DOE Microgrid Planning Meeting

Microgrid Standards and Protocols

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Current Status

IEEE 1547 Series Standards

1547-2003 Standard for Interconnecting Distributed Resources with Electric Power Systems
Reaffirmed in 2008

1547.1-2005 Conformance Test Procedures for Equipment Interconnecting DR with EPS

1547.2-2008 Application Guide for IEEE 1547 Standard for Interconnecting DR with EPS

1547.3- 2007 Guide for Monitoring, Information Exchange and Control of DR

1547.4 - 2011 Guide for Design, Operation, and Integration of DR Island Systems with EPS – Approved – July 2011

Current Projects

P1547.5 Guidelines for Interconnection of Electric Power Sources Greater Than 10 MVA to the Power Transmission Grid

P1547.6 Recommended Practice for Interconnecting DR With EPS Distribution Secondary Networks

P1547.7 Draft Guide to Conducting Distribution Impact Studies for Distributed Resource Interconnection

P1547.8 Draft Recommended Practice for Establishing Methods and Procedures that Provide Supplemental Support for Implementation Strategies for Expanded Use of IEEE Standard 1547

Microgrids

http://grouper.ieee.org/groups/scc21/index.html

IEEE 1547.4 Information

Due to some of the confusion surrounding the definition of microgrid in 2005 (and continues today), IEEE 1547.4 developed the term **Distributed Resource Island System.**

The term "DR island systems", sometimes referred to as microgrids, is used for electric power systems that:

1. have DR and load
2. have the ability to disconnect from and parallel with the area EPS
3. include the local EPS and may include portions of the area EPS, and
4. are intentionally planned.

DR island systems can be either local EPS islands or area EPS islands.

Clause 4 – DR Island System Overview

General considerations:

Power Flow

Voltage, Frequency

Single PCCs or Multiple PCCs (need coordination)

