



IPERC[®]

Microgrids for Resiliency

Brad Luyster

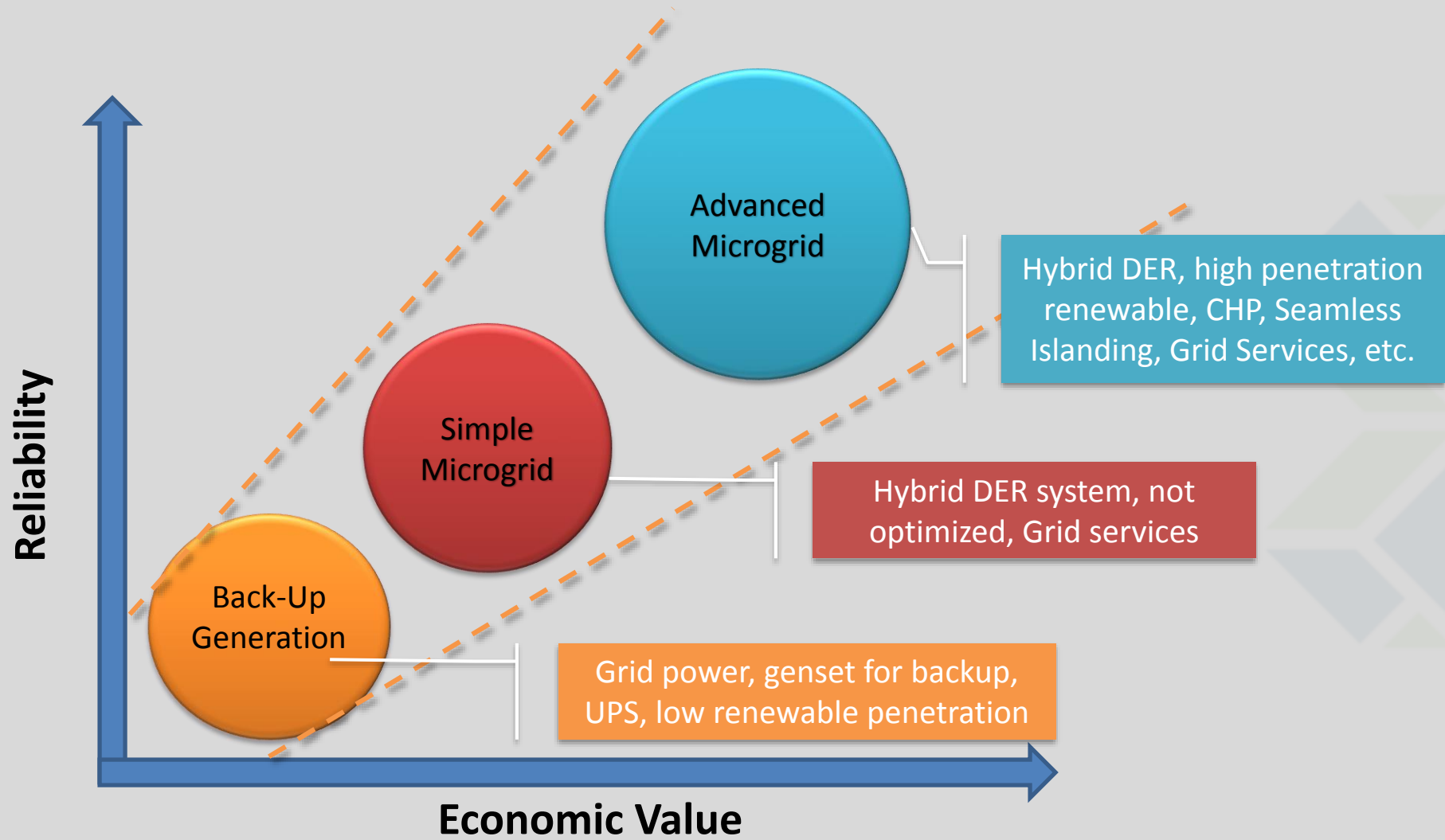
► **Director of Business Development**

ADVANCING *THE POWER OF ENERGY*

Microgrid Critical Success Factors



Microgrid Value Improved by Resiliency

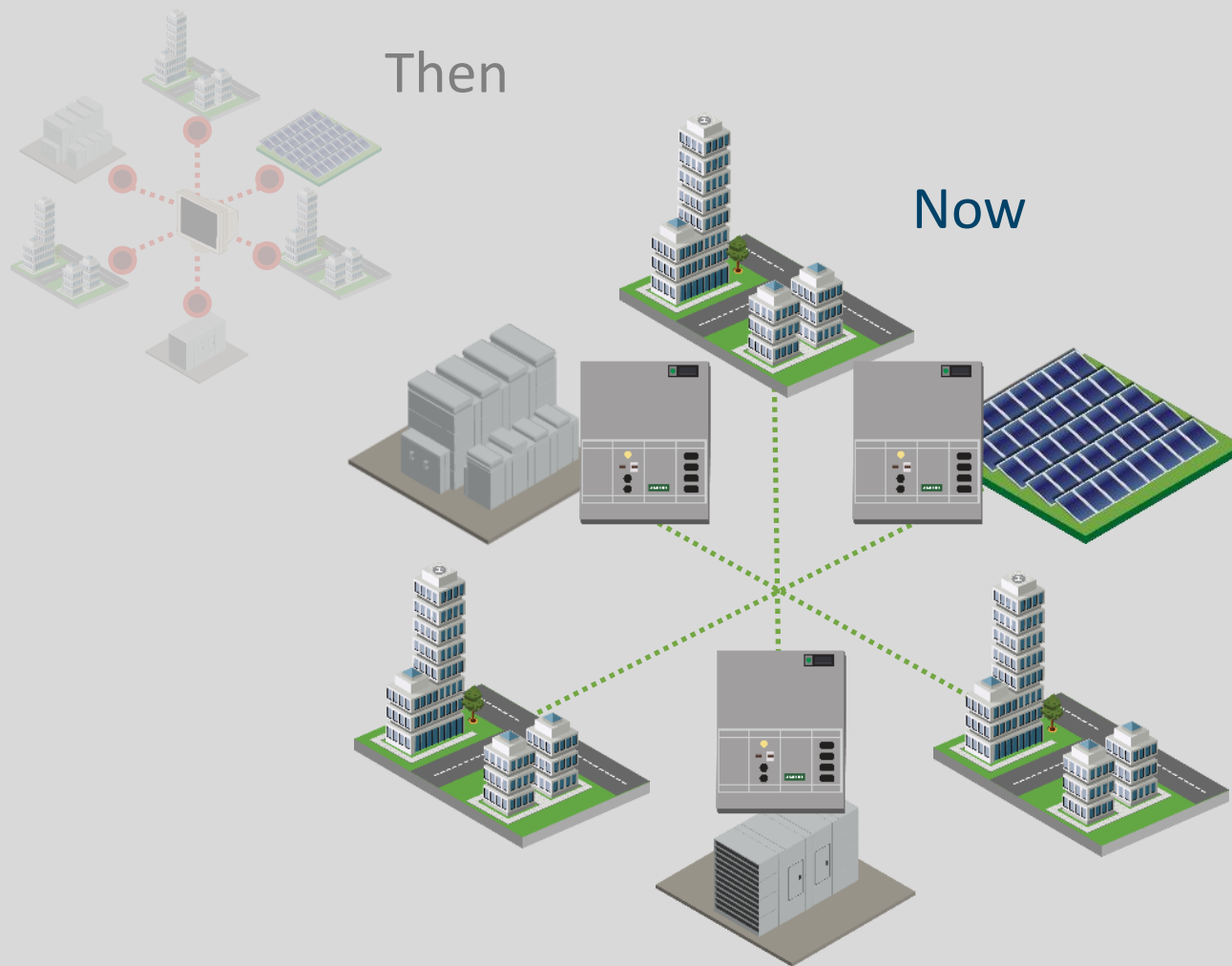




Standard Available Microgrid Operations

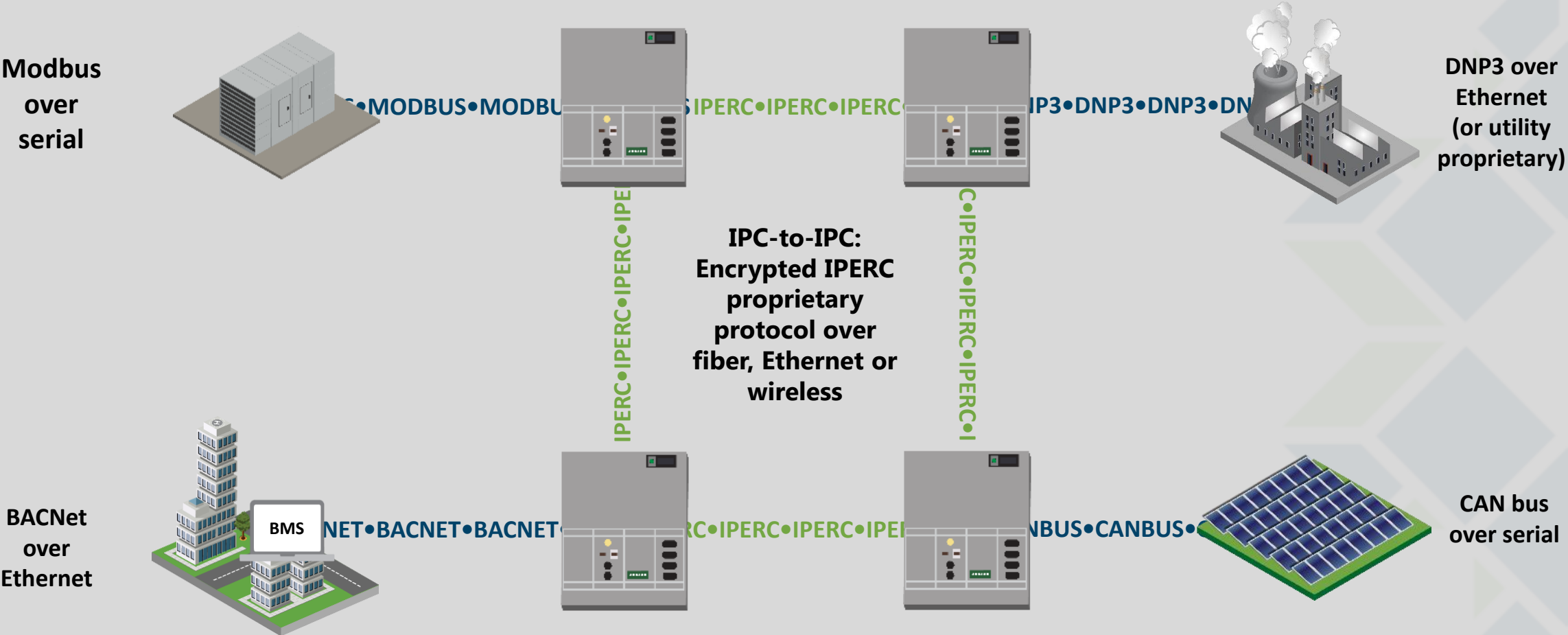
- Grid-Tied
- Island
- Transitions
 - Black start
 - Intentional Island
