

Energy Infrastructure Security: Advanced multidimensional threats and responses

By
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Outline

Energy Infrastructure Security: Advanced multidimensional threats and responses

A Multi Dimensional View of Energy Security Domains is required, including optimization of the:

- – Physical Domain and Function
- – Control Domain and Function
- – Performance Domain and Function

- Development of Software and Hardware architectures that support the 3D Functional view is imperative for the evolving threat environment of today and tomorrow for any energy system.

- Understanding of interdependencies and interactions between the domains and functions and how those interdependencies are acted on by internal and external threats.

- Planning for capability vs. system vs. function specific performance and understanding how security interacts with a capability view: Top down and bottom up are both required for success.

- Smart Grid and Micro-Grid compromise: understanding the operational decisions needed to prevent, mitigate and recover

- Policy, Linking policy to technology is an important part of the solution... plus finance and innovation is a six dimensional approach to the problem.



Apollo 11

By John Cogliandro, Senior Program Manger, Raytheon IDS

Be Happy? No, the data says otherwise.

- Northeast Blackout of 2003:
 - affected 50 million people in eight states and Canada,
 - took days to restore, and caused a financial loss in the United States estimated to be between \$4 billion and \$10 billion.
 - People lost water supplies, transportation systems, and communications systems (including Internet and cell phones). Factories shut down, and looting occurred
- 3,050 of the Gulf's 4,000 platforms and 22,000 of the 33,000 miles of Gulf pipelines were in the direct path of either Katrina or Rita
 - As of May 3, 2006, shut-in natural gas production in the Gulf of Mexico from Hurricanes Katrina and Rita was equivalent to 12.95 percent of current daily gas production.
- Total damage to pipelines caused by 2008's Hurricane Ike was estimated between \$80 million and \$120 million
 - Pipelines can average 100,000 barrels per day: about \$289,000 per hour! (@\$69.50 /bbl)

Man Made Disasters even more frequent

- In Colombia rebels have bombed the Caño Limón oil pipeline over 600 times since 1995.
- Nigerian militants have repeatedly attacked pipelines and related facilities, including the simultaneous bombing of three oil pipelines in May, 2007.
- Roughly 170,000 miles of oil pipeline in the United States carry over 75% of the nation's crude oil and around 60% of its refined petroleum products.
 - In the US, There are nearly 200 interstate oil pipelines
 - The U.S. natural gas pipeline network consists of around 210,000 miles of interstate transmission, 85,000 miles of intrastate transmission, and 40,000 miles of field and gathering pipeline, Around 100 systems make up the interstate network.

Energy/Environment is the “new age” of defense...defense of nations / society / business is now linked to environmental (food, water, climate) and energy (supply) issues

A Complex System!

US has:

3000 Electric utilities

2000 independent producers feeding

120 M Residential +

16 M commercial +

.7M industrial =

700,000 miles of high tension lines owned by

over 200 different entities...which becomes

5,000,000 miles of medium voltage transmission fed into

22,000 sub stations owned by over

3000 entities: a complex “system” for sure

The North American electric power industry will purchase more than \$20 billion in grid infrastructure equipment in 2005, nearly one quarter of the worldwide total of \$81 billion. (From “Making the Grid Smart” by Joel Makower Oct. 05)

