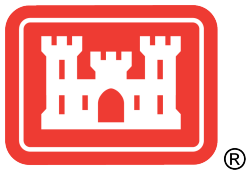
Tactical Microgrid Standard (TMS)

Introduction for the National Academies

https://www.nationalacademies.org/our-work/powering-the-us-army-of-the-future

Daniel Herring

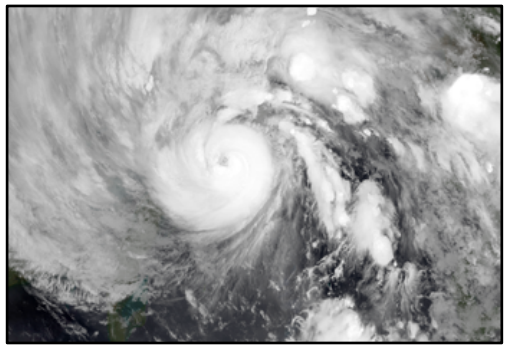
September 2020



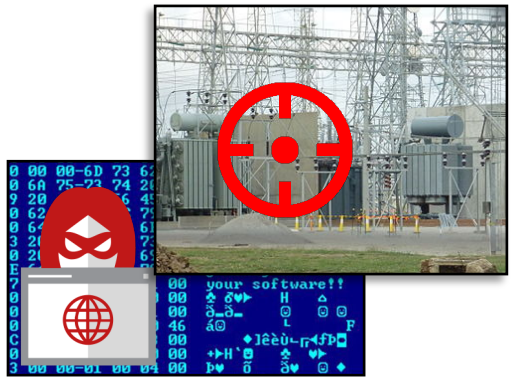
This material is based upon work supported by the Department of the Army under Air Force Contract No. FA8702-15-D-0001. Any opinions, findings, conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the Department of the Army.

The Need for New Power System Architectures

Disasters



Attacks



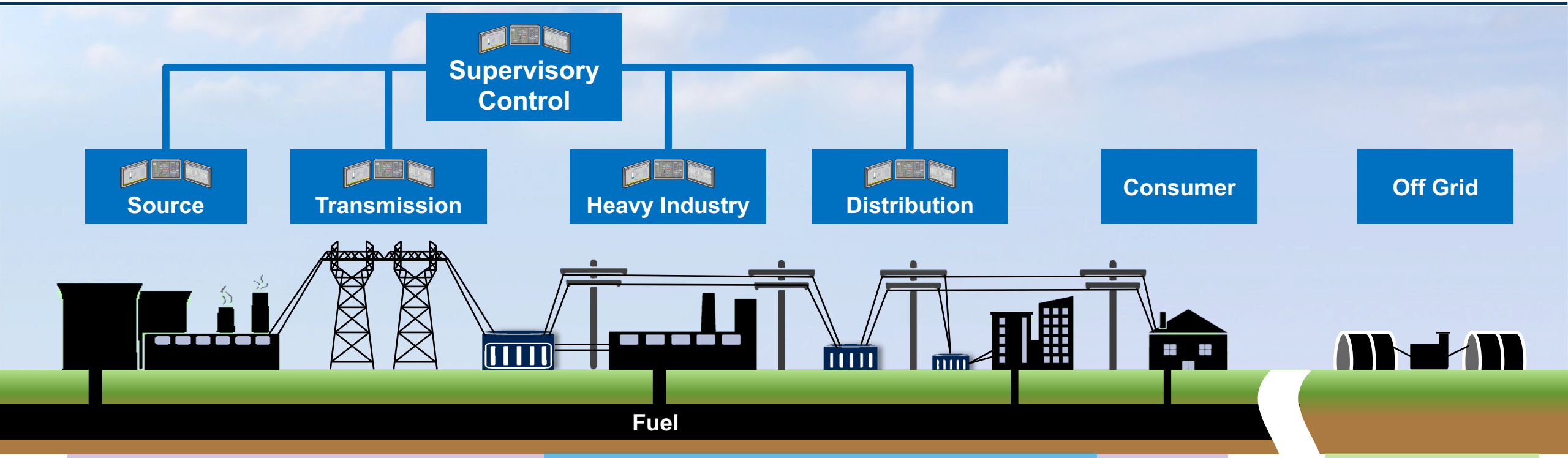
Simple
Efficient
Resilient
Modular
Scalable
Extensible