Fault Protection

Load Requirements

Reserve Margins

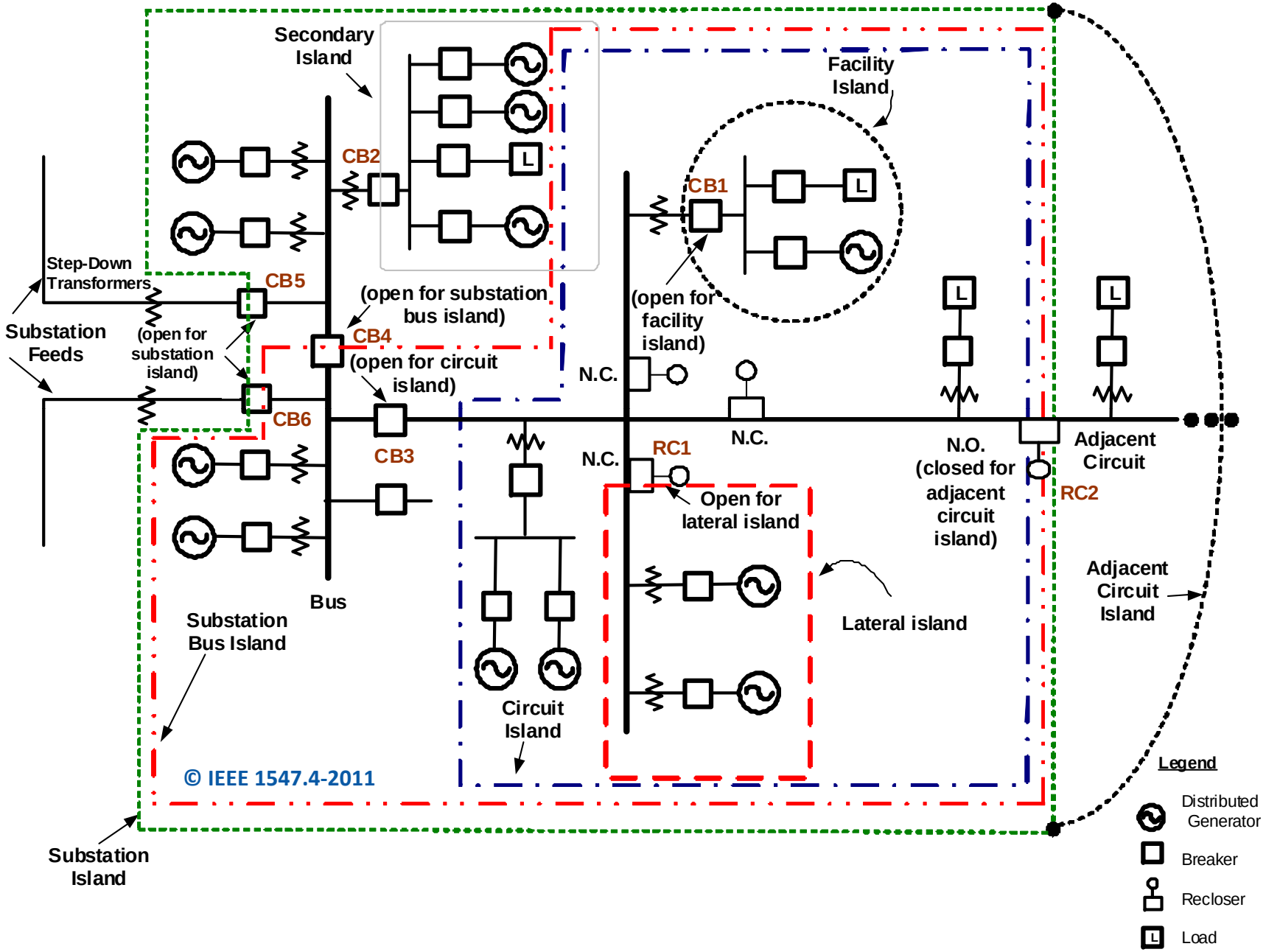
Adequate DR

Power Quality

Transients

Microgrids need to consider all these.

Grid-Tie only systems may not need to worry about all of them.


Secondary Island
Facility Island
CB2
CB1
L
Step-Down Transformers
CB5
(open for substation bus island)
Substation Feeds
(open for substation island)
CB4
(open for circuit island)
(open for facility island)
N.C.
CB6
CB3
N.C.
RC1
N.C.
N.O. (closed for adjacent circuit island)
Adjacent Circuit
RC2
Open for lateral island
Bus
Substation Bus Island
Lateral island
Adjacent Circuit Island
Circuit Island
© IEEE 1547.4-2011
Substation Island
Legend
Distributed Generator
Breaker
Recloser
Load

Clause 4 – DR Island System Overview

Microgrid Operational Modes

- **Area EPS-connected mode (normal parallel operation)**
  - DR operate in IEEE 1547 mode
- **Transition-to-island mode**
  - Recognize that island condition has occurred
- **Island mode**
  - Operate disconnected from main grid
- **Reconnection mode**
  - Only reconnect within correct voltage, frequency, and phase angle windows specified in IEEE 1547.
  - passive, active, or open transitions are acceptable