 - Island to Grid-Tied
- DER Optimization
- Storm Preparedness
- Islanding with renewables (Green Mode)
- Peak shaving
- Curtailment
- Renewable smoothing
- Frequency Regulation
- DER Monitoring and Control
- Power Factor Correction

Distributed Control Maximizes Resiliency



- ✓ Reflects current internet mentality
 - ✓ Distributed Intelligence
- ✓ Distributed CPUs create resilience
- ✓ Consistent platform facilitates updates
- ✓ Original code written for cybersecurity
- ✓ Inherently scalable

Supports All Common Communication Protocols and Media



Defense-in-Depth is Essential Against Constantly Evolving Threats

PHYSICAL

- Controlled Access
- Environmental Protections
- Locked Enclosures

COMPONENT

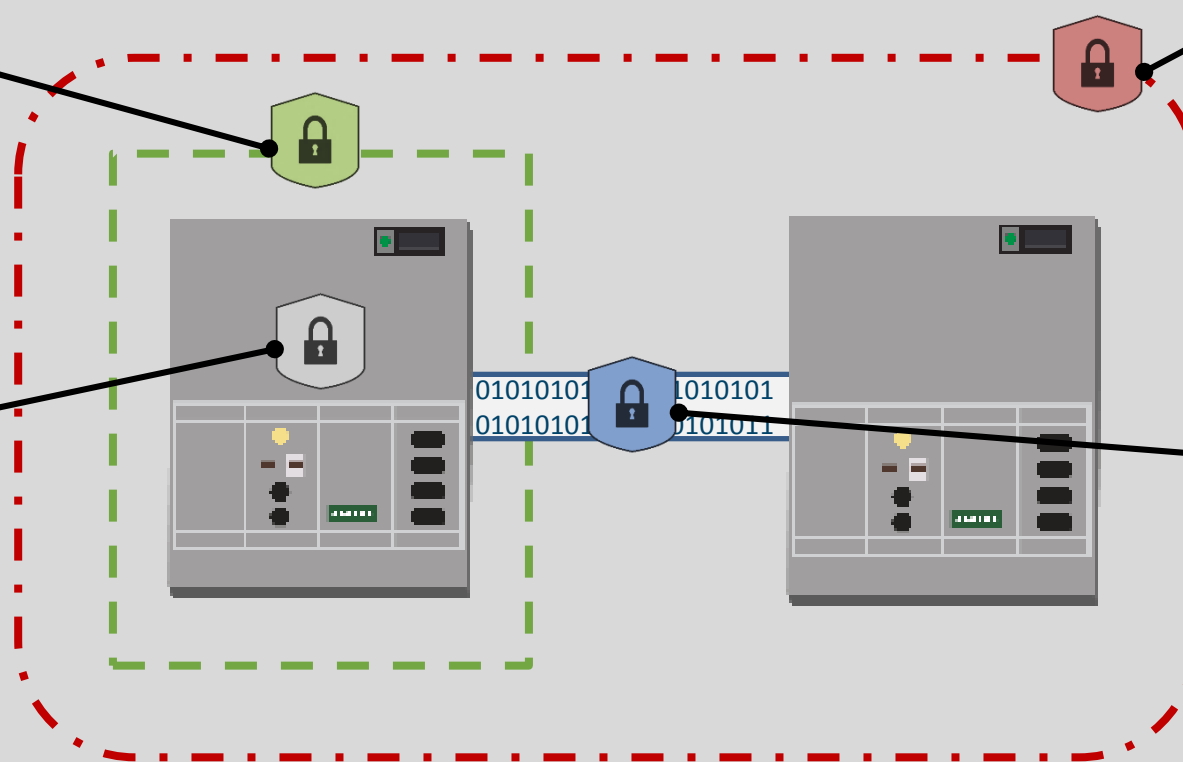
- Operating System Hardening
- Firmware Updating
- Encrypted Data
- Host Intrusion Detection
- Auditing

