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PG&E Ancillary Services Pilot Design and Results of Operations

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FSC FREEMAN, SULLIVAN & CO.
A MEMBER OF THE FSC GROUP

PG&E Pacific Gas and Electric Company®

ENERGYICT
ENERGY INFORMATION AND COMMUNICATION TECHNOLOGIES

BERKELEY LAB
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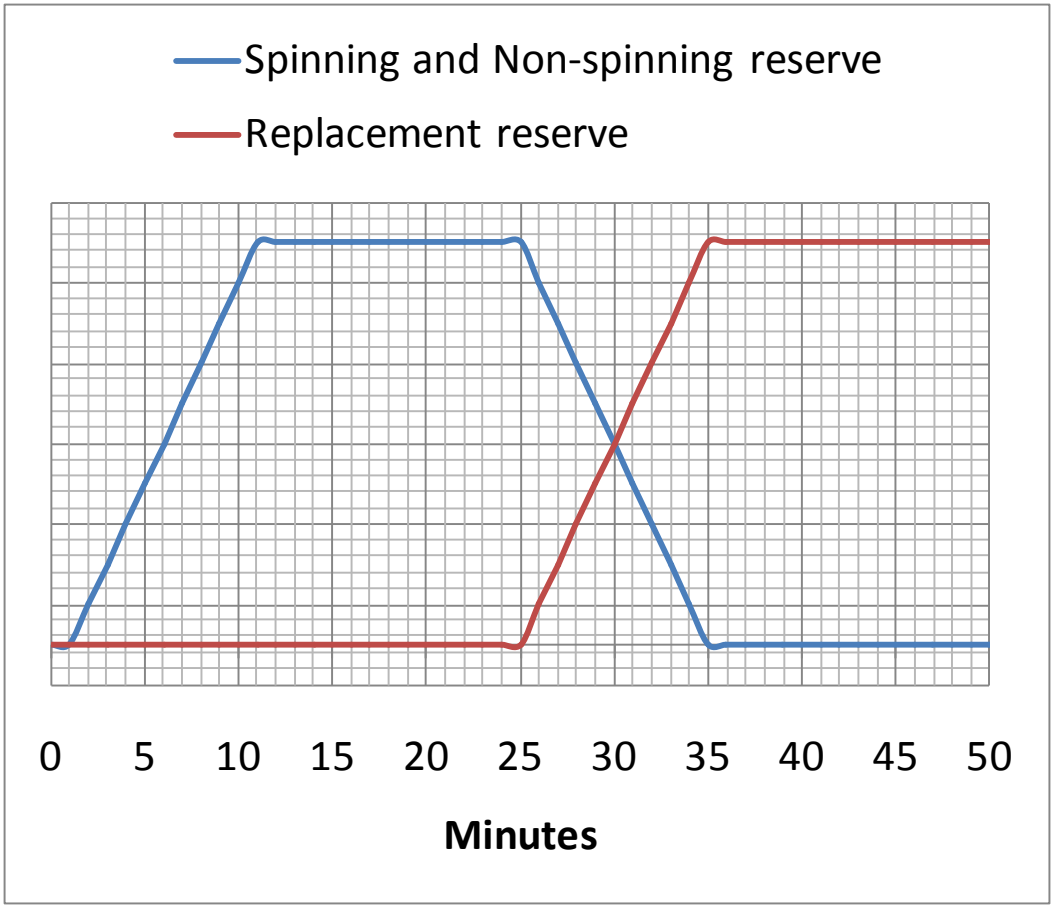
Overview

- What are ancillary services and what are rules market rules?
- What is the pilot testing and why is it needed?
- Description of the pilot design
- Preliminary results on time to response
- Preliminary results on the load impacts

The Project Team

- PG&E – Project leadership and coordination of internal and external assets required to operate and support the system
- LBNL – Project design and oversight
- FSC – project management, sample design, equipment specification, coordination of installation of load measurement devices and telemetry, procurement and customer recruiting
- Mad Dash – installation of load measurement devices
- Energy ICT – telemetry data management, development and support of real time user measurement interface

What are ancillary services?