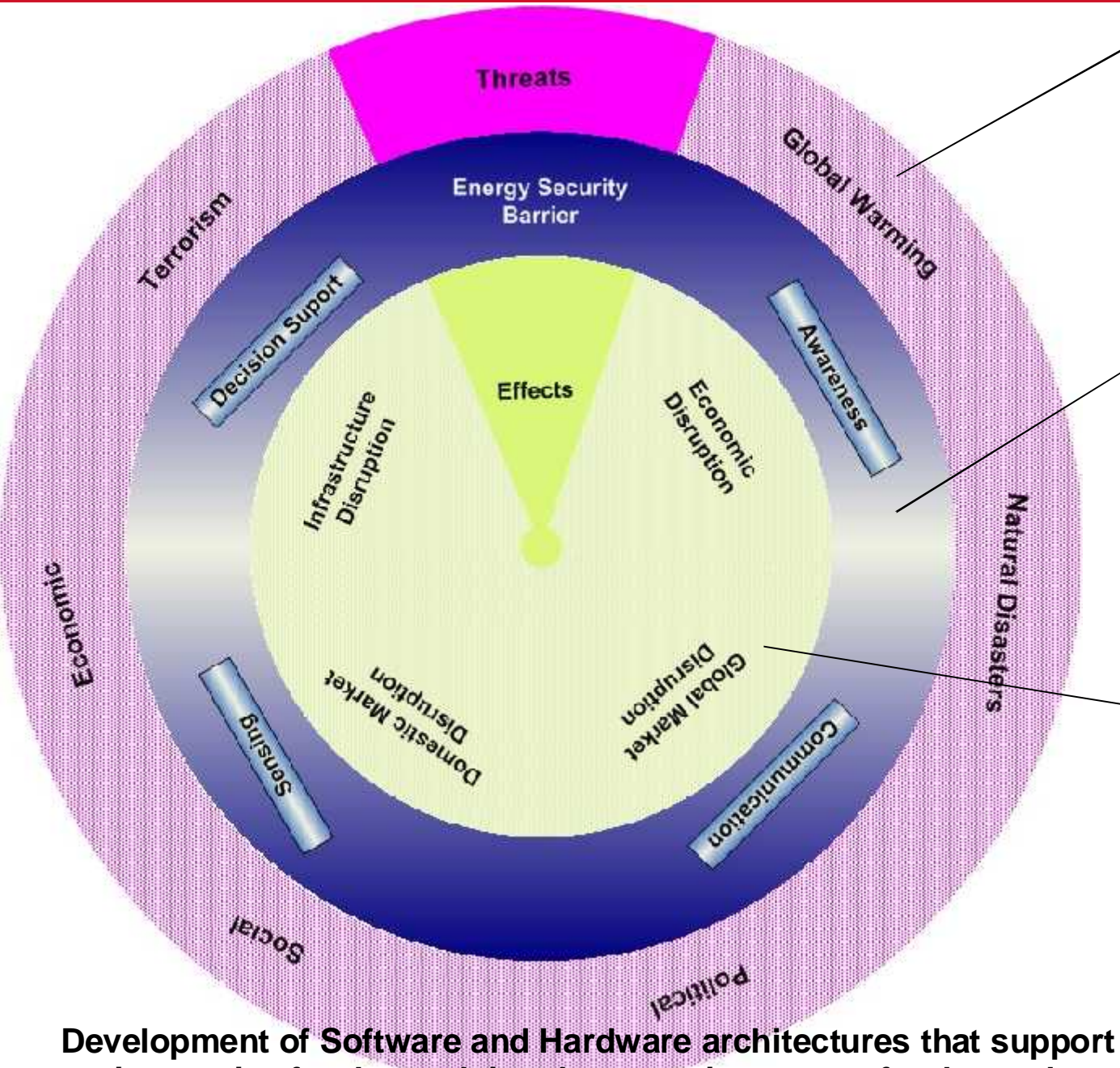
Terrorists Strike U.S. Infrastructure

By Mike Licht



17 Major Power Outages in US alone past 6 months!

High Level Architecture



Threat / Physical Domain:
Effect on: transformers, pipelines, electrical sub stations, etc.

Control Domain:
Ability to:
Re-Rout
Alter levels
Repair, etc.

Performance Domain:
Reduce Damage / costs
Increase Uptime
Mitigate Spills, Etc.

