Data Centers Efficiency
A global leader in power and automation technologies
Leading market positions in main businesses

- 145,000 employees in about 100 countries and 130 years of history
- $38 billion in revenue (2011)
- $5 billion in service revenue (2011)
- Publicly owned company with head office in Switzerland
- Leading provider of the electrical infrastructure solutions in Data Centers
- Completion of the offered portfolio for innovative DataCenter-solutions through several M&As: PowerAssure, Newave, Validus DC, Thomas&Betts, Ventyx
Data Center Facts

- Invest of a 9 M$ (1.000 sqm) in a Tier 3 Data Center with expected reliability of the infrastructure 99.9820% (downtime of 1.6 h p.a.)
- Or invest of 14 M$ (1.000 sqm) in a Tier 4 Data Center with expected reliability of the infrastructure 99.995% (downtime of 0.4 h p.a.)
- With measured Application Reliability (fact) of 99.65% (downtime of 31 h)
- But the SLA defined IT Application Reliability – measured by % uptime is 99.999% (downtime of 0.1 h)

→ Main Concern: (1) Supply Application Reliability then (2) Cost Efficiency
Data Center Risk Factors and Mitigation Strategies

Reliability of IT-Services defined in a SLA = \[
\frac{\text{MTBF}}{\text{MTTR} + \text{MTBF}} \times 100\%
\]

\[ R (\text{IT-Services}) = R (\text{Power}) \times R (\text{Cooling}) \times R (\text{Connectivity}) \times R (\text{Servers / Storage / Network / Security}) \]

IT Hardware → Virtualization:

Software Defined Data Center

Overheating → Run with low temperature:

Software Defined Cooling

No Power → Shifting application to other site:

Software Defined Power

→ Multi site, virtualized and load balanced – Location independent

ABB’s focus
Data Center “Participants”

Key Measure: Application Service Levels
Secondary: Efficient Use of Assets
Convergence
DCIM Maturity Model

Software Defined Power
Software Defined Cooling
Software Defined DataCenter

Level 1: Basic
No integration; basic monitoring supplied with equipment. Health and safety.

Level 2: Reactive
Software installed to monitor environment and equipment power use. Ability to adjust cooling to demand.

Level 3: Proactive
Datacenter equipment characteristics, location and operational status tracked. Energy and environmental data used to reduce risks, waste.

Level 4: Optimizing
Multiple IT and infrastructure subsystems integrated. Data models used for monitoring, service management, multiple views, optimizing in near real time.

Level 5: Self optimizing, autonomic
Integrated software adjusts datacenter behavior and resource use according to rules and data and service requirements.

Source: 451 Research

Source: The 451 Group
The Limit of a Software Defined Data Center Today
50% of downtime is caused by power problems

A few pertinent recent, notable examples

- **Equinix Syd2**: A utility power incident was detected at 8:02AM site local time and customer loads were transferred to generator power. Multiple AHUs tripped and had caused high temperature. Navitaire went down which stopped multiple airlines in Sydney.

- **Internap**: Reportedly out of fuel and offline, but it is trying to get more fuel to the building. As of 12:55pm ET, the Internap network operations center hotline was playing a recorded message that says the facility is "currently without power due to flooding" and that co-location and IP customers can expect "widespread outages" due to Hurricane Sandy.

- **Amazon**: A slew of sites, including Netflix, Instagram and Pinterest, have gone down this evening, thanks to “power issues” at Amazon’s Elastic Compute Cloud data center in North Virginia.
Utilities Facts

- Unexpected Outages
- Generation Problems
- Transmission Issues
- Intermittent Renewables
- Bad Forecast
- Over Production
- Over Utilization

➤ Main Concern: **Supply Reliability**
  Measured by CAIDI, SAIDI, SAIFI

Risk Factors and Mitigation Strategies:

- Adequate Generation ➤ Overbuild, use low LF Peaking Plants (v. costly)
- Transmission ➤ Multi-path, Congestion Management
- Distribution ➤ Redundancy, fast restoration
- Supply / Demand Balance ➤ Adequate reserves or demand response
## Data Center – multiple sites strategy

<table>
<thead>
<tr>
<th>Option</th>
<th>DtC 1</th>
<th>DtC 2</th>
<th>DtC 3</th>
<th>Summary</th>
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<tbody>
<tr>
<td></td>
<td>TIER Reliability (Facility)</td>
<td>sqm</td>
<td>Invest / sqm (Facility)</td>
<td>IT Capacity</td>
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Mitigate against Power Risk using

SLA
IT Services

Move Demand

Monitor Supply

DC1

APPLICATION

DC2
Software-Defined Product Portfolio

IT Applications
- Load Balanced
- Virtualized
- Private cloud
- SAP
- Financials
- Online
- Distributed

IT Management
- HP OpenView
- IBM Tivoli
- BMC
- CA
- Nagios

Software Defined Storage
- Like NetApp, EMC

Software Defined Servers
- Like VMWare, Citrix,
  - OpenStack

Software Defined Network
- Like F5, A10, NetScaler
  - OpenFlow

Inventory Details (DCIM)
- Like nLyte, iT ras, IBM

Cooling Management
- Like ABB’s Decathlon

Power
Software Defined Power

Monitoring & Analytics
- Appliance based integration with existing IT and Facility equipment and monitoring systems
- On-premise or hosted data repository
- IT Inventory integration
- IT Equipment reference data

Automation
- Out-of-band integration with facility and IT components
- Appliance based for easy security integration with in house security framework
- Based on runbooks (standard operating procedures) as defined for operations center
- Event driven, ongoing or schedule based

Energy Market
- Real time and day ahead power pricing details
- Demand response requests using OpenADR
- Alerts and energy forecast information
- Creation of IT forecast and data center operating schedule
- Capacity placement and energy trading integration
Decathlon and Global Energy Intelligence

History Pricing Alerts Forecast

Global Energy Intelligence®

Actual Utilization Data Center Load Energy Demand

Market Participation Trading Aggregation

Adjustments Curtailment Monetization
Result of Software-Defined Power

- Study by LBNL, SVLG & Power Assure completed in August 2012
- Shows how to use automation and analytics to participate in regional demand response markets

- Results:
  - Increased availability and reliability by shifting and shedding load automatically across regional data centers
  - Usable for energy cost arbitrage using a “Follow the Moon” strategy

From: Demand Response Opportunities and Enabling Technologies for Data Centers: Findings from Field Studies – LBNL August 2012
IT Forecast Leads to Data Center Forecast
Energy Management

4 Generators (N+1) / 12MW each

Historic 24hrs

NOW

Generator Maintenance

Sold
Overload
Forecast
Actual Total
Actual IT
Certified Emission Reductions - CERs Countries
E. g. China

- Carbon Credits available for Dynamic Power Management
- United Nations **CDM AM0105** currently translated
- Requires baseline measurements
- Requires dynamic power management as implemented in Software-Defined Power by Power Assure
- 10 year CO2 credit creation for all dynamic reductions
Data Centers as Distributed Energy Resources

- Data Center can increase reliability by knowing the status of the grid and being able to react, for instance by moving application load, turn on generation, pre-cooling, etc.
- Data Center will help stabilize the grid with these actions even though it is not a primary concern of the data center
- This cooperation between data center and utility can be monetized for both parties
Pre-Requisites for Participation

Data Center must have:
- Onsite storage (thermal, batteries, UPS, fly wheels, etc.)
- Own & operate multiple sites across geographies
- Software-defined power by ABB (Power Assure)
- Bi-directional power capability without transfer switch (for additional benefits)

Regulatory environment must support some of these:
- Demand response programs
- Flexible power purchase agreements
- Smart metering – for time of use pricing etc.
- Direct access to the wholesale power market
- Adequate retail rates for onsite generation – no net zero environment