- Spinning and non-spinning reserves provide on-call resources to ensure system reliability despite contingencies – e.g. forced generator outage, forced transmission outages)
- Must be available immediately on command from system operator – resource needs to ramp up within a minute
- Must reach full production capacity within 10 minutes

Participation in Spinning Reserve Market

- Spinning reserve historically has been supplied by machines (that are running but) not operating at full power
- They are bid into the market on a day ahead basis
- Telemetry requirement
- Potential revenue stream from DR
- Can a/c cycling programs participate? Maybe, maybe not.
  - AC load and load impacts need to be predicted in advance and incorporate uncertainty in the weather forecast
  - Telemetry requirement needs to met
  - Response times need to be proven

Ancillary Services Pilot Project Objectives

- Determine how long it takes for the PG&E load control system to respond to an instruction to interrupt A/C load.
- Determine how much load reduction can be obtained under different operating conditions including temperature, time of day and day of week and climate.
- Identify an appropriate design for telemetry, data base management and displays that can provide minute by minute measurements and estimates of the A/C loads available for curtailment before an operation and the load impacts of the operation once it is underway.
- Assess the investment, benefits and risks associated with entering into the ancillary services market in California and identify any changes to program design, tariffs or operating procedures that may be necessary to do so.

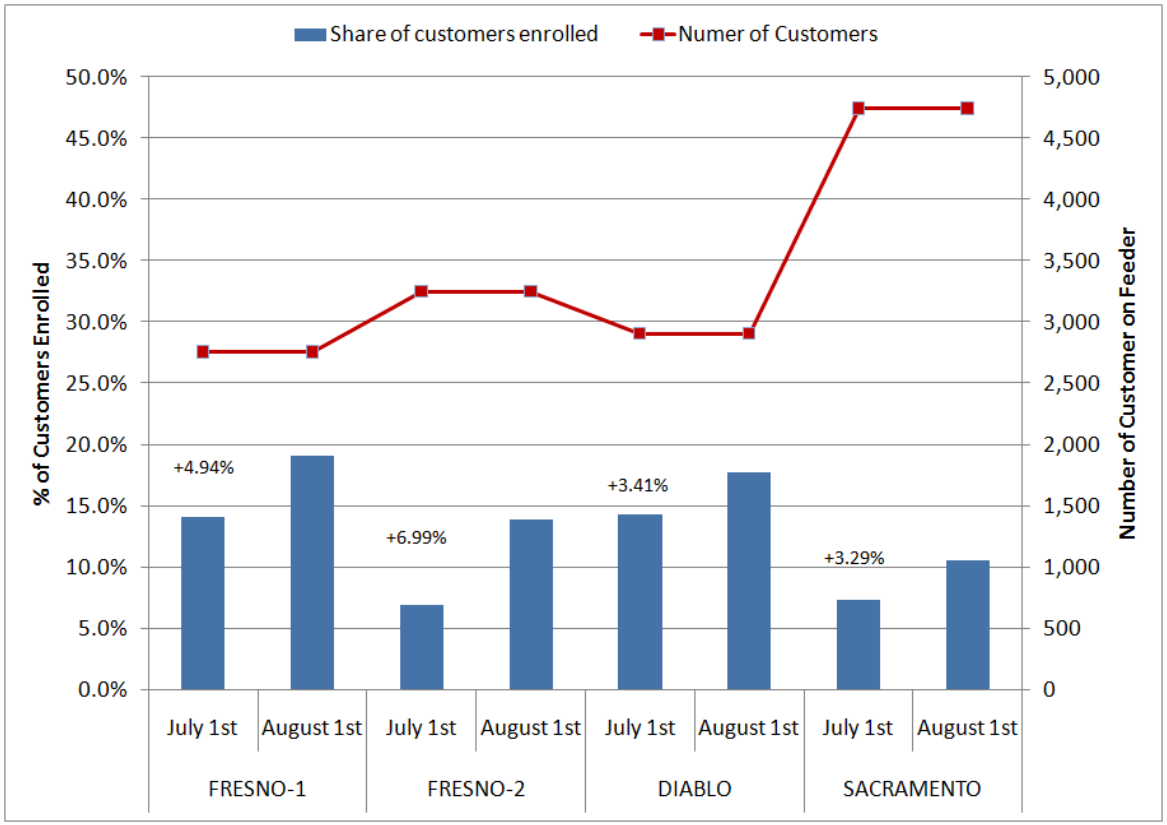
Approach to Pilot

- Observe load impacts of A/C load control simulating spinning reserve operations on feeders and samples of individual premises
- Vary time of day, day of week climate and ambient temperature
- Measure and display feeder and A/C load impacts in real time
- Use resulting data to identify improvements needed to support operations and develop forecasting model to be used in operations