Open Architecture

New Technologies

Better Integration

Canonical Power System Architecture and Example Power Missions



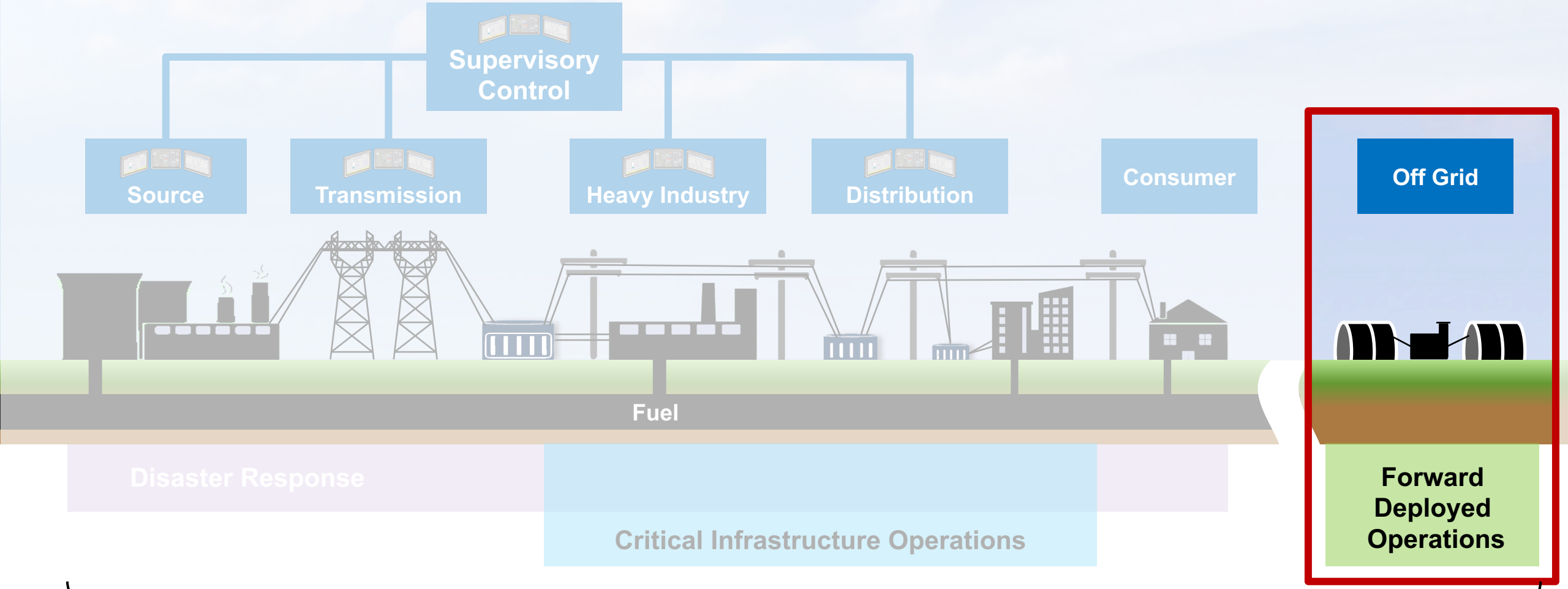
Disaster Response

Critical Infrastructure Operations

Forward Deployed Operations

Example Missions

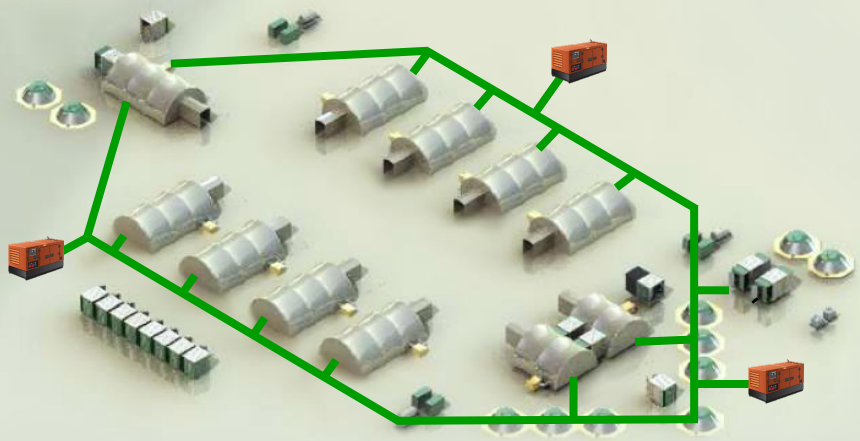
Canonical Power System Architecture and Example Power Missions