SYSTEM PERIMETER

- Firewalls
- Intrusion Detection
- Hardened switches
- Secure remote monitoring

COMMUNICATION

- Internet Protocol Version 6
- Encryption
- Peer-to-peer authentication
- Whitelisting
- Enclaving



The control system must function with attackers inside

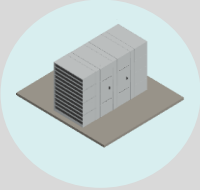
DoD Leads Resilient Microgrid Development

Joint Base Pearl Harbor-Hickam, HI

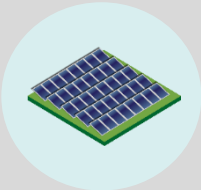
SPIDERS I - Wastewater treatment plant – Completed 2013

2.5

Megawatts



Generators
2.4MW



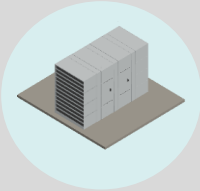
Solar
150 kW

Fort Carson, CO

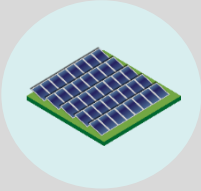
SPIDERS II – 4th ID HQ and data center – Completed 2015

4.3

Megawatts



Generators
3.15 MW



Solar
1.0 MW



Electric Vehicle
200 kW



ATO
RMF

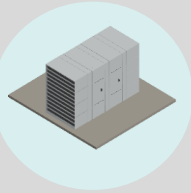
DoD Leads Resilient Microgrid Development

Camp Smith, HI

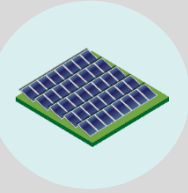
SPIDERS III - Entire PACOM HQ base – Completed 2015

5.8

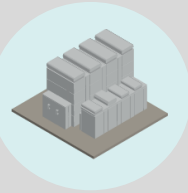
Megawatts



Generators
5 MW



Solar
300 kW



Storage
500 kW



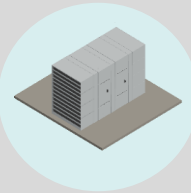
ATO
DIACAP

Fort Belvoir, VA

ESTCP – Scheduled Completion 2018

2.5

Megawatts



Generators
900 kW



Generators
1.6 MW



ATO
RMF

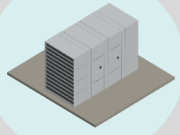
Commercial & Utility Facilities Seek Resilience

Ameren Technical Application Center, IL

Utility prototype with 15 use cases – Completed 2017

1.5

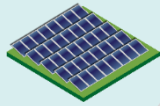
Megawatts



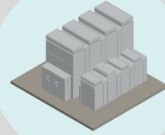
Generators
1.0 MW



Wind
100 kW



Solar
150 kW



Storage
250 kW



Electric Vehicle
Load Only

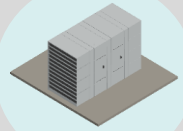


Agricultural Production Facility, HI

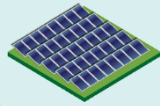
Off-grid industrial facility – Scheduled completion 2018

2.0

Megawatts



Generators
500 kW



Solar
1.0 MW



Storage
500 kW