Sample Design

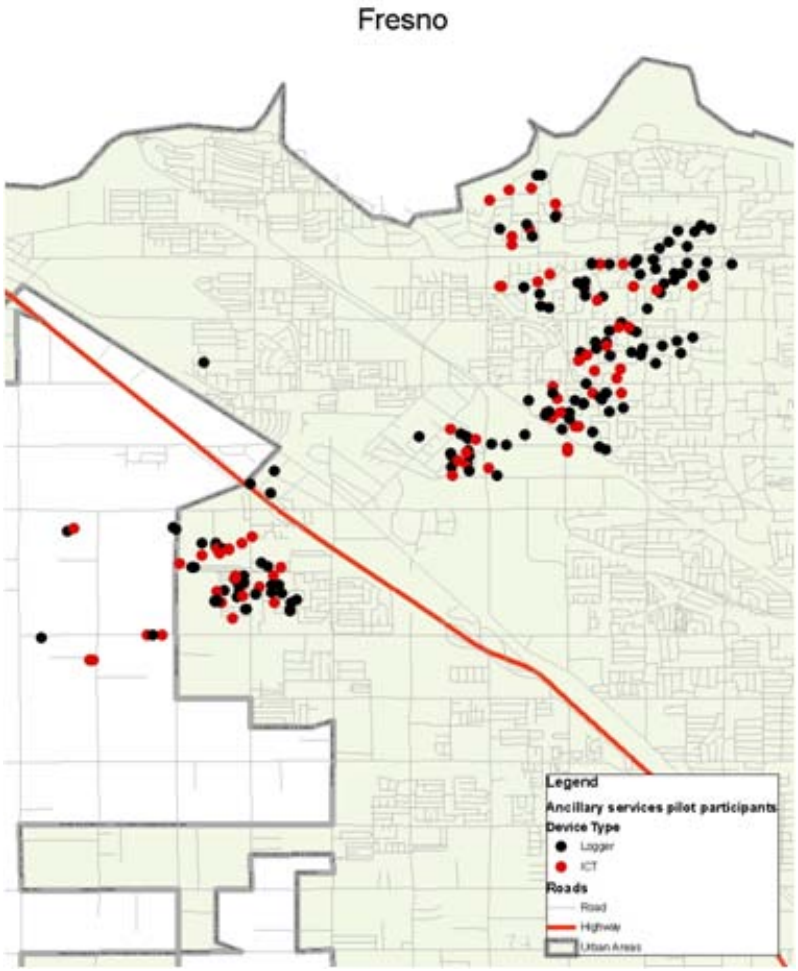
- All feeders in the study recruited so that subscription was at least 500 (total population under control 2000)
  - 400 DLC per feeder – 1600 total DLC
  - 100 PCT per feeder – 400 total PCT
- Feeders selected:
  - Were less noisy in order to allow a comparison of telemetered A/C load data with the SCADA feeder load data
  - Had a sufficiently large population of SmartAC participants to develop a robust sample at the feeder level
- Load Measurement sites recruited at random
  - 100 total per feeder – total 400 points
  - 30 - 40 telemeters per feeder – 110 total telemeters
  - 70 Onset Hobo loggers per feeder – 280 total Hobos

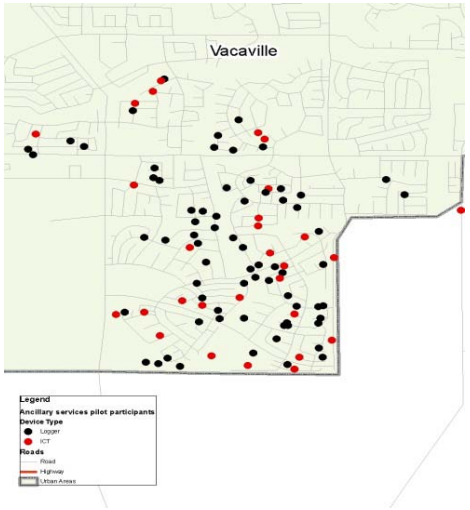
The Feeders Under Study Required High Penetration of Control Devices

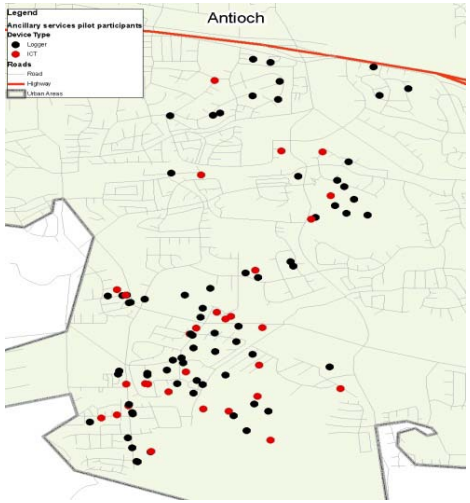


- The graph shows the share of customers enrolled (versus the share of customer with central A/C)
- Penetration was substantially increased over the course of a month and more than doubled for one feeder
- Multiple recruitment methods were employed
  - Mail
  - Phone
  - In-person