Example Missions

Microgrids Power DoD Forward Deployed Operations

Example Forward Operating Base



Source
Distribution
Load

- Self-sufficient power
- Warfighter owned and operated
- Thousands of sites
- Each site unique

Supporting Missions

Communications

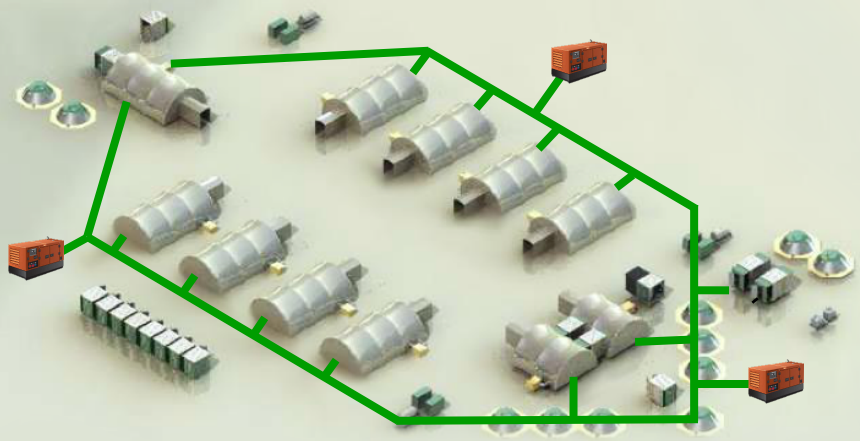
Sensors

Weapons

Climate Control

Microgrids Power DoD Forward Deployed Operations

Example Forward Operating Base



Source
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Supporting Missions

Communications

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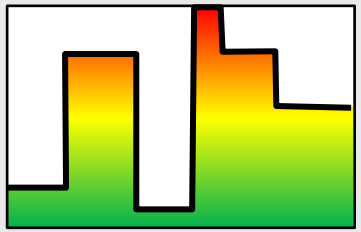
Climate Control

Operational Challenges

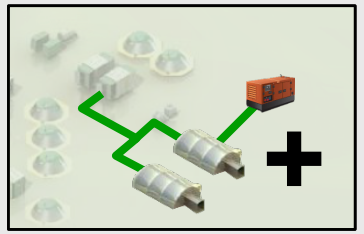
Rapid Deployment

Operator Training



Dynamic Loads

Equipment Failures

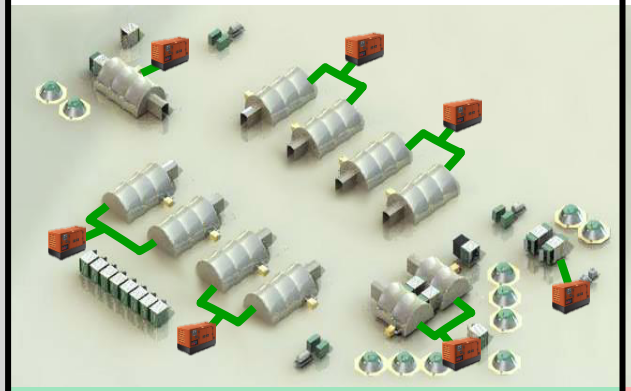
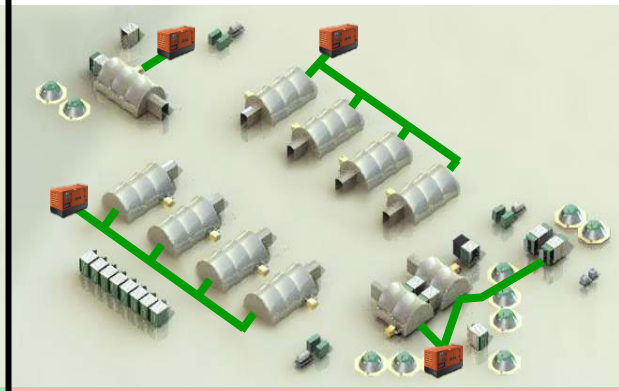
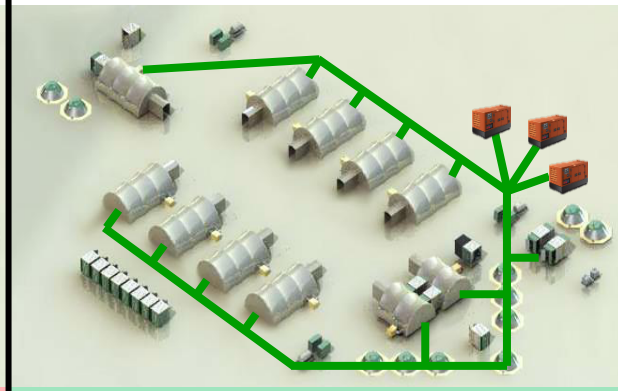
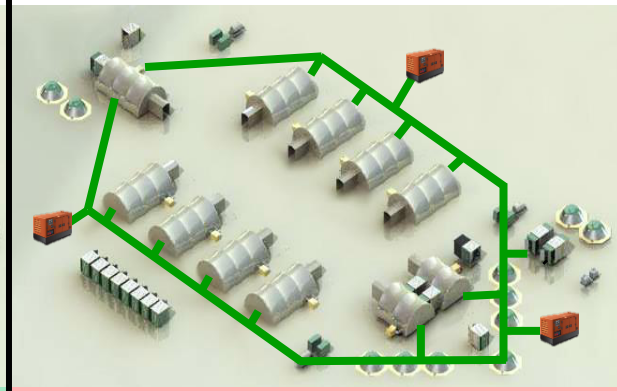