Clause 5 – Planning and Engineering

5.1 Load requirements and planning




5.2 EPS requirements and planning

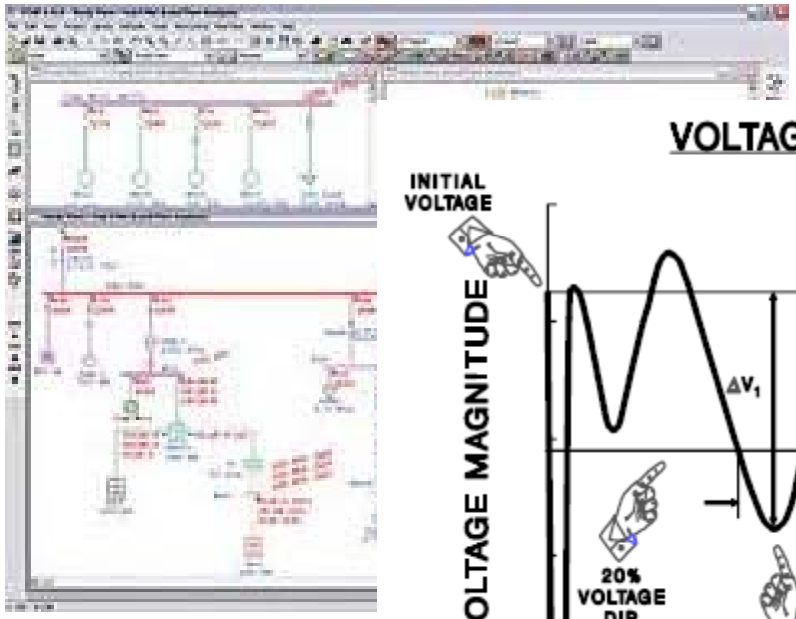


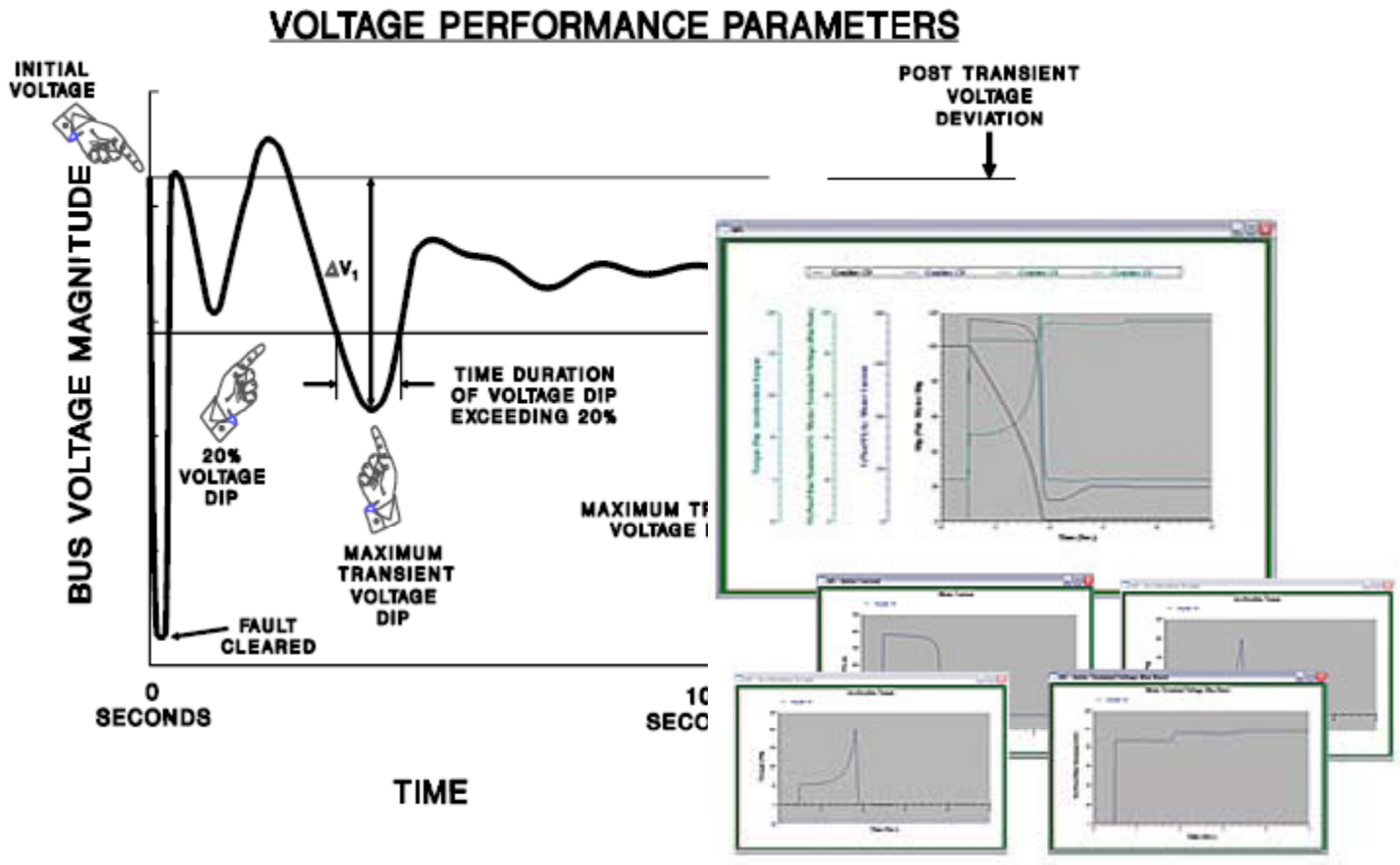
5.3 DR requirements and planning


Clause 5 – Planning and Engineering

5.4 System Studies