Load Measurement Points -- Feeders Under Study



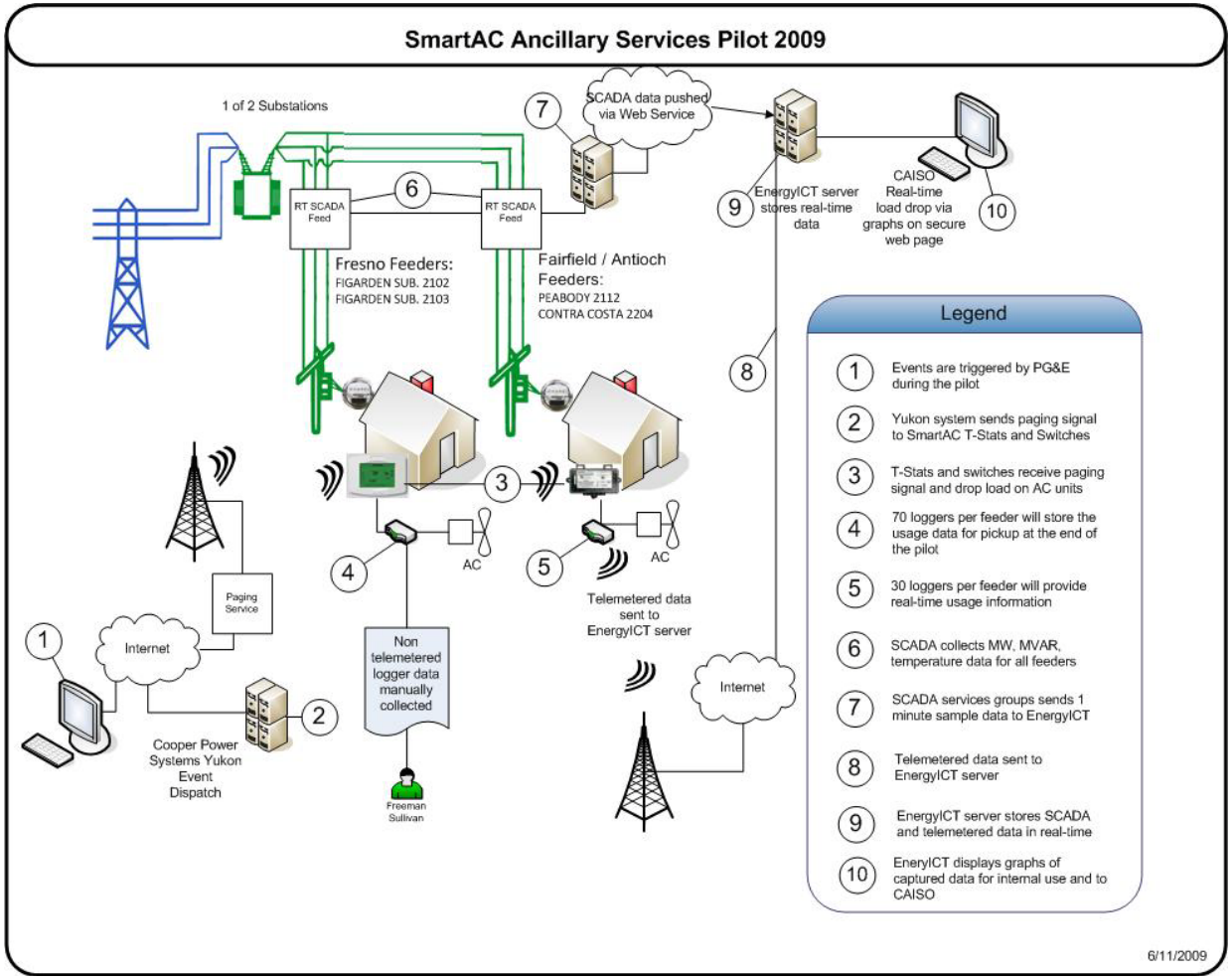




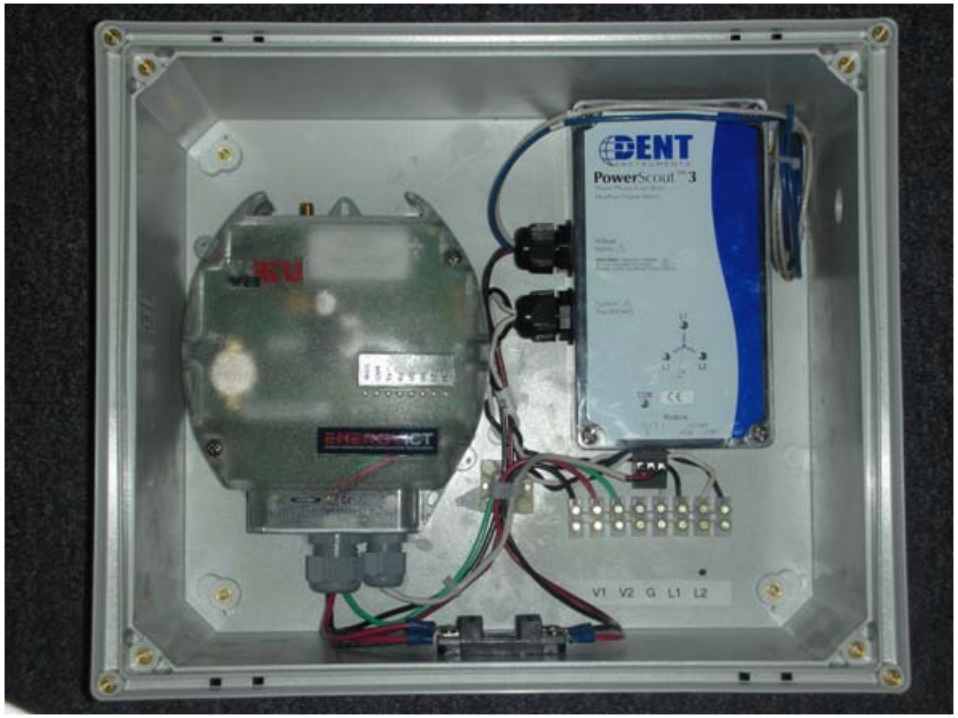
Testing Protocols

- Signal Latency and Load Impacts observed using notch testing
  - 15 minute shed
  - Loads interrupt immediately on receipt of signal
  - Completely off for 15 minutes
  - Control returned to thermostat randomly over 2 minute interval
- Testing Schedule
  - Two tests daily between 12:00 and 19:00 separated by 2 hours
  - Weekdays only
  - Testing visible 15 minutes before event, during event and for 15 minutes after event
  - System conditions observable hourly on the hour between events
- Load measurements
  - By feeder and for all feeders taken together
  - Aggregate monitored AC load by minute
  - Aggregate extrapolated AC load by minute
  - Percentage of monitored units active