Organic Growth

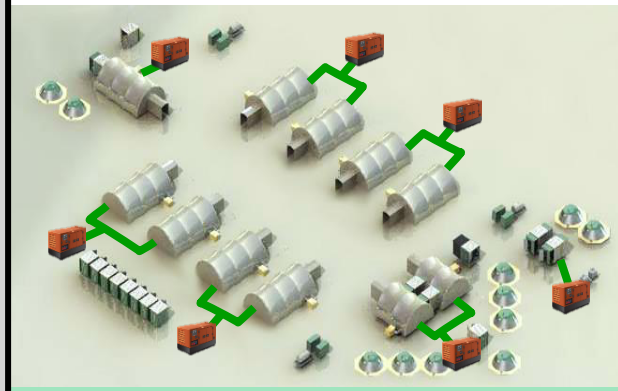
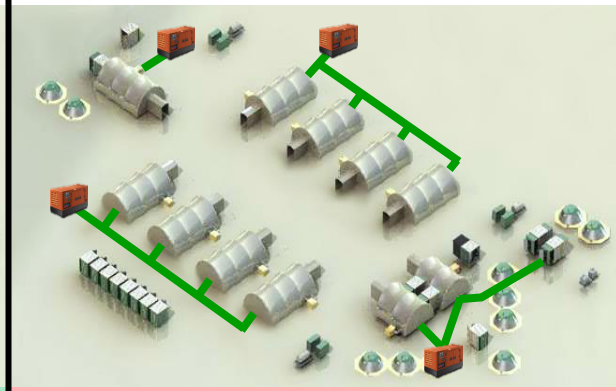
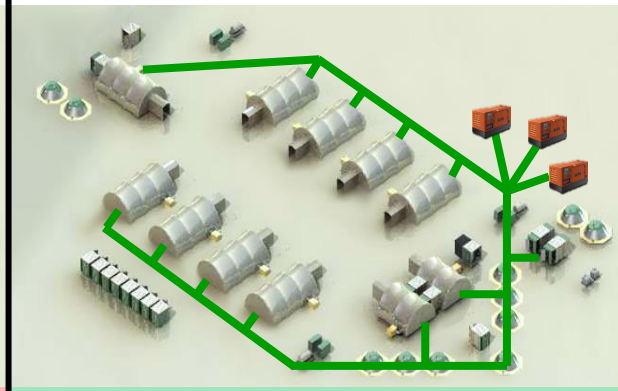
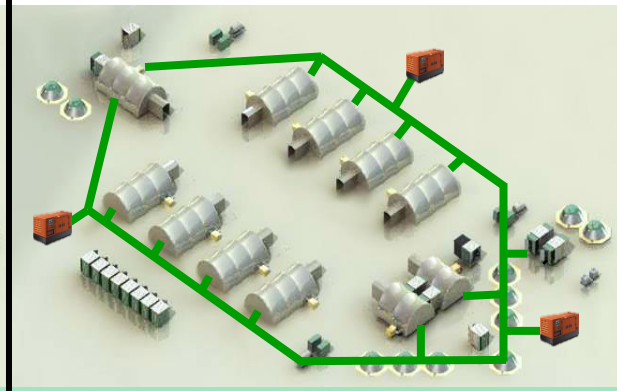
Insert New Tech

