

PNM/EPRI Smart Grid Demonstration DER Operational Control

**Advisory Council Meeting
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Functional Requirements PNM -1

Customer Site Functional Requirements – stemming from PNM Use Cases

Max capacity is based on inverter size

Customers are net exporters of electricity

Inverters have to be communicating (two-way) and must be able to communicate with the Premise Interface system (which may be part of the meter).

NERC CIP requirements do not apply.

The Renewable Energy Credit Meter (AMI meter) can be controlled separately. This would be a fail-safe to turn off the PV input if needed. Could also be needed to stabilize the systems.

Distribution Operator is responsible for initiating Customer Inverter commands via the Distribution Management System - implications: has to be within framework of reliability, Big Brother issue, alternative through internet?

PNM can remotely monitor the output from the Customer PV Installation. This will enable PNM to more accurately view the performance of the Distributed Generation installations on the PNM grid.

Functional Requirements PNM - 2

Distribution Management System Functional Requirements

Responsible for maintaining an estimate, with a known precision, of how much resource is available for dispatch - what's on line now

Dist Gen forecast? What's available in an hour or tomorrow?

Responsible for accepting requests for blocks of energy and/or capacity and implementing that request by issuing load control requests

Contains an optimization function - determines the optimal set of distributed assets for needed for curtailment - based upon a variety of factors/parameters, including the size and location of the desired resource

System uses measured responses to load demand requests to refine its internal model

The Customer has the ability to Override a Demand Response Event, but it may affect the rate at which they are billed

Functional Requirements PNM - 3

Utility scale Functional Requirements

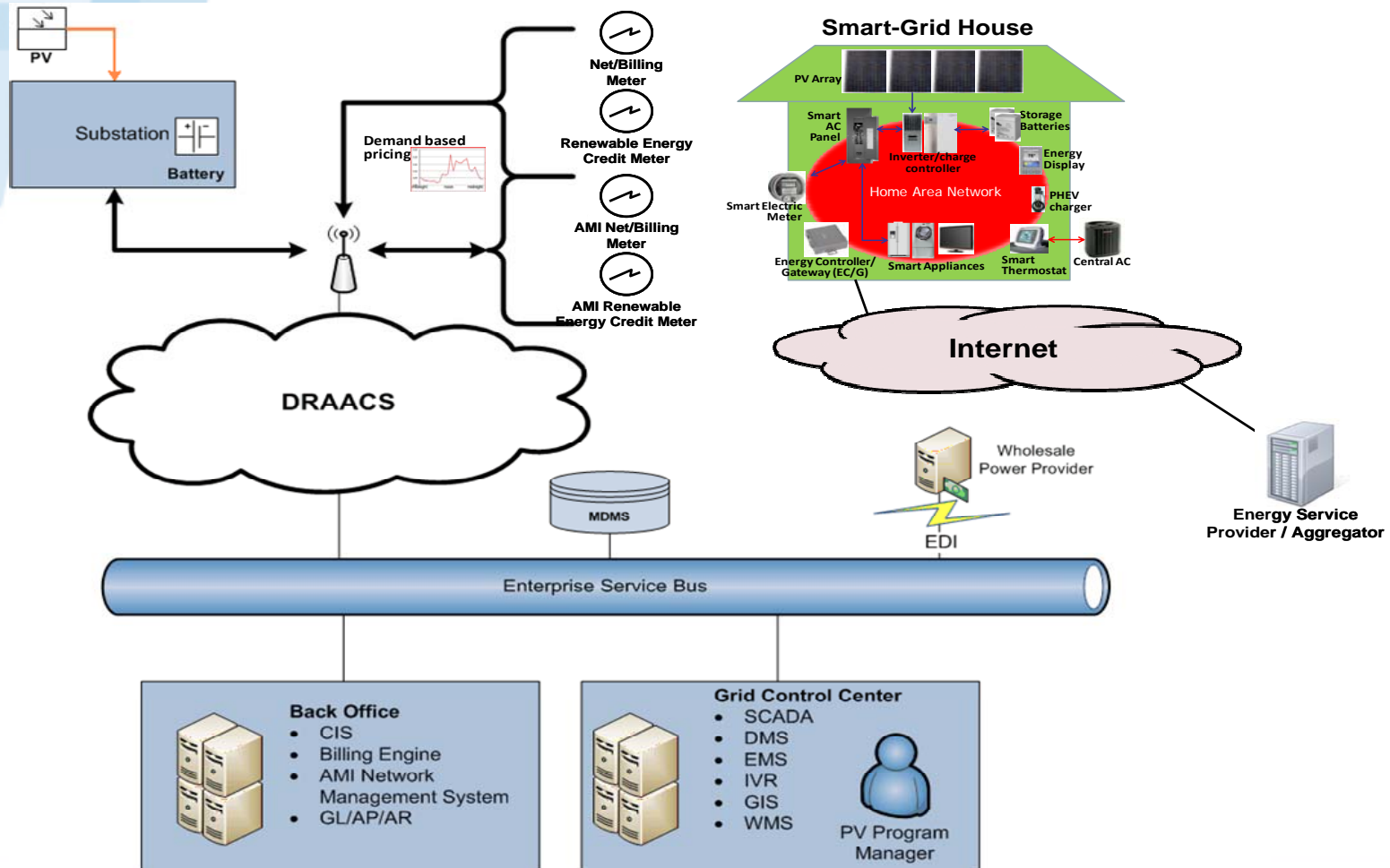
By using Utility storage, PNM will be able to ensure the effects of the inherent PV fluctuations will not cause undo stress and operations on the Load Tap Changer Controls and Capacitor Bank Controls.