  - Baseline measurement – average aggregate monitored load 5 minutes before operation

Control/Measurement System Diagram



Telemetry Load Measurement Interface



Telemetry Load Measurement Interface

- Instrumentation
  - Dent PowerScout 3 (EIMeter)
  - Two current transformers with voltage reference for power measurements
  - < 1% accuracy

- Data logging and communication
  - EICT WebRTU-Z2
  - 500 ms modbus sampling
  - kWh, kVarh, per phase volts and amps
  - Watt-hour resolution
  - One (1) minute interval length
  - GPRS communications
  - One minute data transmission frequency 15 minutes before and after events
  - One hour data transmission frequency for non-event periods

- Central Software
  - EICT's EIServer MDM software running in ASP

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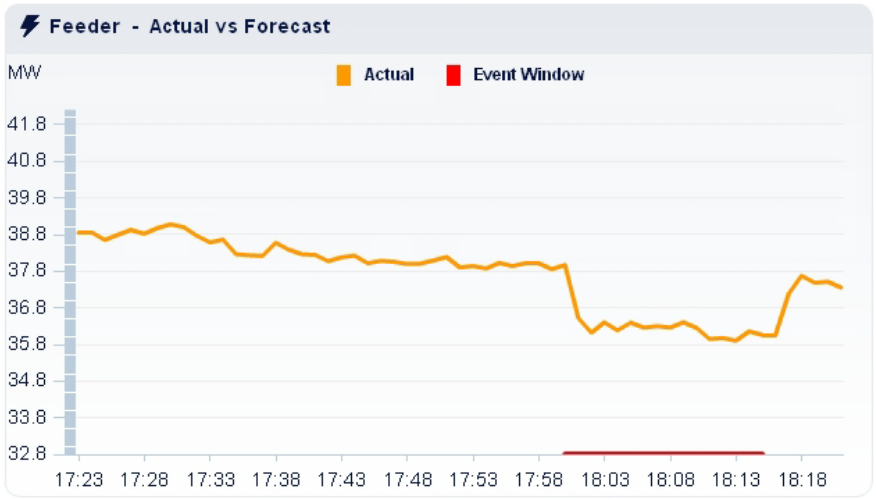
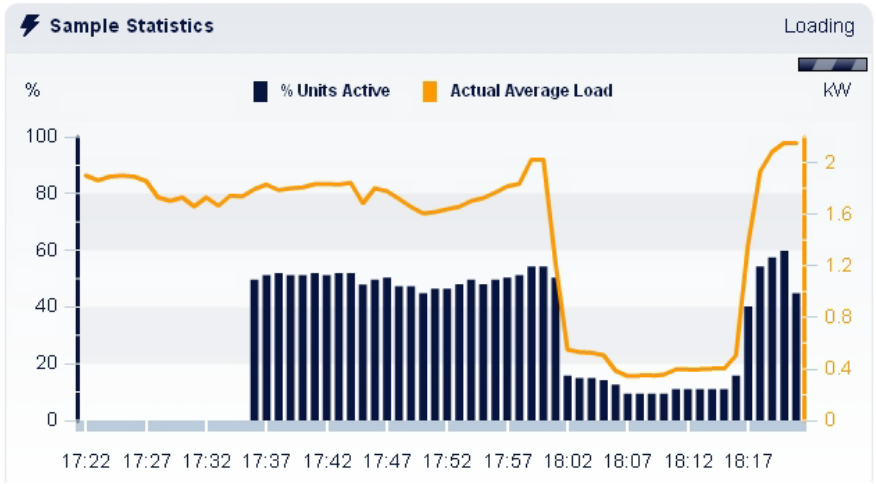
User Interface

