Smart Meter Monitoring – Why TimeSeries is the only option

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Session: B12
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Smart Meter Monitoring

- Why Smart meters?
  - Energy Resource Issues
  - We Must Know What Our Energy Usage Is
- Why now – Who's Interested?
  - Individuals
  - Utility Companies
  - Governments
- DEHEMS
  - An EU Initiative for Understanding Resource Usage
  - Utilises Smart Meter Data
  - Complex Data Challenge

Smart Meter Monitoring Challenges

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- Beyond DEHEMS
- The Challenges
  1. Large Data Volumes
  2. High Insert Rate
  3. Complex Analysis
- The Answers
  1. Informix TimeSeries
  2. Informix TimeSeries
  3. Informix TimeSeries

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Energy Usage Issues

What are the Goals

- Reduction in Energy Usage
  - Increasing cost
  - Political issues with global power market economy
- Reduction in Emissions
  - EC goal is 20% emissions reduction in 2020 as compared to 1990
  - UK goal is 60% by 2050

Energy Usage Issues

- 2020 is not very far away
  - Less than 3,600 days
- Long lead times for new, “clean” energy supply
- Lasting legacy of energy inefficiency
  - 80% of refrigerators bought in 2007 will be in use in 2020
  - Less than 1/3 of industrial infrastructure will be replaced by 2020
  - Over 20%of cars bought in 2007 will still be on the road in 2020

We Must Act Now

- Supply side will not be ready in time
- Humans are essential to the solution
- Household efficiency a priority
  - 25-30% of carbon emissions are from regular households
  - 80% of home energy usage is heating
  - EC projects 27% savings through efficiency in buildings

What is required?

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- Measurement
  - Metrics: What is being measured
  - Context: How do you compare to others and norms?
  - History: How am I changing over time?
  - Trust: Can I trust this is real and personal?
  - Detail: Is there enough granularity to explain what is happening?
- Models
  - Projections: How do today's actions impact on tomorrow's metrics?
- Management
  - Access: Does information find me or do I find information?
  - Control; Can I take action?

Smart Power Consumption Meters

- In the past, utility meters have been used to provide monthly or quarterly readings for billing purposes
- A Smart Meter is able to show instantaneous usage instead of simply indicating previous, historical usage
- Short timeframe snapshots of consumption can be analysed for patterns of usage

Who is Using Smart Meters

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- Utility Companies
  - Main drive is not reducing billing costs
  - Better analysis of usage patterns
  - Can different tariffs change energy consumption
- Consumers
  - Looking to reduce energy costs
  - Wanting to improve their green credentials
- Governments
  - Need to show improvements in emissions
  - Want to reduce energy consumption/reliance

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DEHEMS

Digital Environment Home Energy Management System

DEHEMS Consortium

- Manchester City Council [United Kingdom]
- Technical University of Cluj-Napoca [Romania]
- Clicks and Links Ltd [United Kingdom]
- Hildebrand Technology Ltd [United Kingdom]
- Bristol City Council [United Kingdom]
- Corinex Communications [Slovakia]
- Plovdiv Municipality [Bulgaria]
- Ivanovo Municipality [Bulgaria]
- Institute e-Austria Timisoara
- University of Rousse [Bulgaria]
- Birmingham Council [United Kingdom]
- University of Coventry [United Kingdom]
- The Centre [Belgium]
- University of Salford [United Kingdom]

DEHEMS Approach

- Energy performance measurement rather that total consumption
- Community dimension to behaviour change
  - Comparison
  - Education
  - Feedback
- Enabling easy, effective action

Consumer Education

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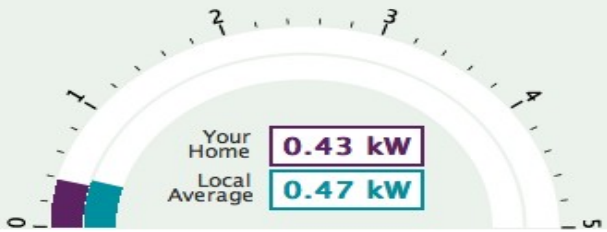
DEHEMS
An EU funded climate change initiative

Last Updated: Tue Feb 10 2009 09:17:40 GMT

Current live energy usage



Energy Saving

Compared to your last bill we currently estimate the difference in your spending is:

+£7.96

per month

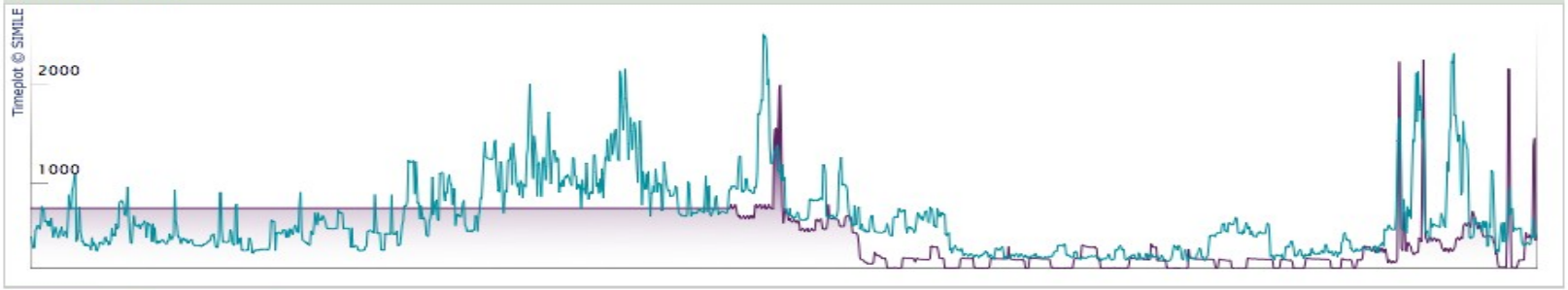
Usage so far this month

kWh | Cost | CO_2

Energy Fact

Set-top boxes for the reception of digital TV are inexpensive to buy, being given away for free with subscription packages, but by 2010 they could be costing UK households £472m every year in electricity or £19 per household