Storage will also allow firming of renewable resource

Voltage Measurement System shall provide voltage profile of entire feeder - implies V measurement at AMI meters

Voltage/VAR application shall track Load Tap Changer Controls and Capacitor Bank Controls actions (counts).

DMS Concept - Block Diagram

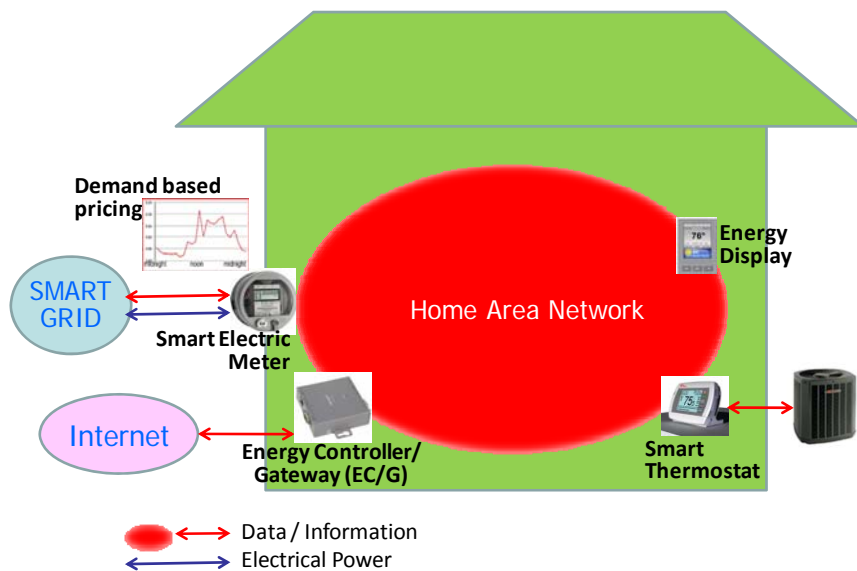


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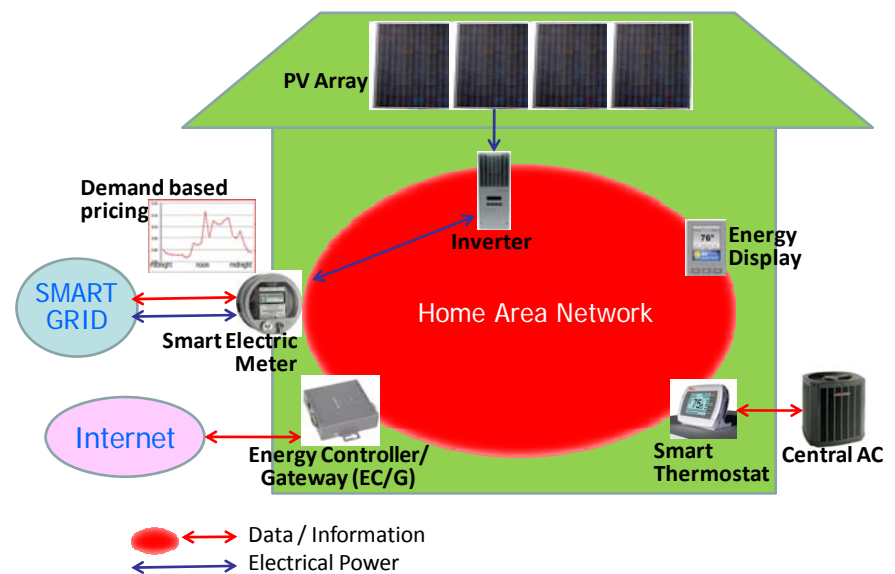