Preliminary Findings

- Significant load impacts observable in real time on all feeders on some days – on others not so much
- Load impacts vary by time of day, temperature and climate
  - The higher the temperature the higher the impacts
  - The later in the afternoon the higher the impacts
  - The hotter the climate zone the higher the impacts
- Several performance issues must be resolved:
  - Response time (signal latency) minimum 2 minutes and varies
  - Intermittent performance by control devices

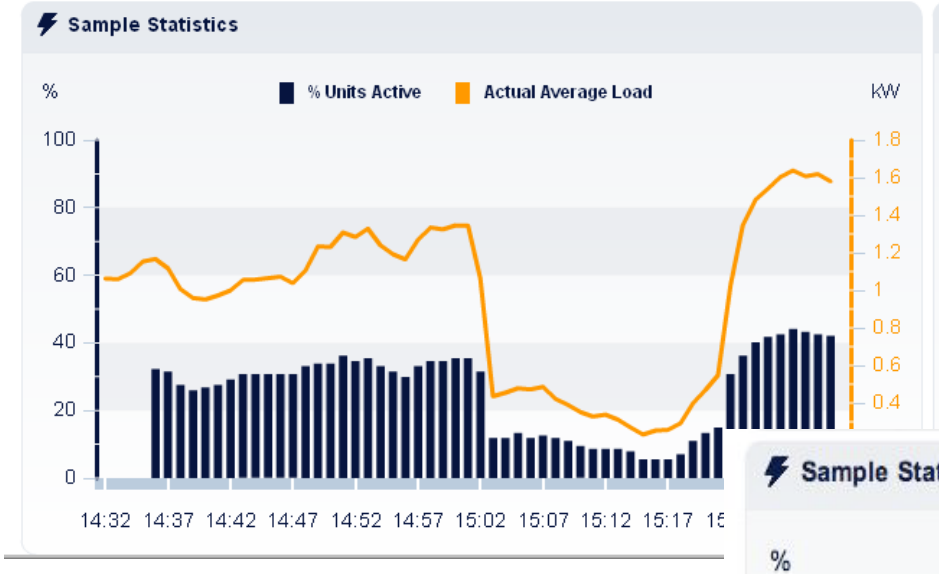