Energy Usage



Your home | Local Average

24 Hour | Hourly | Daily

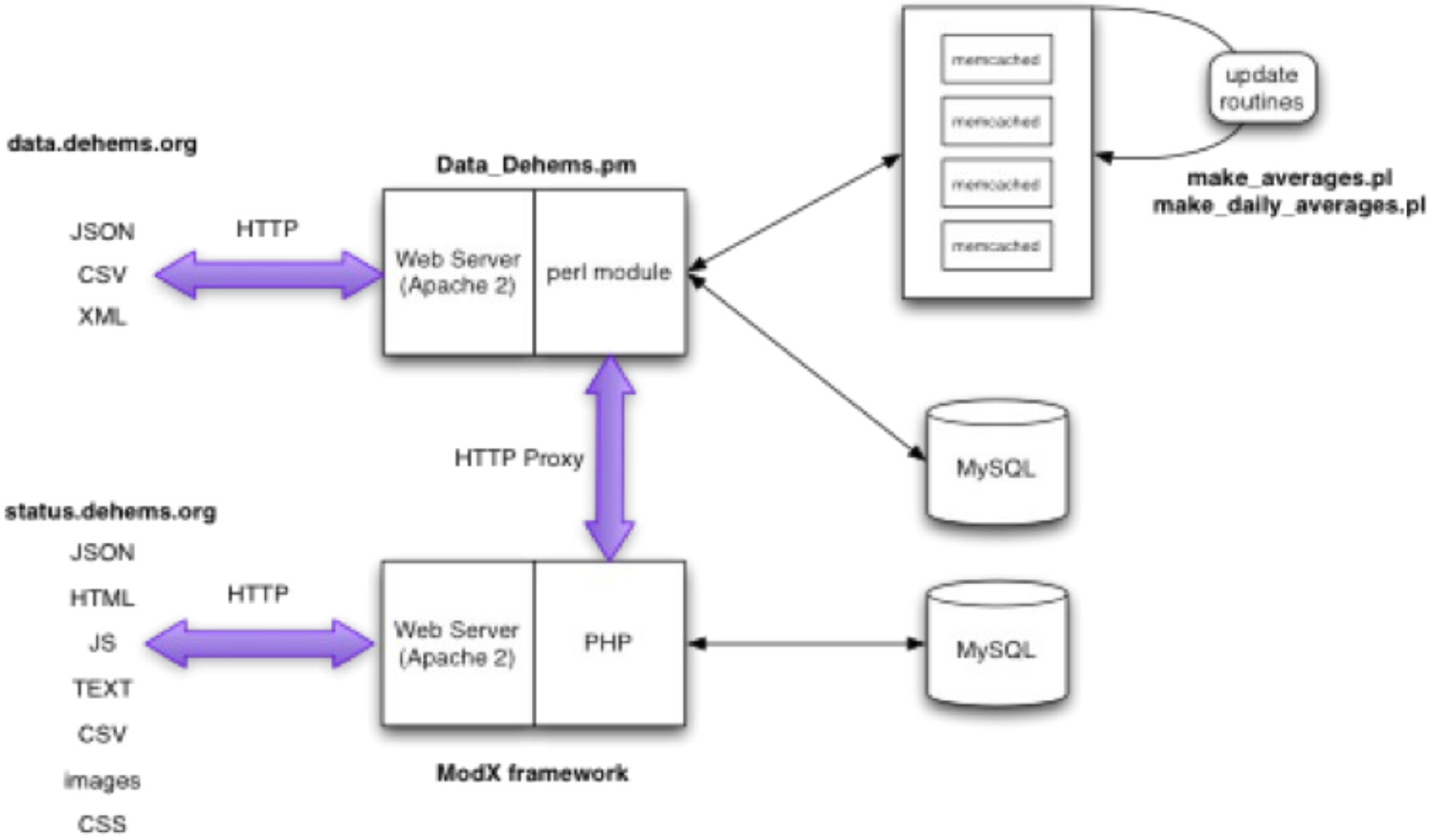
Living Labs

- Observations are real and dynamic
- Take requirements from end users
- Makes R&D market ready
- Simple pilot of 250 homes
- Significant excess public demand

Results

- People want to engage with issue
- Immediate impact in behaviour change
- New behaviour seems to be sustained
- Big scope for community functions
- People want to know more
- Target of 20% savings is very achievable

Pilot System Architecture



Future Projects

- UK Government DECC
  - Department of Energy and Climate Change
- Initial Tender for 10,000 homes to be monitored
  - Won by IBM Business Partner Hildebrand
- Prospect of 3 million homes in the future
  - 3,000,000 meters
  - A set of 26 readings every minute
  - 4TB raw data per week

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Hildbrand + Informix
3,000,000 Meter Challenge

3 Million Meters

- 3,000,000 Homes to have Smart Meters
- Up to 26 values recorded
  - Meter ID
  - Timestamp
  - 3 Electricity phases
  - 1 Gas reading
  - 20 Individual electrical sockets
- Initial data collected every 6 seconds
  - Aggregated to per-minute readings

3 Million Readings Per-Minute

- 3,000,000 meters, one reading every minute
- High data rate
  - 60*24 = 1440 readings per day
  - 50,000 Inserts per-second
- Large data volume
  - 12 Character Meter ID
  - 11 Byte timestamp YEAR TO MINUTE
  - 24 * 2 byte values (optimistically using SMALLINT)
  - Approaching 500Gb per day for data + simple index

Informix TimeSeries Efficiency

- Does not need to store NULL data
- Stores values as one long row including index + data on same page
- With typical 50% socket usage, storage required is ¼ of standard relational method
- Reduces I/O and physical media costs

Data Analysis

- Typical queries will look at sequence of readings over time
  - For an individual meter
  - Comparison between one meter and another or an average
- Relational storage requires series of index then multiple data page lookups
  - Data on a page will be for multiple, random meters
  - Data returned as multiple tuples which client must process
  - Missing data points must be generated
- TimeSeries data for one meter is held on sequential pages in index
  - No need for separate data page lookups
  - Much faster to build a sequence of readings
  - New TimeSeries datatype can be manipulated in the server
  - Missing values interpolated in the server

Example Query

- A common problem is to apply a tariff to the usage to calculate actual or predicted cost

- Complex tariffs exist which can only be sensibly held as TimeSeries themselves

```
SELECT house_id, plan, getnelems(reading),
    getFirstElem(reading).tstamp, getLastElem(reading).tstamp,
    ChargeCost (houses.reading::timeseries (meter_data),
            '2010-02-01', '2010-03-01',
            plan, tariff.charges::timeseries(tariff_t))
FROM houses, tariff
WHERE house_id = "d00001875159"
AND plan IN ("S", “W”)
AND region = "WEB";
```

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