

Electric Vehicles – Why Does IT Matter?

(Cloud Services IT, specifically)

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October 2009

Driving Forces – Governmental Incentives



U.S.

- \$25B Advanced Technology Vehicles Manufacturing Loan program from the DOE; \$2B economic stimulus program for battery development – to put 1 million EV on the road by 2015 (President Barack Obama)
- Stimulus grants awarded to date to Ford (\$5.9B), Nissan (\$1.6B), Tesla (\$0.5B)



China

- Funding to raise annual production capacity to 500,000 EV by the end of 2011



France

- €2.5B (\$3.68B) to 2 million electric cars on the road, and 1 million charging points in place by 2020 (Ecology and Energy Minister Jean-Louis Borloo, October 2009)



Germany

- €500M (\$705 M) stimulus funding to put 1 million electric cars on the road by 2020. "It is our aim to make Germany into the market leader for electric mobility" (Economy Minister Karl-Theodor zu Guttenberg, August 2009)



Japan

- Funding to guarantee that half of all cars sold by 2020 will be electric.



Spain

- €245M (\$360M) funding to put 1 million electric cars on the road by 2014 (Miguel Sebastian, Minister of Industry, Business and Tourism, July 2008)



UK

- £250M (\$400M) incentive program for buyers of electric cars (Transport Secretary Geoff Hoon, April 2009)

Driven Forces

- EV models expected to be seen in U.S. consumer market in mass quantities starting in 2010



Daimler
2010 Smart ForTwo EV



2010 – Transit EV
2011 – Focus launch



GM Chevy
2010 – Volt EV



Nissan
2010 – Leaf EV



- European and Asian market models



Volkswagen/Audi
2011 – Toureg PHEV
2013 – E-Up! EV



Tata Motors
2010 – Indica EV



BYD
2010 - s f6 EV



Mitsubishi
2013 – iMieV



Th!nk City
2008 - EV



BMW
2009 - Mini EV trial



Toyota
2009 – Prius PHEV
2012 - EV

Projected EV Adoption Rate – The Industry View



- By 2020, the worldwide EV population will be approximately 30M vehicles
- **By 2030, up to 50% of the vehicles manufactured worldwide are likely to be electrified**



- By 2015, worldwide sales of EV to account for 1%-2% of the market
- By 2020, 6% of the market
- In 2030 - 2040 timeframe, 'extended hockey stick' curve.



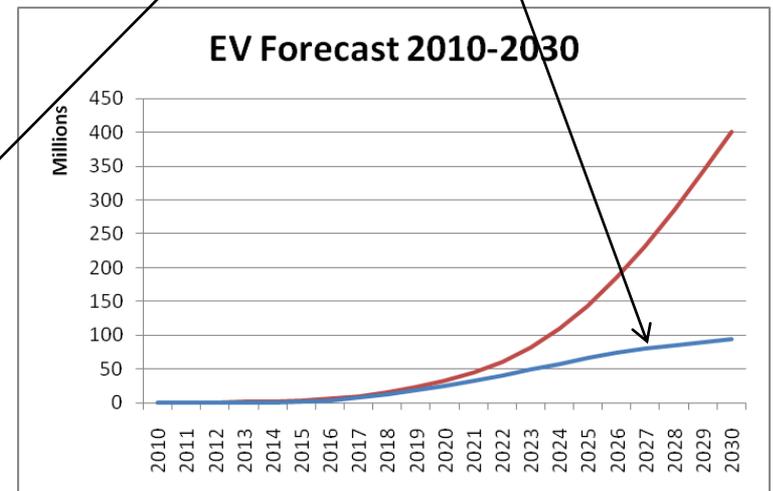
- By 2020, 10% of all Nissan car sales will be plug-in EV
- **By 2025, 1/3 cars made will be electrically powered**