5.5 Motor Starting Studies

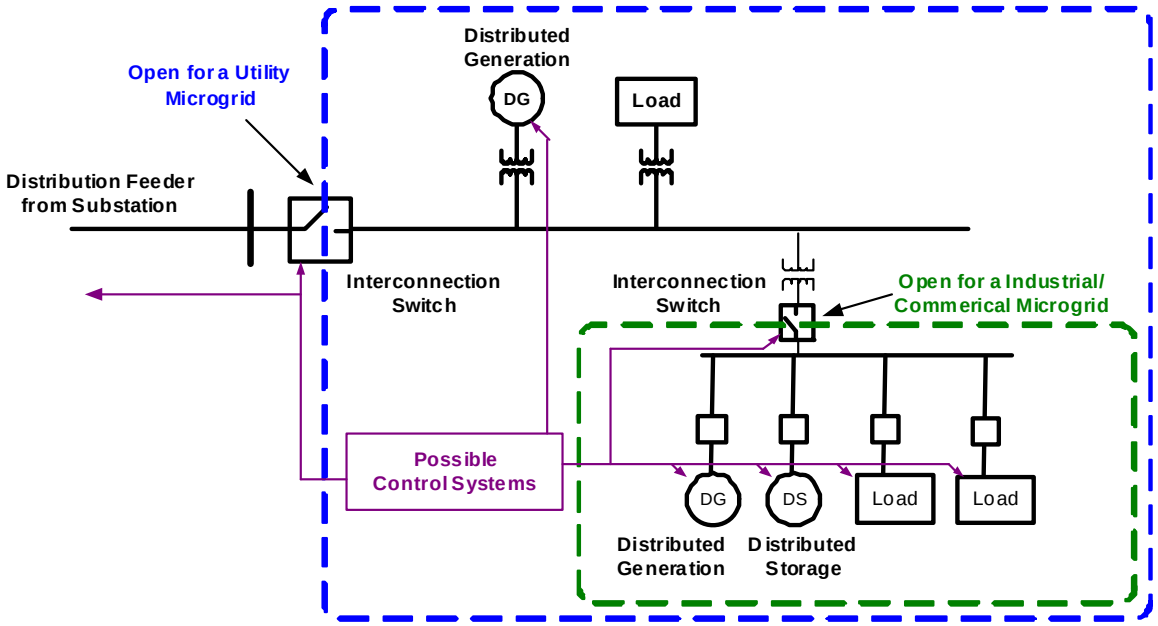




Clause 6 – Operations

6. Operations of DR island systems

- 6.1 DR island system management
- 6.2 DR island system transitions
- 6.3 Control strategies of DR island systems
- 6.4 Restoration after disturbances