Tactical Microgrid Architecture Options

Before TMS

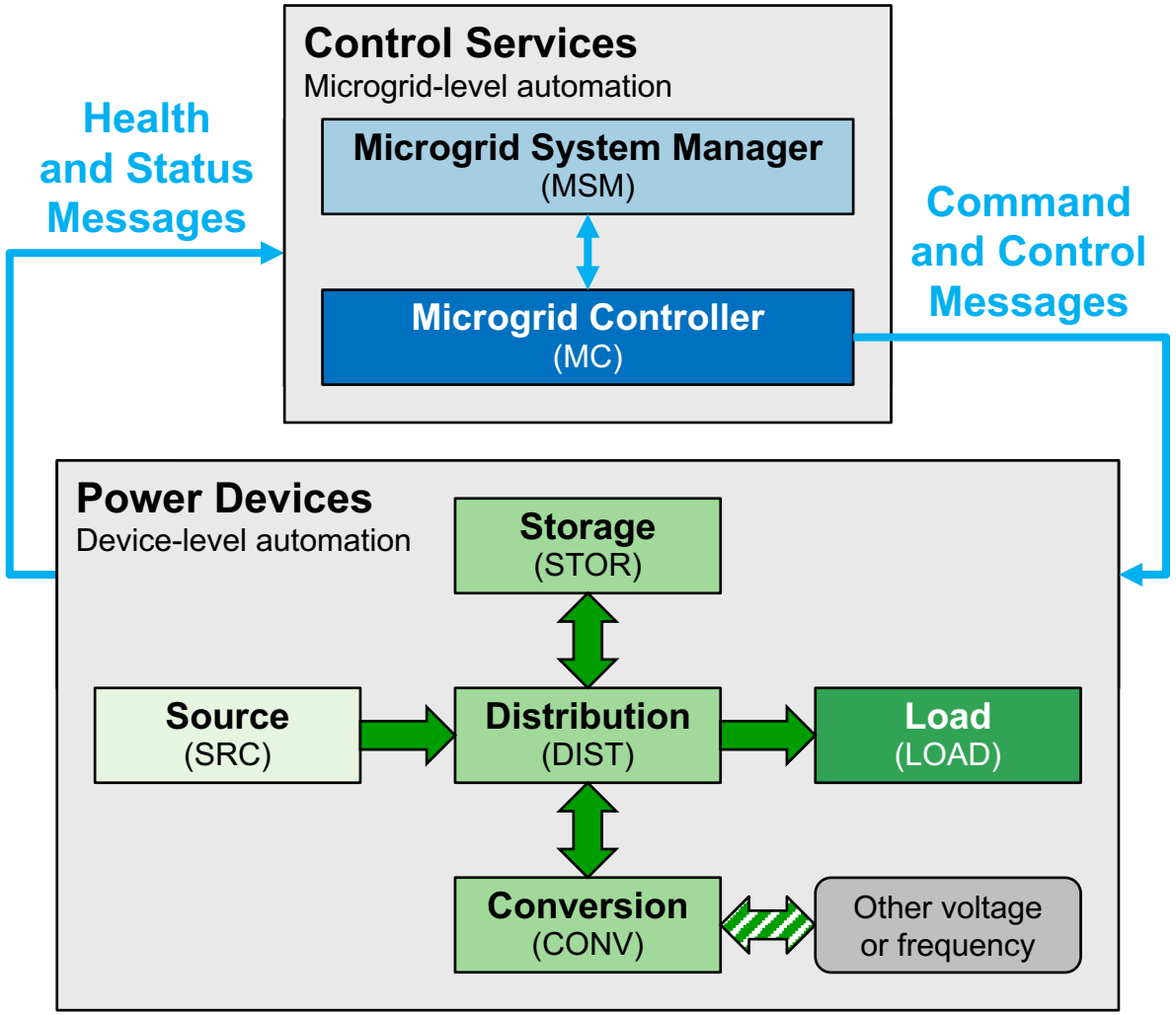
Spot Generation	Consolidated Generation	Central Microgrid	Distributed Microgrid
			
• Simple setup	• Complex setup	• Simple setup	❑ Very complex setup
• Inefficient	• Efficient	• Efficient	• Efficient
• Fragile generation	• Fragile generation	• Backup generation	❑ Spread out generation
• Minimal distribution	• Fragile distribution	• Fragile distribution	• Resilient distribution
• Extensible, modular	• Extensible, modular	❑ Proprietary vendor lock	❑ Proprietary vendor lock
Typical DoD Approach	**Limited Use**	**Initial Deployment**	**Prototyping Today**