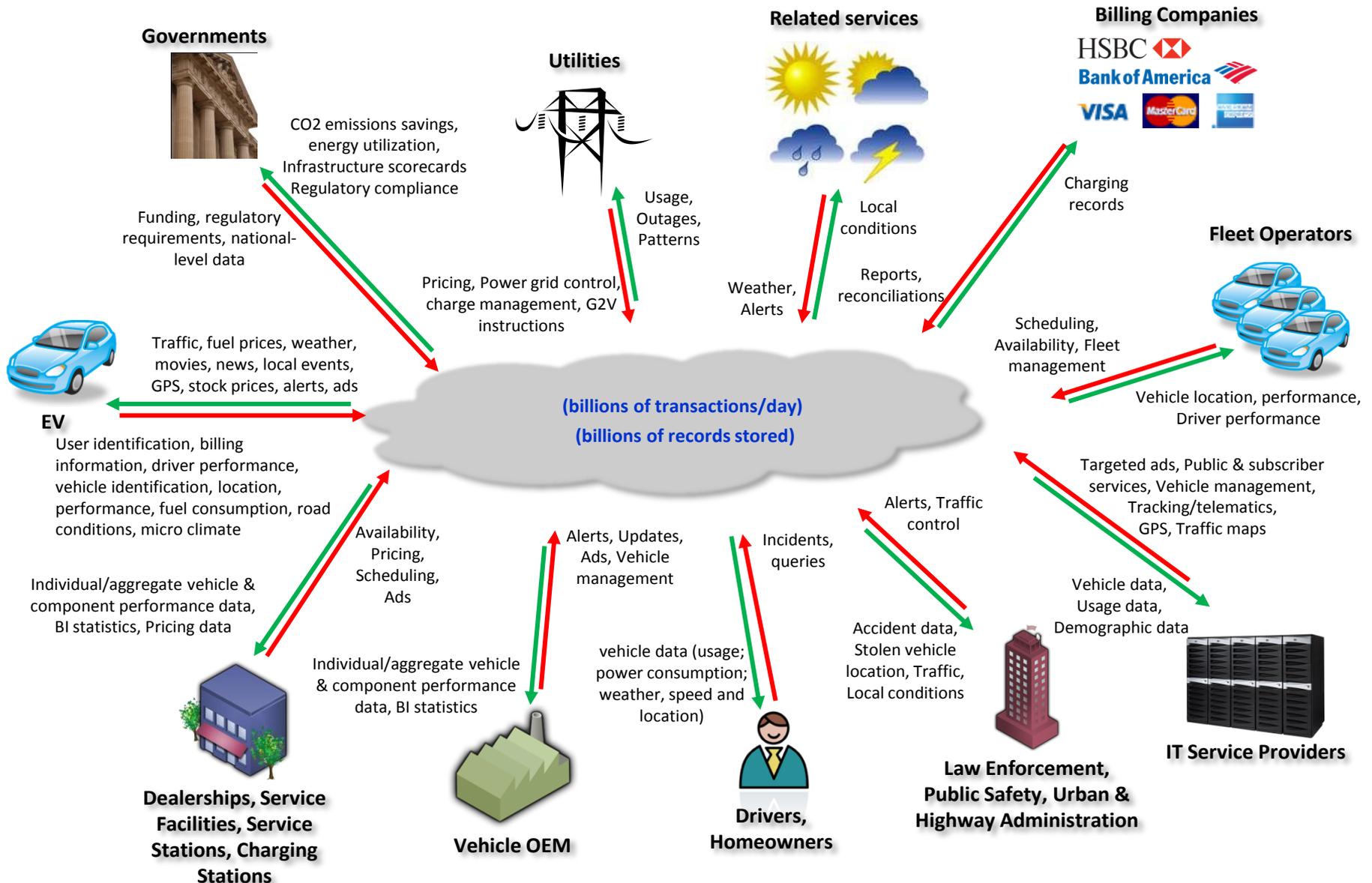
- **By 2050, nearly all vehicles on the road will be plug-in vehicles.**