Clause 6 – Operations

6. Operations of DR island systems

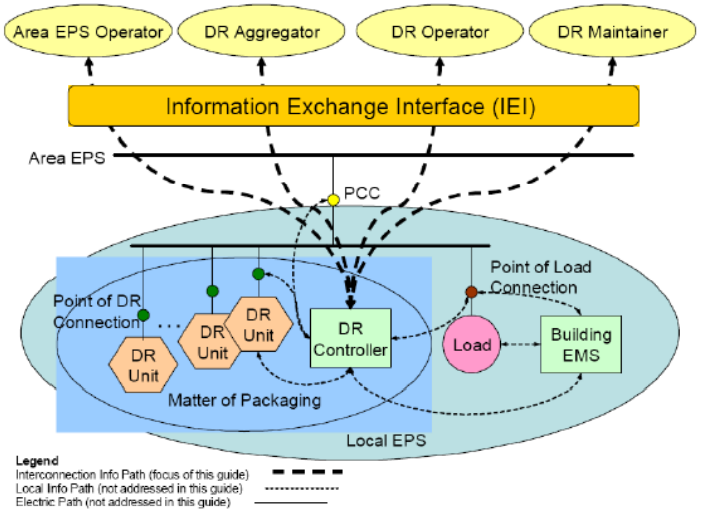
6.5 Safety considerations

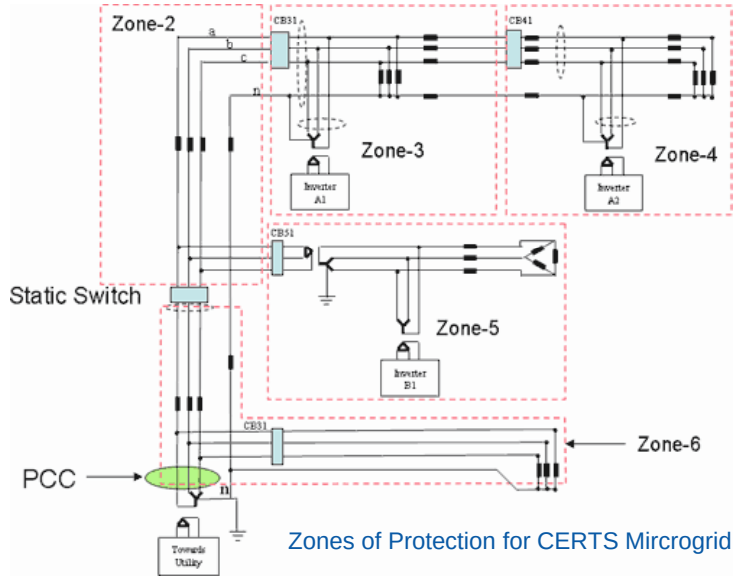
6.6 Periodic review, maintenance, and testing