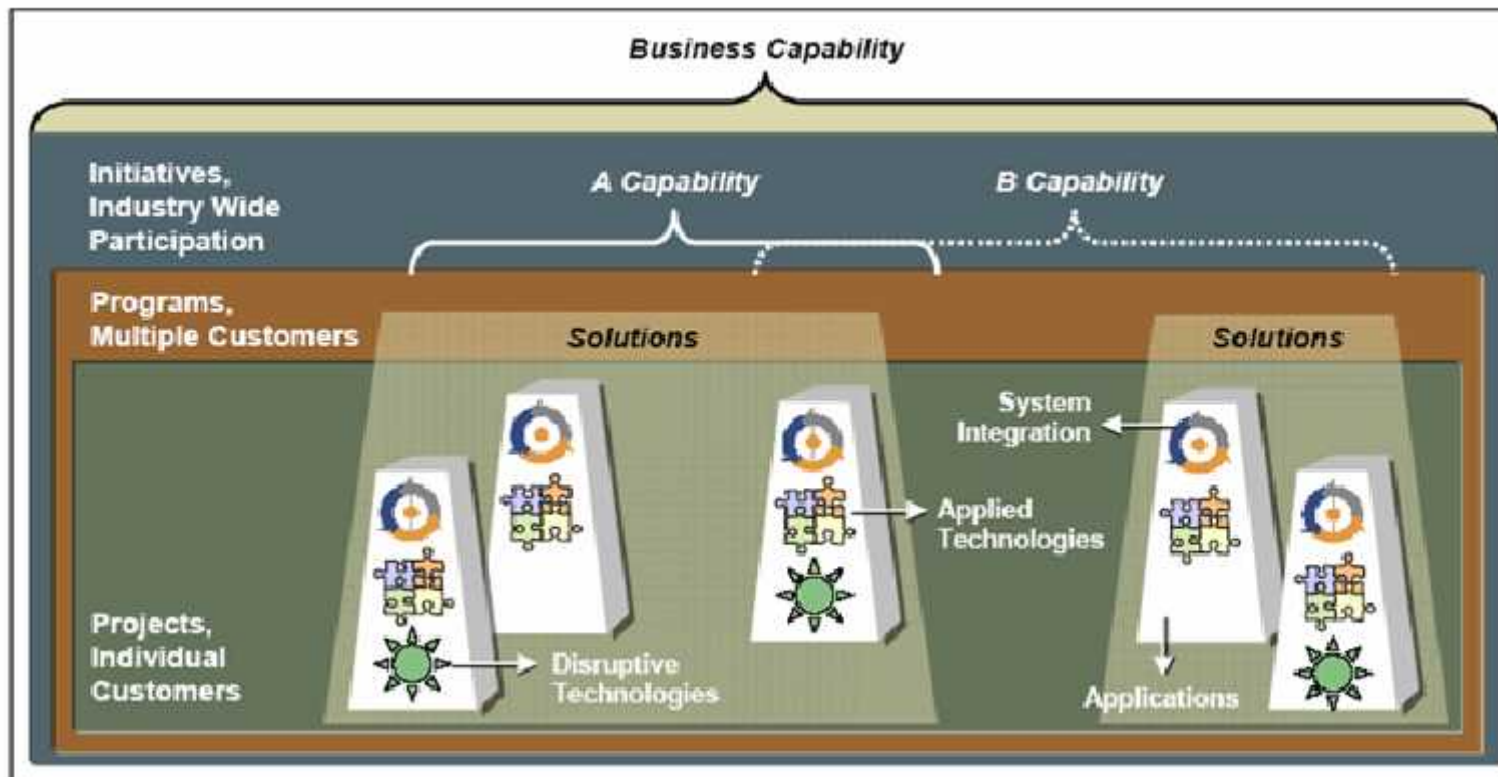
Development of Software and Hardware architectures that support the multi-dimensional view is imperative for the evolving threat environment of today and tomorrow for any energy system

A Requirements view of Architecture

- If the current architecture is multi-dimensional, each pane being the same view, focused on:
 - » Physical (protecting)
 - » Control (Increasing)
 - » Performance (the goal)
- Then, what about adding two more dimensions (requirements, opportunities, supply = motivation)
 - » Finance
 - » Policy
- Then what about adding in a big word like “Innovation”
 - » Incremental to match up with existing infrastructures: directional, bring new innovations into an established path
 - » Disruptive to keep ahead of threats and increase performance; Intersectional, bringing ideas in from a different domain

Technology Is A Building Block, Not a Solution

- It is the integration of *technologies* into **systems** & *capabilities* that make them valuable
- The integration of *multiple capabilities* make up a *solutions* which can be disruptive
- A capability must be created with the architecture and project goals in mind



- Capabilities are applicable to multiple problems and customers
- Systems are applicable to multiple problems
- Applied technologies are building blocks for Sub-systems and systems
- Disruptive technologies are building blocks for future applied technologies

Gets us back to architecture

- OODA Loop based thinking
 - Observe
 - Orient
 - Decide
 - Act
- Intelligent advice to system user based on optimization of physical / control / performance parameters
- The key to optimization in a crisis of any type is not to rely on the technology, the “thingy” (any currently hot individual technology) or even the system: the key is to act intelligently at that point in time.
- Architecture is bigger than technology, it includes the multiple perspectives and yields action

Conclusion

- Must take this seriously and leverage our ability to architect solutions to the problem
- Actionable architecture and technology are needed to survive
 - Evolve your solution based on what you can do now, and what you would like to do tomorrow = solution / technology road map
 - Also includes definitive actions: the plan for insertions
- Policy and finance are part of the mix – AND should match the architecture
- Threats are multi-dimensional (weather, natural disasters, terrorism, denial of service (nuisance terrorism), ...
- AND...SQUIRRELS!!!

Don't develop a system for a local problem when it needs a global solution