Significant Load Impacts Are Possible



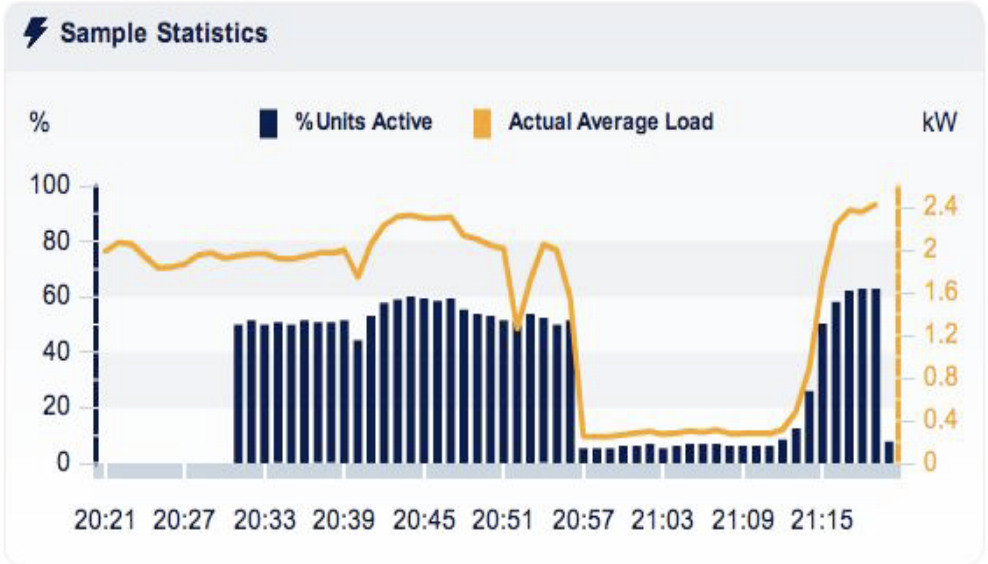


- Over half of the A/C units were on
- 80% of the units that were on shut down
- The impacts were clear both at the feeder level and at the a/c sample level
- Almost all of the load drop occurred with the first two minutes
- 3.3 MW load reduction among four feeders

Depends on Temperature and Time of Day

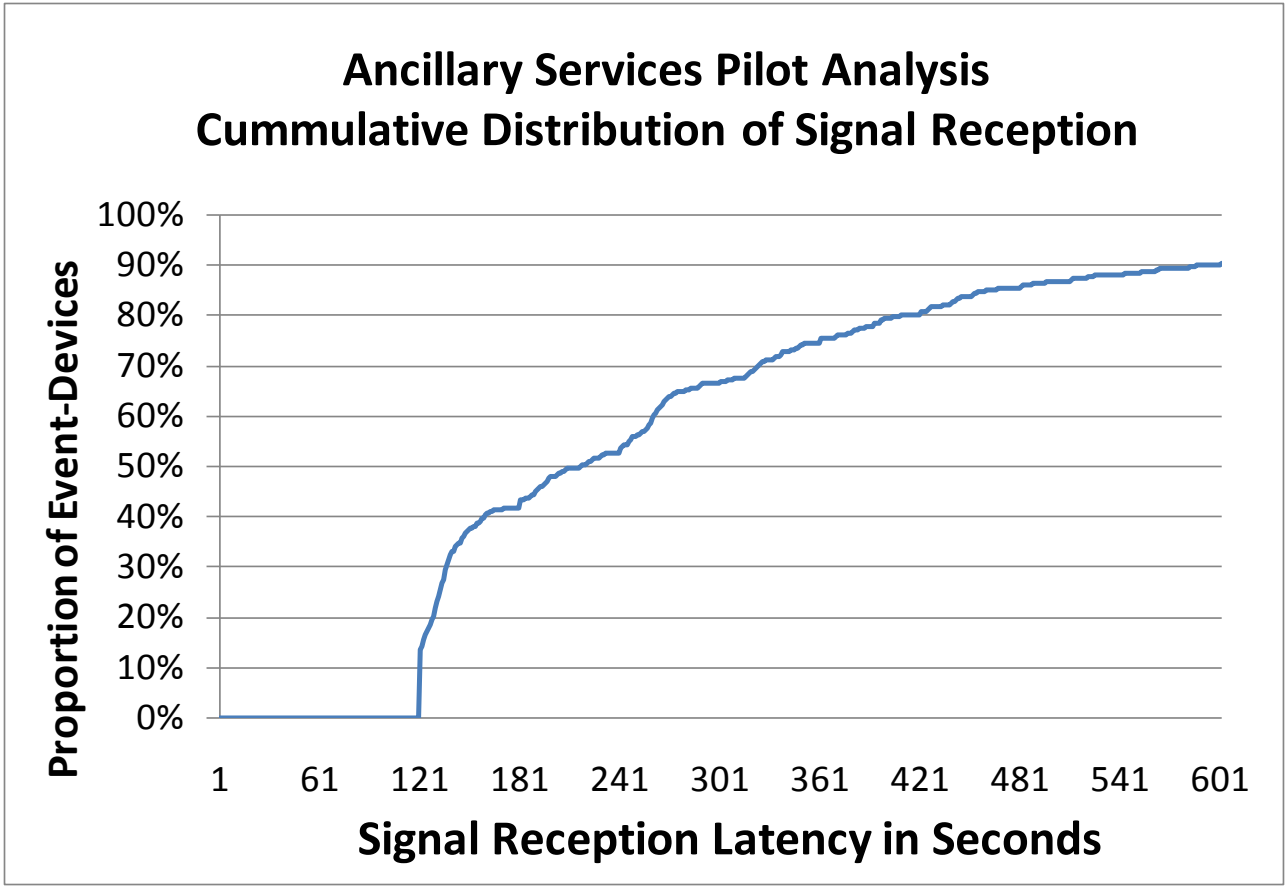


- Approximately 35% of unit are in operation
- A/C load averages approximately 0.7 kW per unit.
- Two thirds of units in operation shed load



