Smart Grid Challenges

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What is the Smart Grid?

- The US power grid has been described as the most complex machine ever built.
- For ~100 years, meter reader came by to get a monthly kWh read, which you got billed for. That's it.
- Smart meters are capable of measuring hundreds of different data items:
  - kWh of course
  - Peak demand (kW)
  - Momentary and sustained interruptions (power blinks)
  - Voltage levels
  - Time of use programs
  - Three-phase power has many things to measure
  - Then you have service disconnect, load control devices, soft fuses, etc.

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Current options

- Drive-by wireless
- Wireless direct to collector
- Wireless mesh (eventually to collector)
- Wireless comes in 1-way and 2-way
- GPRS
- Powerline carrier
- All have cost/speed/bandwidth/feature tradeoffs

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Problem Scope

- 3.5 million meters (largest customer so far)
  - 15 minute kWh reads + 1 daily read of a few dozen data items
    - OLTP: (for 15 min reads)
      - Nearly 900 million records/day (10400/sec)
      - 176 GB/day
      - 45 days = 7.9 TB
  - Seeing some RFPs for 5 and even 1 minute reads
    - OLTP: (for 1 min reads)
      - 11 billion records/day (156000/sec)
      - 2 TB/day

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Reporting Requirements

- Monthly billing cycle
- Time-of-use programs
- Peak demand
  - Identify hourly block with highest peak demand for commercial customers, sync up with G&T bill
- Grid Analytics
  - At 15min or hourly intervals, examine voltage readings, temp readings, powerline signal fluctuations
  - Identify transformers that are getting ready to fail, corroded meter sockets in damp climates (can lead to house fires), buried feeder lines that are developing shorts
- Future applications mostly unknown
  - Stream processing and realtime analytics?
  - Load balancing and individually measuring usage for smart grid aware devices (dishwasher, clothes dryer, plug-in electric hybrid vehicles, etc)?

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Data Retention

- 1 year history available in DW
- Roll off years 2-5 to archival storage (max 5 years retention)

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Current Recommended Solution

- SunFire 32-cpu (2.1GHz) box, 283GB RAM
- Oracle
- Hitachi SAN
- The usual struggles to tune indexes, setup the logging disks, etc.
- High Availability concerns (offsite backup server has much less horsepower, will have degraded performance)
- Scalability concerns

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