Tactical Microgrid Architecture Options
With TMS

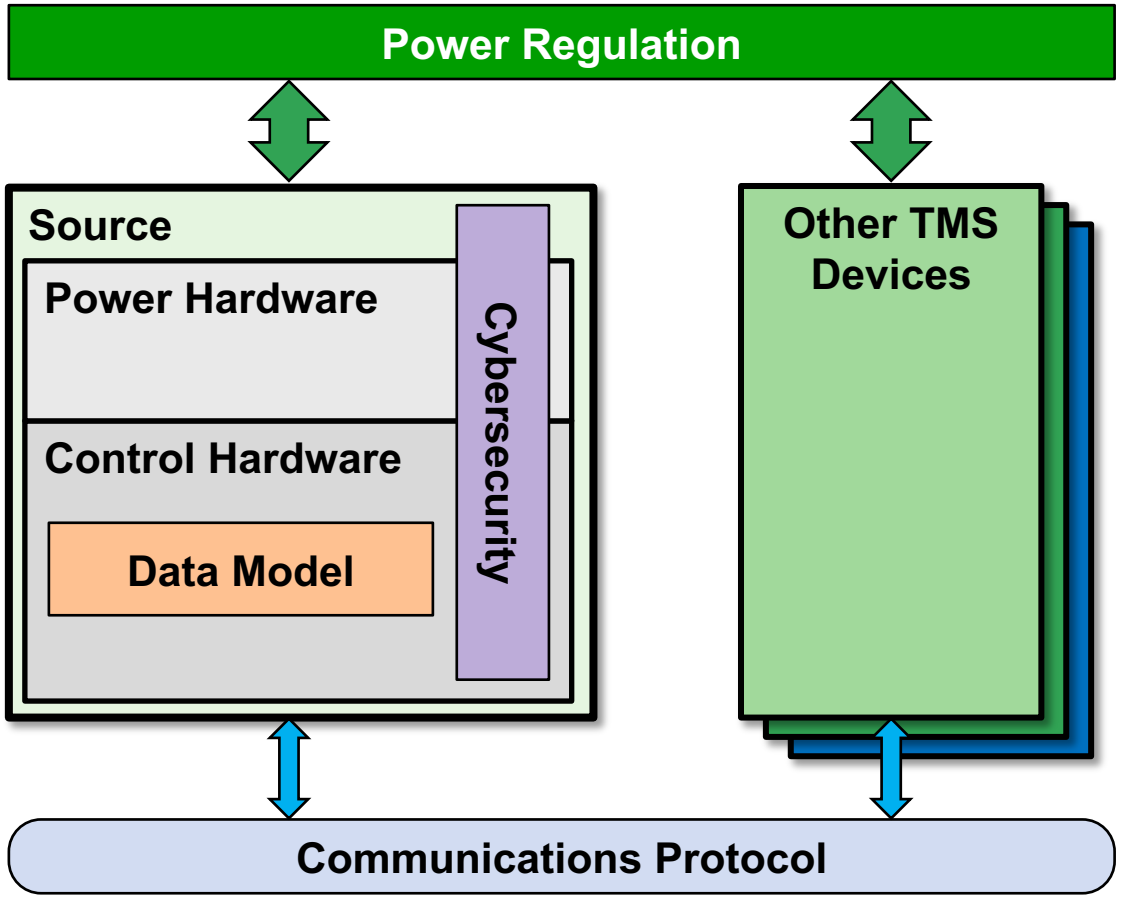
Spot Generation	Consolidated Generation	Central Microgrid	Distributed Microgrid
			
• Simple setup	• Complex setup	• Simple setup	✓ Simple Setup
• Inefficient	• Efficient	• Efficient	• Efficient
• Fragile generation	• Fragile generation	• Backup generation	✓ Resilient generation
• Minimal distribution	• Fragile distribution	• Fragile distribution	• Resilient distribution
• Extensible, modular	• Extensible, modular	✓ Open Architecture	✓ Open Architecture
Typical DoD Approach	**Limited Use**	**Initial Deployment**	**Prototyping Today**