DMS Concept - Block Diagram - home configurations

Base configuration



PV Configuration



Protocol Targets - 1

General

Internet Protocol Suite

Network management standards

Cyber-security standards

Distribution Management System

IEC 61968/61970 Common Information Model (CIM)

Utility Scale Project

DNP3

IEC 61850

Third Party Customer Supplier

Web-services interface

Protocol Targets - 2

Interface to Customer Premises

- IEC 61850
- 3GPP Family of Standards
- Fiber-based Broadband
- IEEE1547 Suite

Inside Customer Premises

- ZigBee (Smart Energy Profile, initially v1.0, ultimate goal v2.0)
- Wi-Fi, Ethernet

Commercial Building Controls

- BACnet, etc

Benefits Estimates – Road Map

Model through GridLAB/Transys

- Base case established for specific building & feeders in question
- Incorporate NREL/SNL equipment models
 - Smart inverters
 - Storage

Capture significant amount of high resolution data

- 1 second interval – utility side
- 15 minute interval – customer side

Calibrate model base case

Generate power and energy predictions through model

Validate model and re-calibrate if necessary based on field and lab data (SNL)

Develop cost/benefit assessment through modeled and actual data

Benefits Estimate – Utility Side

Economic for utility side equipment will center on creation of firm renewable resources

- Utility Scale Solar PV – 500kW
- Capture increased capacity factor (~50% → 95%)
- Avoided peaking capacity
- T & D deferral (target 15% reduction in peak → reduced conductor and equipment size)

Reliability and Power Quality

- Voltage stability in high PV penetration environment - Test end and beginning of feeder large PV configurations – difficult to quantify benefits
- Lower SAIDI – not assessed - also difficult to quantify

Environmental

- Carbon credit through avoided fossil dispatch and avoided capacity builds
- Higher value RECs (Also measurement of RECS with Storage)

Energy Security – TBD, perhaps guided by NIST

Benefits Estimate – Customer Side - 1

Deployment of solar resources

- Economic: Exploit incentives/rebates, REC payments, net metering for positive return: IRR in 10-15% range over 20+ years with existing PNM/NM programs
- Economic: Significant upside potential as TOU/RTP emerge
- Environmental: commitment to renewable energy
- Energy Security: Future energy costs hedged

Deployment of Storage

- Economic: No direct benefit today; tariffs and incentives to be addressed
- Reliability/Power Quality: Ability to island through black-outs

Benefits Estimate – Customer Side - 2

Deployment of Energy Management / DR capability

- Economic: Visualize and better manage energy consumption, savings in order of 5-10% possible
- Economic: Generate revenue or further reduce bills by easy ability to exploit DR programs and variable pricing
- Environmental: Rich data from EMS allows customer to be better informed
- Reliability/Power Quality and Energy Security: Indirectly benefit from improved distribution system operations

Gaps / Challenges – Utility Perspective - 1

Technology

- Storage
 - Durability/reliability –unproven
 - Cost –still to high –see EPRI TR 1017813 Energy Storage Market Opportunities
- End Use Equipment
 - Integration to utility communications
 - Response and validation

Standards

- Evolving- too quickly, too slowly/Engagement with NIST is a full time job
- FERC issues in translating wholesale price (vertically integrated utility, non ISO- WECC)

Policy

- Cyber security
- Data Ownership
- Micro-grid – who owns, who controls?

Gaps / Challenges – Utility Perspective - 2

Customer Acceptance

- Load control – Big Brother issue

Architecture

- Integration to legacy system
 - SCADA – DNP3 vs implementation cost of IEC 61850
 - Definition of real time price in vertical utility (WECC = non ISO → no “real” real time price)
 - FERC issues with real time price transmitted from wholesale and balancing authority
 - AMI via MDMS integration to SCADA

Suppliers (availability of hardware/software)

- DMS/DRAACS – do they really exist?
- Need to validate on a prototype – demo basis without serious financial commitment
- Regulatory Prudency

Gaps / Challenges – Vendor’s Perspective - 1

Technology and Standards

- Home Area Network: ZigBee SE1.0 not adequate, SE2.0 not done; WiFi a contender
- Home to Utility Comms Interface: No viable standards yet; Internet versus AMI path
- Inverter Interconnect: no support for voltage regulation, reactive power, islanding
- Aggregator to Utility interface: No standardized approach
- Storage: low lifetime; environmental/maintenance concerns; in-home versus community level