	2009	2010	2015	2020	2025	2030
Automotive Forecast Data (000)						
Worldwide Auto Sales	56.79 M	58.51 M	77.49 M	98.68 M	119.09 M	137.83 M
Auto Sales Growth	-13.96%	3.03%	5.76%	4.46%	3.45%	2.67%
Car & Light Trucks In-Use	918.27 M	939.47 M	1.06 B	1.15 B	1.22 B	1.27 B
Autos In-Use Growth	1.85%	2.31%	2.21%	1.49%	1.01%	0.69%
Electric Vehicle Sales (% New Car Sales)						
Low estimate	0.05%	0.15%	1.10%	6.75%	7.90%	7.90%
High estimate	0.10%	0.20%	2.00%	10.00%	30.00%	50.00%
EV Forecast - low						
Worldwide EV Sales (low)	28,395	87,765	0.85 M	6.66 M	9.41 M	10.89 M
Total EV In-Use (low)	28,395	116,160	1.73 M	25.31 M	66.20 M	94.05 M
EV as % total vehicles in-use (low)		0.01%	0.16%	2.20%	5.42%	7.39%
EV Forecast - high						
Worldwide EV Sales (high)	56,790	117,020	1.55 M	9.87 M	35.73 M	68.92 M
Total EV In-Use (high)	56,790	173,810	3.54 M	32.53 M	144.28 M	401.01 M
EV as % total vehicles in-use (high)		0.02%	0.34%	2.82%	11.81%	31.53%

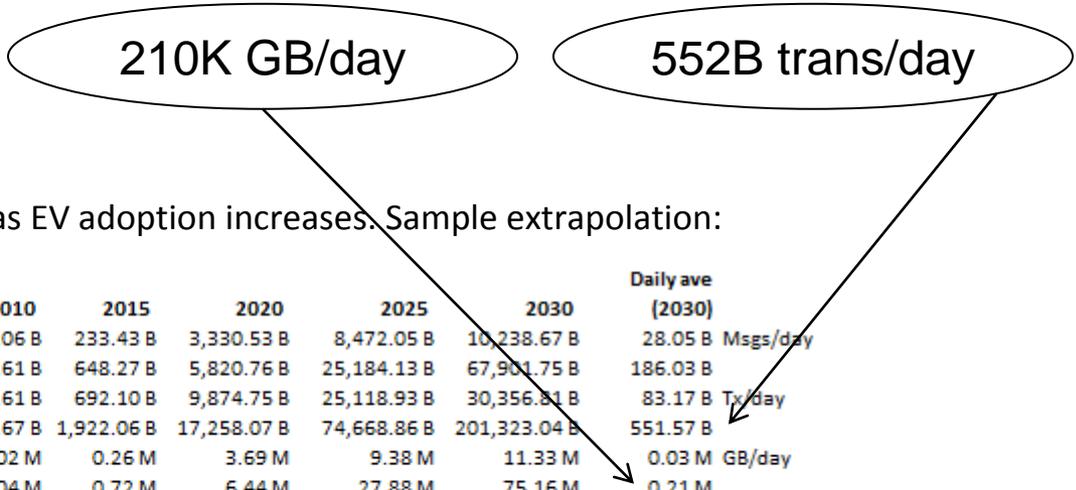


EV Ecosystem



Challenges for Pure In-Vehicle Solutions

- What do we have to deal with?
 - Hundreds of vehicle models
 - Thousands of device types
 - Thousands of governments
 - Thousands of government regulations
 - Hundreds of thousands of utilities
 - Millions of roads spanning thousands of utility borders, states, countries
 - Millions of charge points (service stations, parking lots, homes, offices)
 - Hundreds of millions of cars and drivers
- From an IT perspective - different types of computing requirements
 - Bandwidth - car to cloud communications
 - Messaging transactions – interface I/O
 - Storage transactions – file system I/O
 - Storage
 - Database storage
- Traffic and storage volumes build quickly as EV adoption increases. Sample extrapolation:



	2009	2010	2015	2020	2025	2030	Daily ave (2030)
Messages (low)	3.92 B	16.06 B	233.43 B	3,330.53 B	8,472.05 B	10,238.67 B	28.05 B Msgs/day
Messages (high)	10.65 B	32.61 B	648.27 B	5,820.76 B	25,184.13 B	67,901.75 B	186.03 B
Storage Transactions (Queue/Blob/Table) (low)	11.64 B	47.61 B	692.10 B	9,874.75 B	25,118.93 B	30,356.81 B	83.17 B Tx/day
Storage Transactions (Queue/Blob/Table) (high)	31.59 B	96.67 B	1,922.06 B	17,258.07 B	74,668.86 B	201,323.04 B	551.57 B
Bandwidth, GB (low)	0.00 M	0.02 M	0.26 M	3.69 M	9.38 M	11.33 M	0.03 M GB/day
Bandwidth, GB (high)	0.01 M	0.04 M	0.72 M	6.44 M	27.88 M	75.16 M	0.21 M
Storage, GB (low)	3,883	15,886	230,951	3,295,143	8,382,031	10,129,879	0.03 M GB/day
Storage, GB (high)	10,540	32,259	641,378	5,758,909	24,916,532	67,180,245	0.18 M
Database, GB (low)	2,715	11,107	161,472	2,303,834	5,860,385	7,082,411	0.02 M GB/day
Database, GB (high)	7,369	22,554	448,426	4,026,401	17,420,654	46,969,770	0.13 M

Opportunities to Improve EV Experience with Software + Services Solutions

- Base functionality
 - Registration
- Device Management
 - Battery data collection
 - Environment data collection
 - Other vehicle probe data collection (OBD-II, CAN, other)
 - Vehicle service data collection
 - Remote device management
- Information Services
 - Relating to charging at home
 - Relating to charging away from home
 - Standard/enhanced navigation (street maps, topological maps, charging stations, traffic, calendar/itinerary synchronization and route optimization)
 - Intelligent navigation – Dynamic /Preference-based vehicle routing from the cloud
 - Infotainment (Connectivity, collaboration, media management and procurement, entertainment)
 - Targeted advertising
- Application and Update Delivery
 - Base application store
 - Initial applications (news, stocks, weather, movie times, POI, etc)
- Business Intelligence, Management and Reporting
 - Consumer interfaces (in-vehicle, home, mobile device)
 - Other organization interfaces (utilities, Nissan, dealer, fleet management, law enforcement, etc)
 - BI functions (energy utilization, driver efficiency, vehicle performance, etc)

Driving a Familiar User Experience

The screenshot displays a calendar application interface for Wednesday, October 7, 2009. It features three overlapping schedule views: 'My Schedule' (blue), 'Car Schedule' (green), and 'Utility Rate Schedule' (light blue). The 'My Schedule' and 'Car Schedule' views show a series of events throughout the day, while the 'Utility Rate Schedule' view shows a vertical bar chart of electricity rates.

My Schedule (Blue):

- 7:00 - 8:00: Commute to work
- 8:00 - 9:00: Catch up on email
- 9:00 - 10:00: Team meeting; my office
- 10:00 - 11:00: Customer visit (101 Main St.)
- 12:00 - 1:00: Lunch
- 1:00 - 2:00: Get new tires (Service station)
- 2:00 - 3:00: Finish my billings
- 3:00 - 4:00: Prepare weekly sales report (Conf room 34/1301)
- 5:00 - 6:00: Commute home

Car Schedule (Green):

- 7:00 - 8:00: Commute to work
- 10:00 - 11:00: Customer visit (101 Main St.)
- 1:00 - 2:00: Get new tires (Service station)
- 5:00 - 6:00: Commute home

Utility Rate Schedule (Light Blue):

- 6:00 - 8:00: Discounted rate (\$0.05/kWh)
- 8:00 - 11:00: Peak rate (\$0.15/kWh)
- 11:00 - 12:00: Off-peak rate (\$0.10/kWh)
- 12:00 - 1:00: Peak rate (\$0.15/kWh)
- 1:00 - 3:00: Peak rate (\$0.15/kWh)
- 3:00 - 6:00: Off-peak rate (\$0.10/kWh)
- 6:00 - 7:00: Discounted rate (\$0.05/kWh)

The interface includes a left sidebar with a calendar for October 2009, a list of active calendars (My Calendars, Car charging, My Schedule, Car Schedule, Utility Rate Schedule), and a bottom taskbar with icons for Mail, Calendar, Contacts, and Tasks. A search bar at the top right is labeled 'Search Utility Rate Schedule (Ctrl+E)'.

Drive Where Do You Want To ~~Go~~ Today?



Photos from Beyond Oil conference, Redmond, 10/23/09.