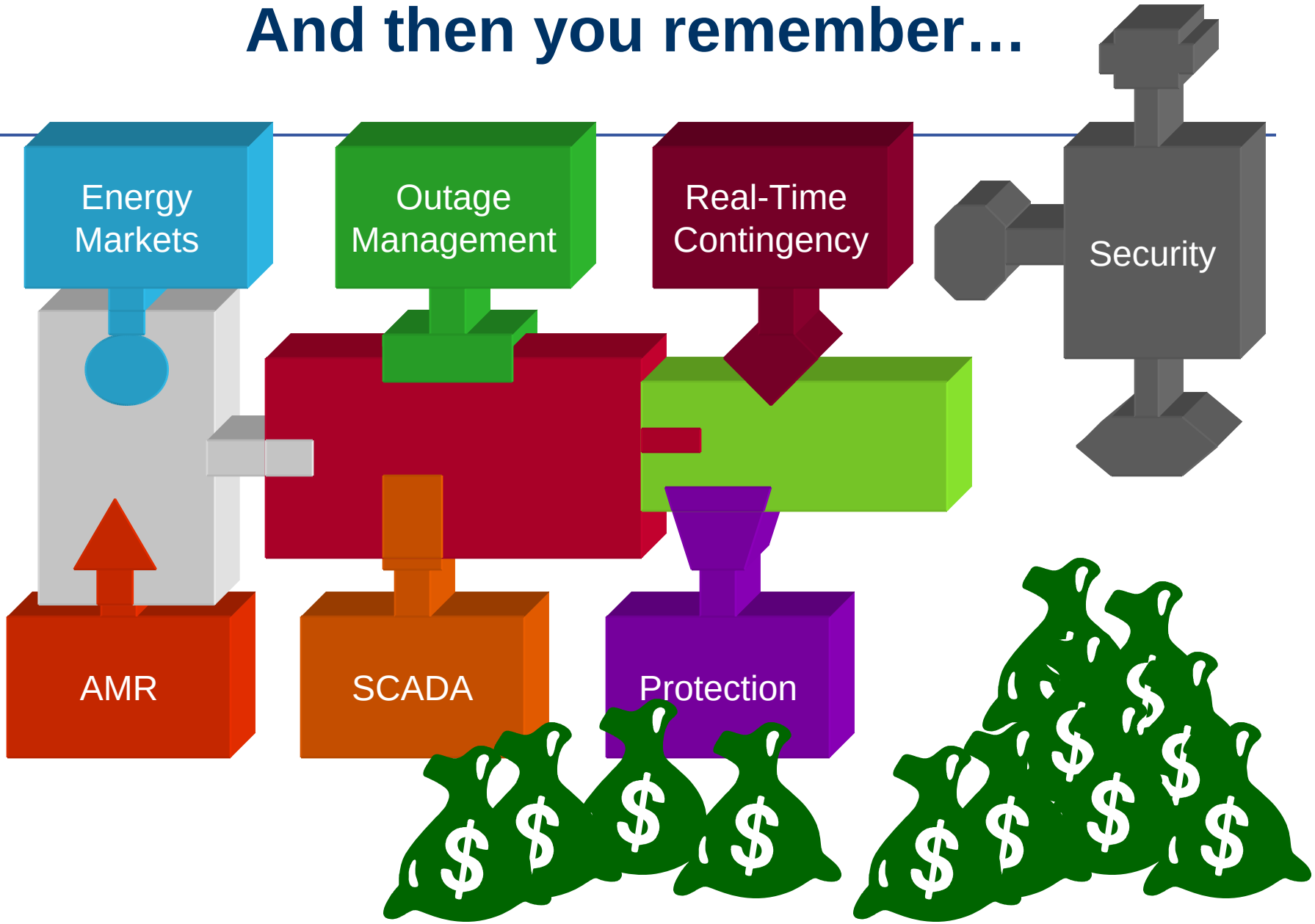
CHALLENGES OF INTEGRATION:

And again…

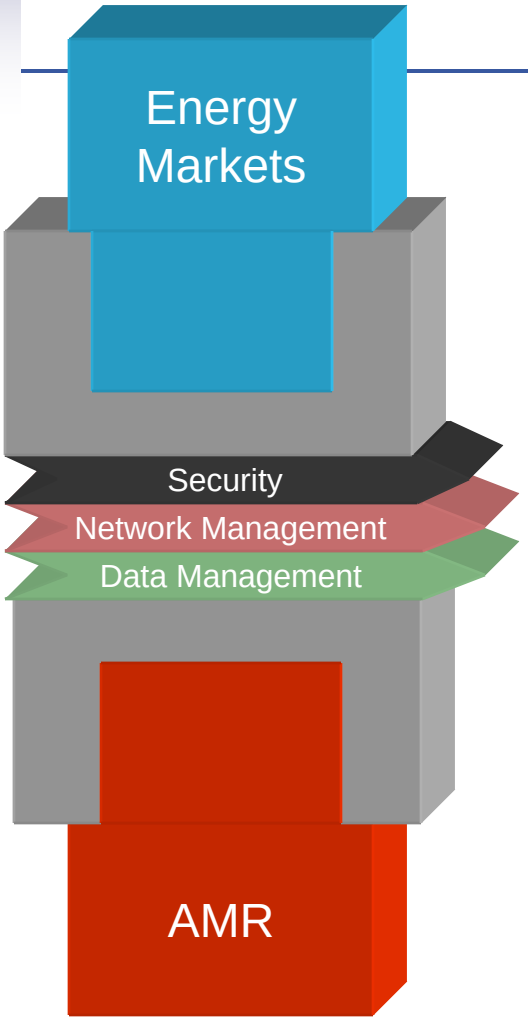


CHALLENGES OF INTEGRATION:

And then you remember…

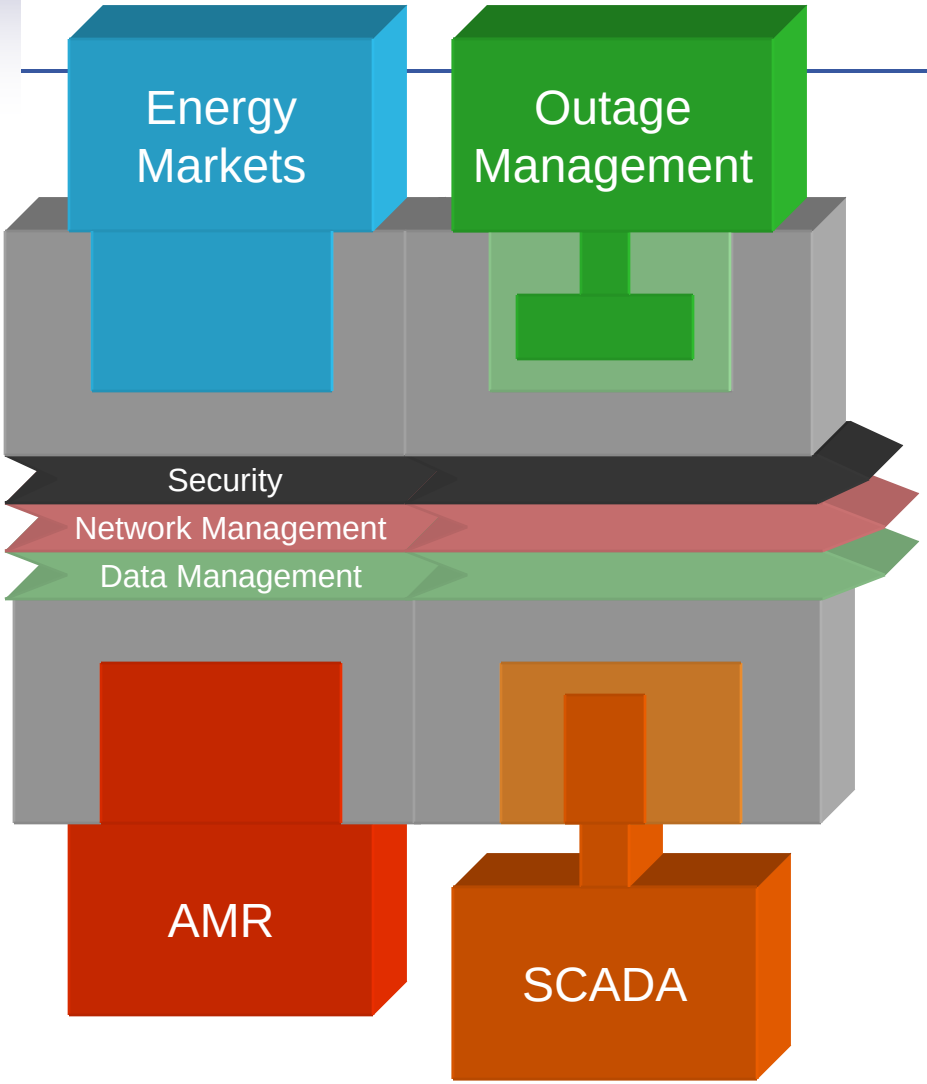


Doing it Right: Top-Down Architecture



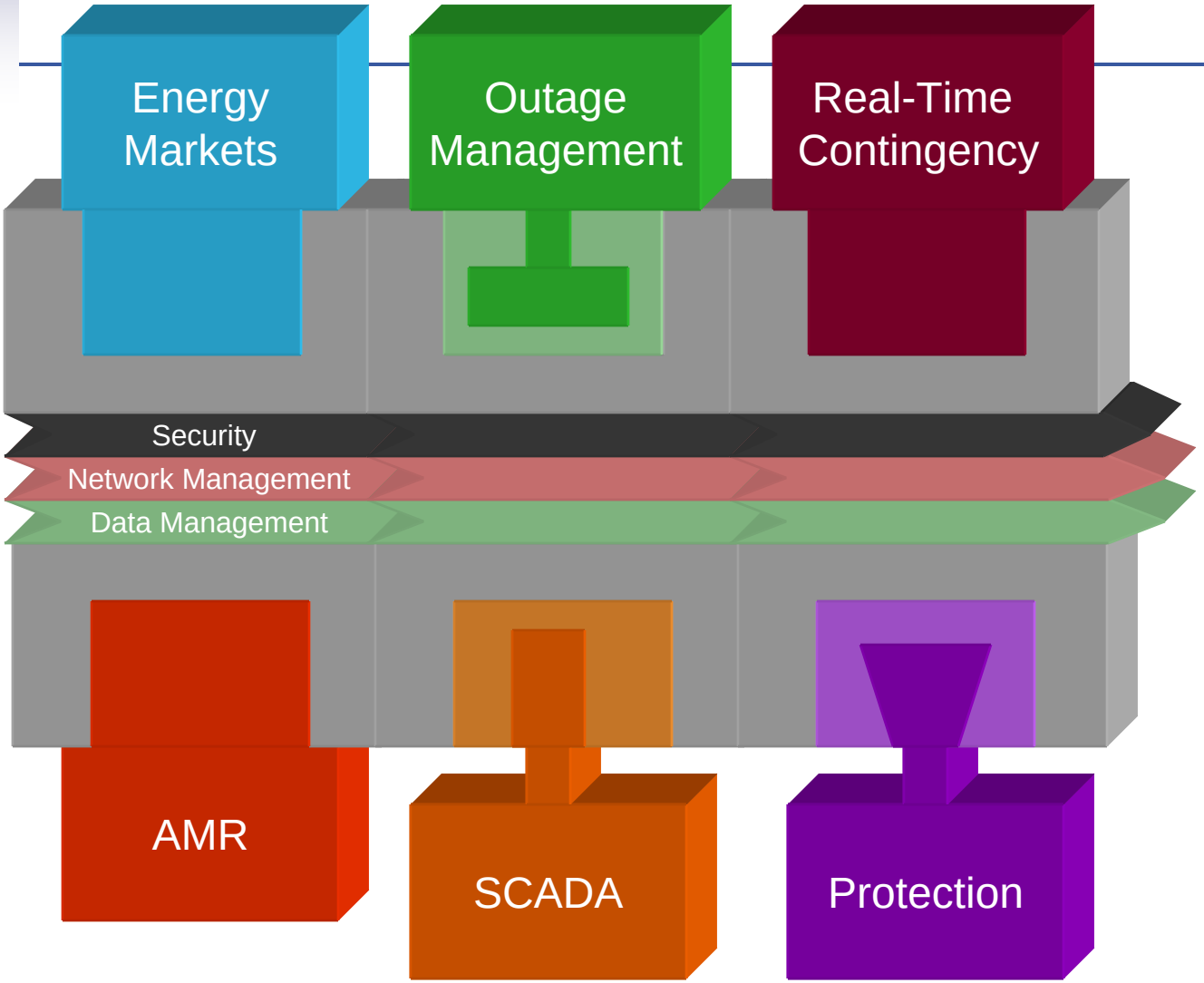
- Define standardized interfaces first
- Incorporate security, network management and other strategies right from the beginning
- Initial costs are a bit more than one-off integration, but not much more
- New applications can build directly to the new architecture

Doing it Right: The Next Phase



- Can re-use the development from the first phase
- Expansion was expected
- Adaptation to legacy systems was planned in advance
- Overall costs much lower