Economic

- Solar Installations: financing difficulty; weak incentive programs viable TOU rate needed – hard to deploy without funding support
- Load Management / DR: new rate plans/incentives needed
- Customer vs Utility: with established rates, no/low value to customer of peak reduction
- Storage: not viable financially; need incentives – utility must share the value of peak energy

Gaps / Challenges – Vendor Perspective - 2

Acceptance

- Ease of Use: customer's EMS must be simple, automatic, customizable
- Marketing gap: customer education needed for acceptance
- Control: customer must be decision maker – no utility direct control

Regulatory

- Incentives: Solar incentives for NM deployment are in consideration; future program structure uncertain; no incentives for storage deployment
- Rate plans: PNM need revised TOU/CPP/RTP pricing plans approved for pilot

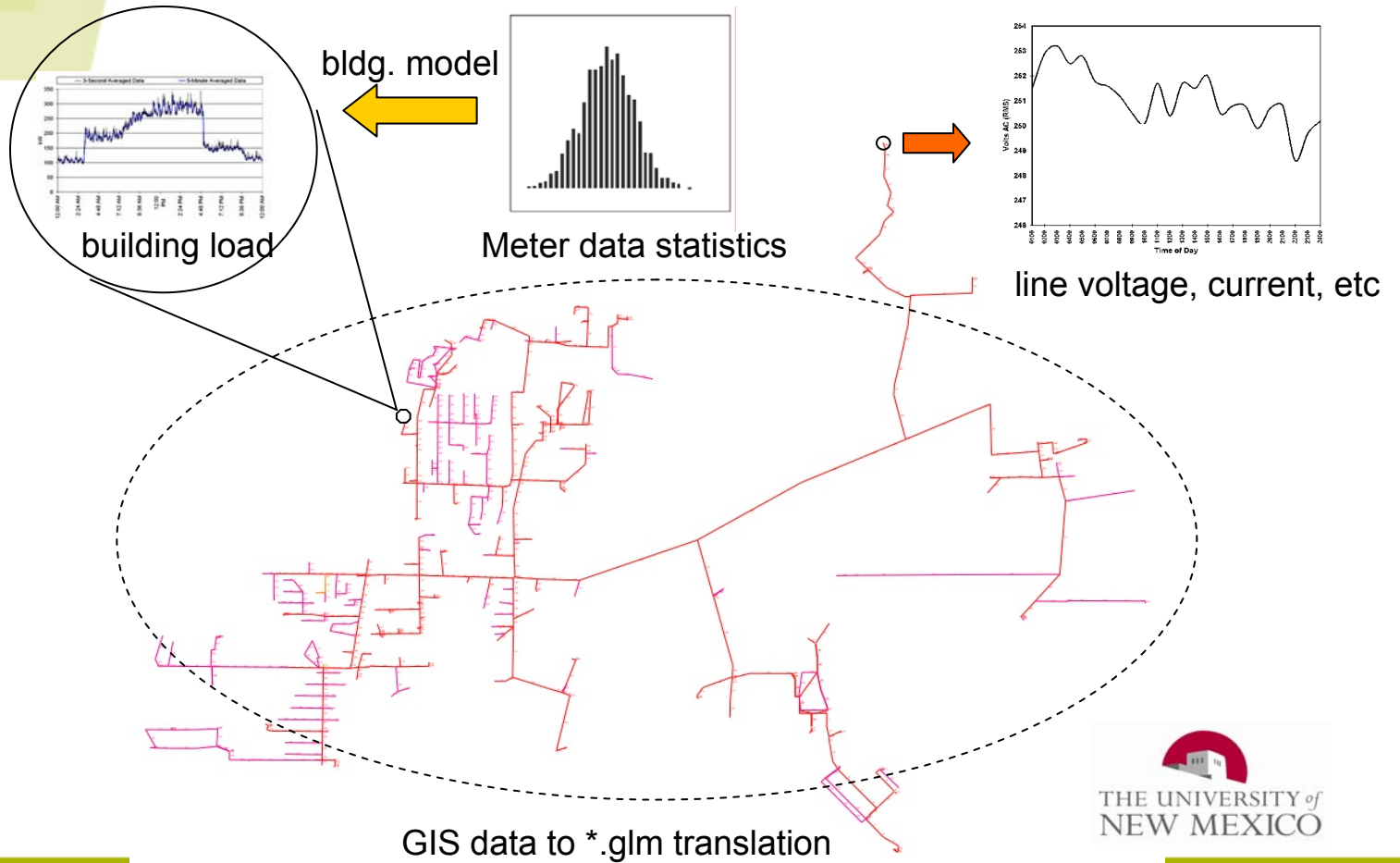
Modeling Update

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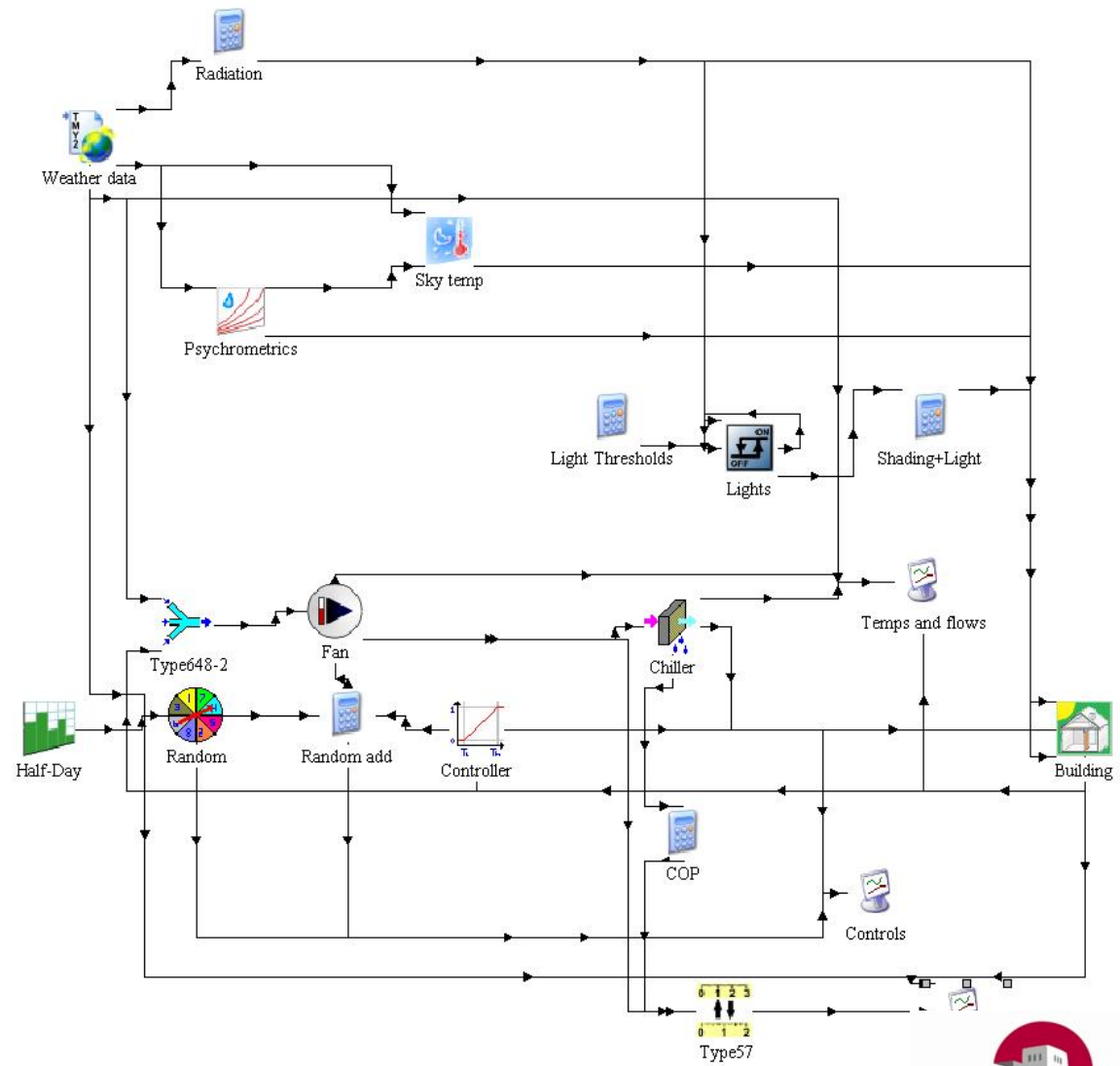
UNM GridLAB Modeling

Studio 14 feeder simulation



UNM Transys Modeling Mechanical Engineering Building

Simplified model of ME building HVAC (cooling only), enabling the calculation of various forms of electrical, chilled water and other loads, and zone comfort conditions



UNM Transys Modeling

Effect of random fan VFD signal on zone temperature

The application of a random high-frequency signal to the fan VFD controller has little effect on temperature control, but substantial effect in power consumption.

Motor VFDs could provide balance to variable PV output.