Tactical Microgrid Standard (TMS) Open Architecture Defines

Components



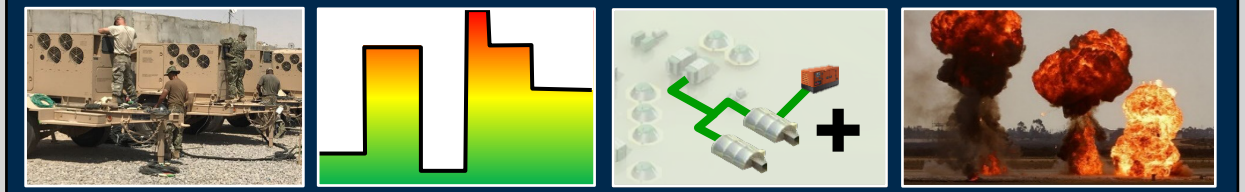
Interfaces



Tactical Microgrid Standard (TMS) in Operation

DoD & Commercial Equipment … Upgraded with TMS

Input Test Disturbances



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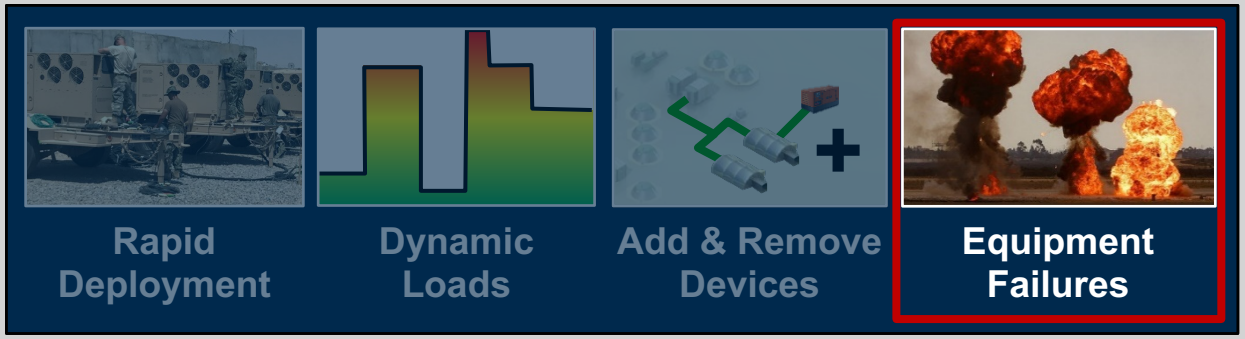
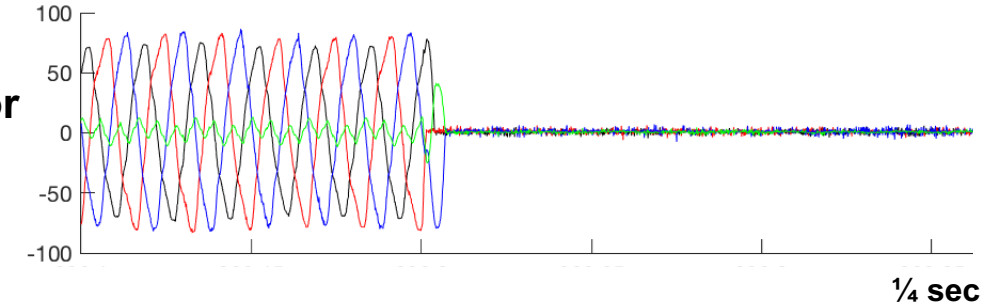


Generator Current



(3-phase, 120/208 V, 60 Hz AC)