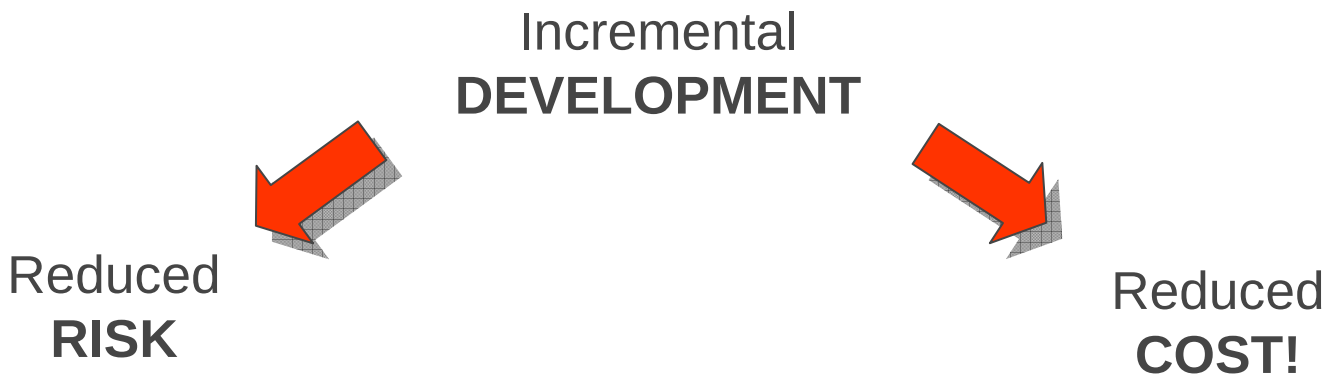
Doing it Right: And so on…



- Benefits INCREASE with time
- Opposite of the old way

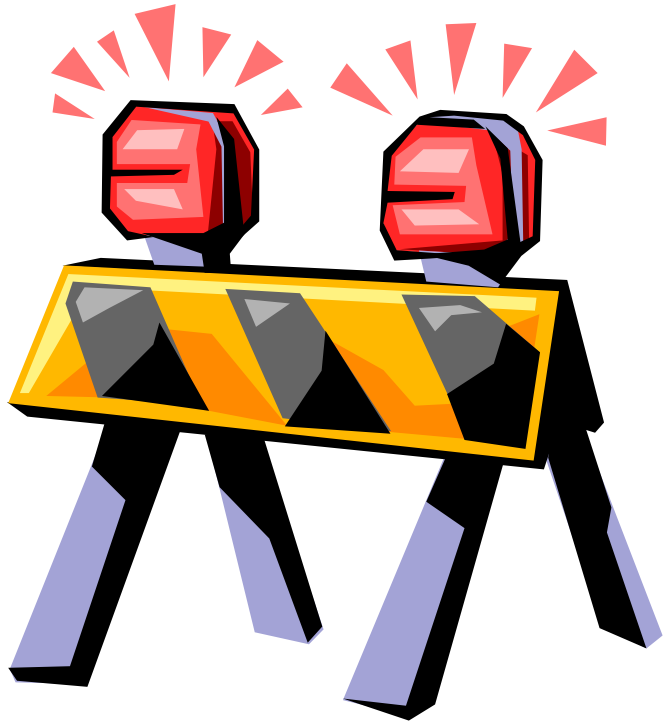
The Value of Top Down Integration

- Permits existing infrastructure to be re-used
- Eliminates redundant effort and last minute retrofits
- Prevents forklift upgrades
- Vital system-wide capabilities, like security, comes standard
- Prepares the system for unforeseen change:
  - New technology
  - New applications
  - New organizational change