6.7 Protection consideration

6.8 Monitoring, information exchange, and control

6.9 Power quality



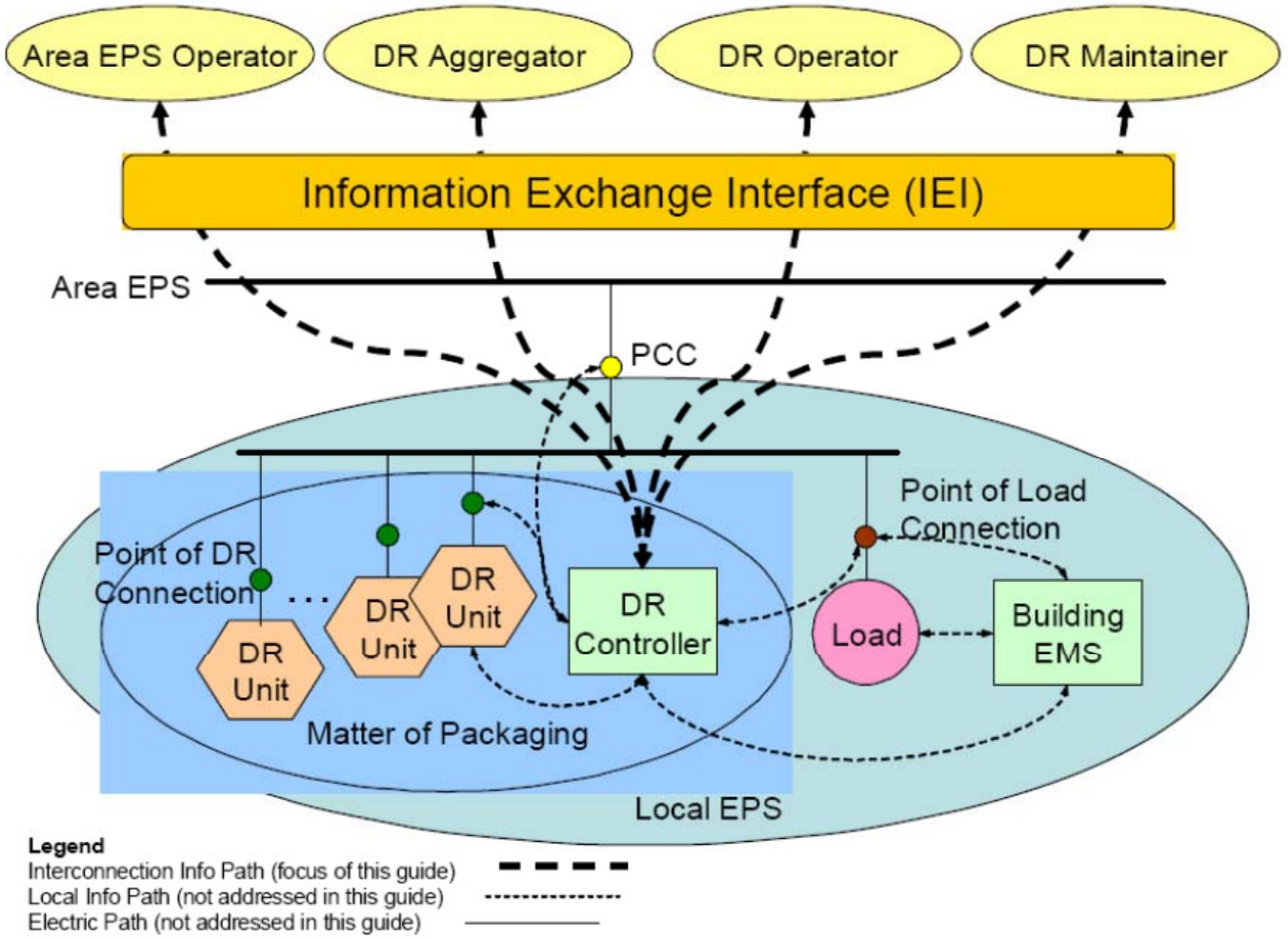


Zones of Protection for CERTS Mircrogrid

Communications Protocols

IEEE Std. 1547.3-2007

Communications Infrastructure Overview

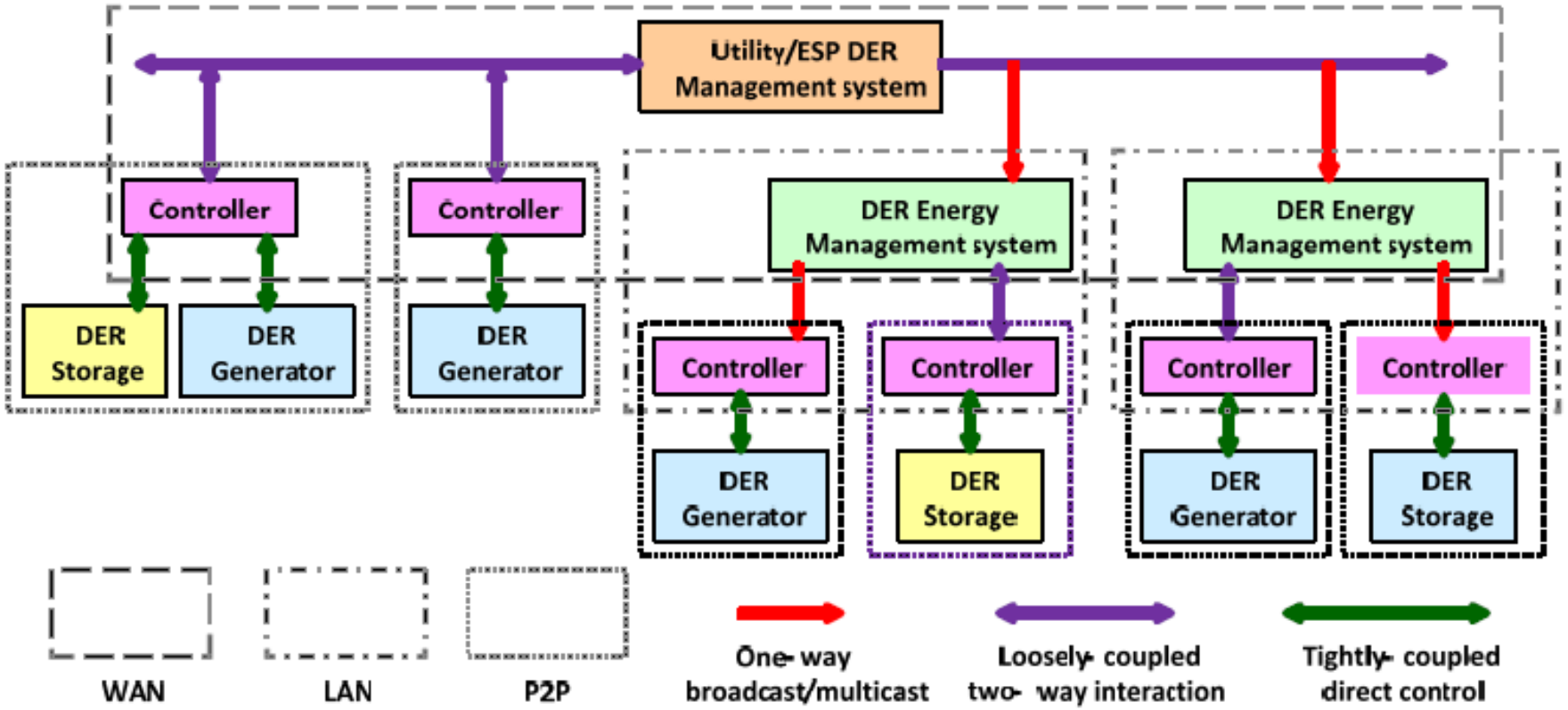


Communications Protocols

IEEE P1547.8 – Draft 1

Many different communication configurations and protocols are possible, with the decisions on which to implement based implementation-specific factors, such as what communication options are available, what the costs involved might be, how much data traffic might be involved, how many DER systems will be included, etc. However, some basic alternative communication configurations

DER Management Network Alternative Configurations



Communications Protocols

IEEE P1547.8 – Draft 1

Tightly-coupled communications characteristics:

• High availability of the communications channel is required

• Many communication configurations are point-to-point, but LANs are also possible. IEC 61850-7-420 provides object models for the types of information that could be exchanged. A common protocol for tightly-coupled interactions is ModBus, although MMS and web services could also be used.

Loosely-coupled interaction communication characteristics:

• Reasonable availability of the communications system is required. It is presumed that the DER systems can manage their own behavior.

•The communication network could be a LAN and/or a WAN.

•IEC 61850-7-420 and, more recently, IEC 61850-90-7 can provide the object models 17 for exchanging this information. These object models can be mapped to MMS, web services, DNP3, Smart Energy Profile (SEP), ModBus, and others.

Broadcast and multicast communication characteristics:

•Reasonable availability is necessary, with the quality of service based on contractual and/or financial requirements for ensuring that DER systems receive the broadcast/multicast messages. DER systems would manage their own behavior if no messages are received.

•The communication network would be a WAN.

•IEC 61850-7-420 and, more recently, IEC 61850-90-7 can provide the object models for broadcasting/multicasting this information. These object models can be mapped to MMS, web services, DNP3, Smart Energy Profile (SEP), ModBus, and others.

Microgrid Standards and Protocol Needs

Communications:

- Central Control, Semi-autonomous, Autonomous
- Component and System Interoperability
- Cybersecurity

Testing:

- Microgrid capability testing
- Conformance testing

System Protection and Coordination:

- Protective relay use
- Protection equipment selection