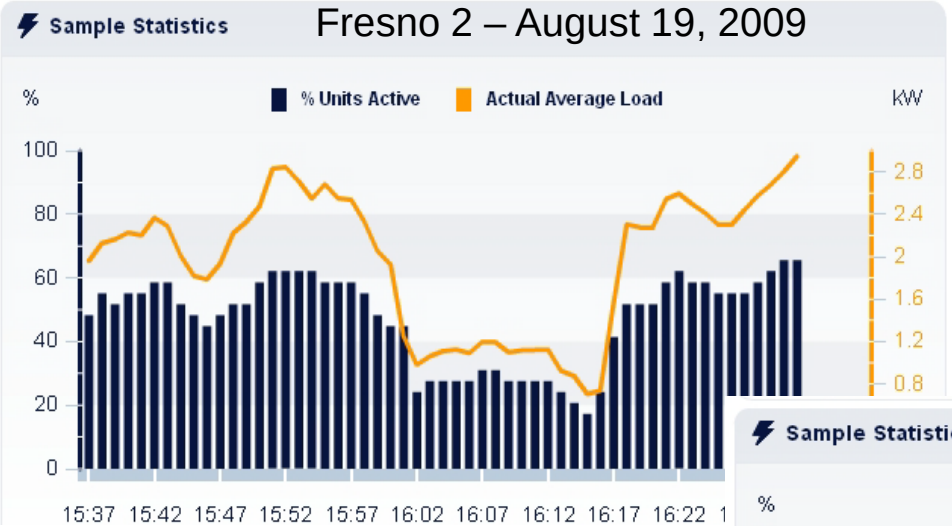
- Approximately 55% of units are in operation
- A/C load averages approximately 1.5 kW
- Approximately 90% of units shed load

Latency in Signal Transmission - Very Preliminary Data

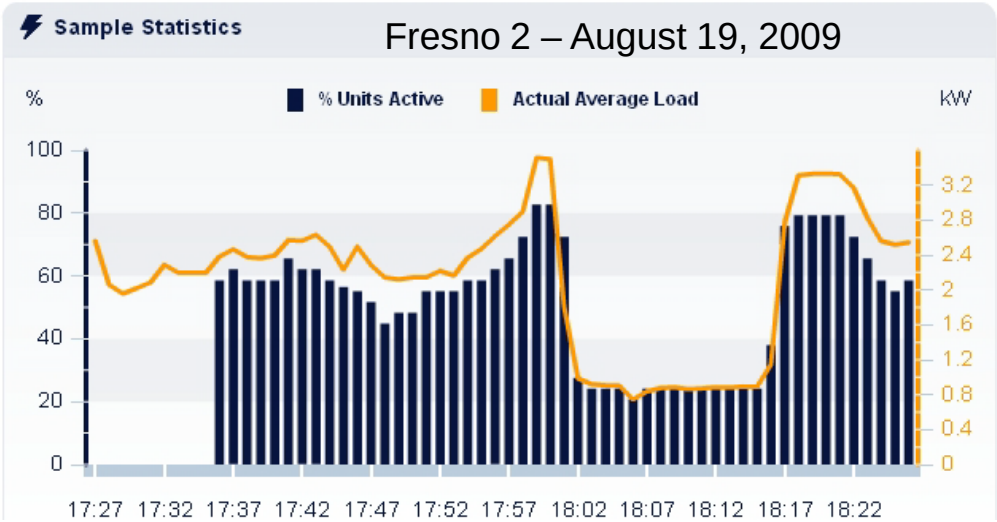


- Initial data indicates that almost all A/C units receive control within10 minutes
- However, they do not received the signal until two minutes into the event.
- More data will be collected and analyzed prior to finalizing results

Preliminary Data Indicates Intermittent Performance for Some Feeders



- The drop for event at 4 pm was slower.
- Fewer units were on
- Fewer shed load



- Same feeder, same day
- Faster drop in load
- More units were on
- A higher share of units that were on shed load

Summing up

- Real time program evaluation!
- There is technical potential
- Pilot is still under way and more data will be analyzed to provide a more in depth understanding
- Initial results indicate there are improvements that need to be made in system performance
  - Decrease latency
  - Improve reliability of communications system
- Telemetry sample can provide reliable real time feedback to monitor a large population of installations
- The load impacts and sampling may need to be scaled for the SmartAC program as a whole