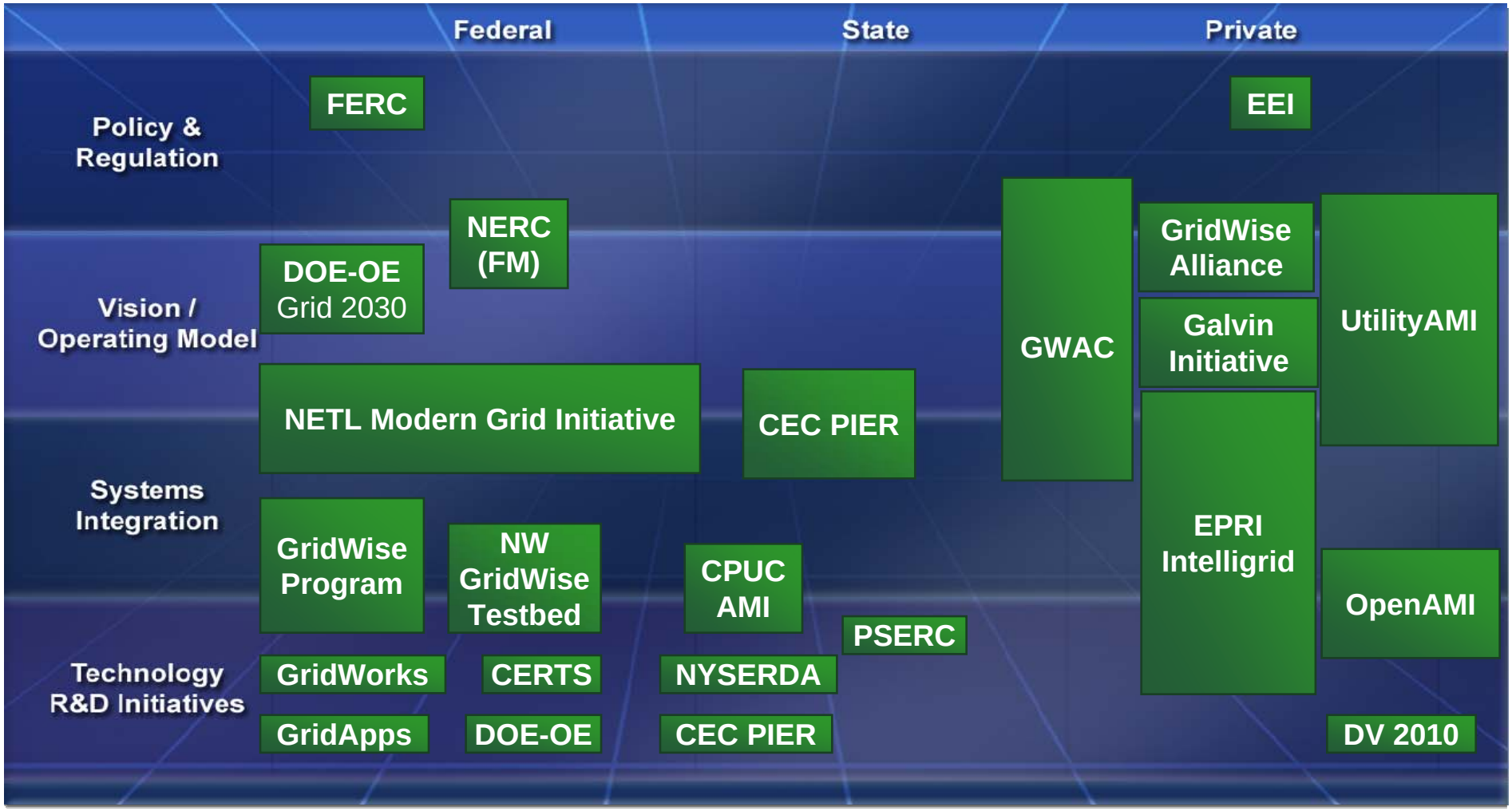


Barriers to Planned System Integration

- ***Organizational***
  - Corporate culture
  - Existing policies
  - Departmental “Silos”
  - Lack of human resources
- ***Knowledge***
  - Missing applications
  - Missing algorithms
  - Lack of training
- ***Systems***
  - Lack of standards
  - Too many “standards” to choose from
  - Missing products and services
  - Not applying formal methodology



Developers of the Modern Grid



Recent Success Stories

- EPRI IntelliGrid Architecture
  - Methods and technologies for implementing interoperable systems
- DOE GridWise Architecture Council Constitution
  - A fundamental framework for interoperability
- California Energy Commission reference design for demand responsive infrastructure
- OpenAMI and UtilityAMI
- Southern California Edison – a 1.5 Billion dollar application of all of the above and lessons learned
- DOE Modern Grid Initiative
  - A multi-perspective based approach to modern grid development
  - The simulation, evaluation and application of fieldable technologies to demonstrate the ability to build the modern grid

Summary

- Today's electric grid is more advanced and more intelligent than most of us realize
- That capability is generally utilized locally rather than optimized globally
- System integration without architecture will eventually fail because of scalability, manageability, or security issues
- There is a clear life cycle cost benefit to architecting a system rather than haphazardly gluing something together
- There are numerous non-technical barriers to "doing it the right way"

Summary

- Many organizations and companies are successfully applying a systems engineering architecture approach – OpenAMI, UtilityAMI, Southern California Edison, Alliant Energy, Salt River Project, TVA, Polish Power Grid, and many more
- By applying advanced communication, information, and computational technologies we can make the grid even more intelligent, efficient, and reliable
- Programs such as the Modern Grid Initiative, EPRI IntelliGrid, and GridWise are leading the industry in all of these areas through fundamental research as well as practical application
- It will take the efforts of multiple organizations representing a wide variety of disciplines and interests to realize this goal

Who are the true developers of an advanced, more intelligent grid?

You Are!