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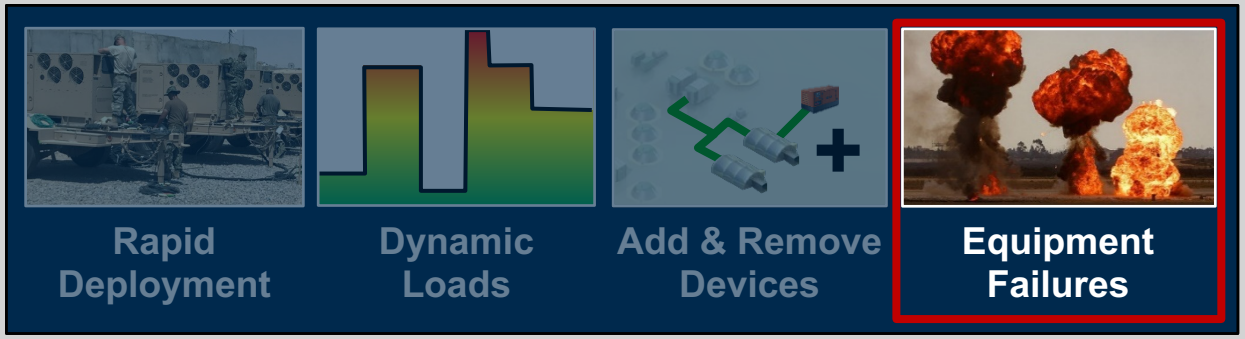
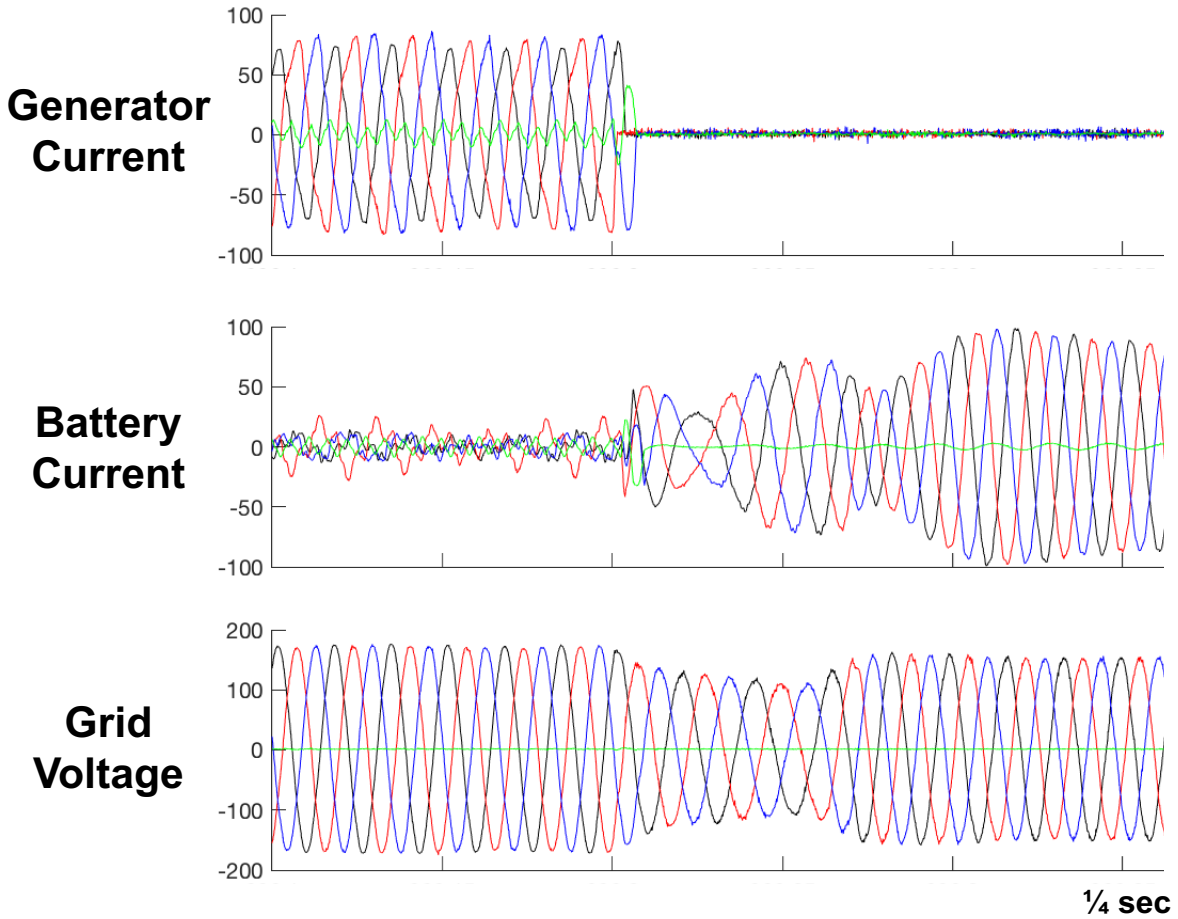


Example: Resilient Power Sharing



(3-phase, 120/208 V, 60 Hz AC)

Why Data Distribution Service? (OMG DDS)

- OMG DDS is a communications middleware ➔ modular software re-use.
- Strong Technology
  - Fully distributed publish/subscribe (pub/sub)
  - Machine-readable Interface Definition Language (IDL)
  - Rich Quality of Service (QoS)
  - Portable API
  - Interoperable wire protocol
  - Security architecture
- Healthy Ecosystem
  - Open standard
  - Stable governance
  - Multiple independent commercial implementations
  - Continuous innovation
  - Used across multiple industries

TMS Software Integration