Hybrid Cloud Architectures for Operational Performance Management

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Technologies

- Microsoft Azure
- HDI Insight
- SQL Server
- Azure Machine Learning
- Power BI

Areas of Expertise

- Customer Analytics
- Operational Intelligence
- Analytics for Finance
Quick census

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- Engineering
  - Design
  - Manufacturing
- Information Technology
  - Architect
  - Data Scientist
  - DBA
  - Developer
- Other
  - Manager
The NIST cloud definition framework

### Hybrid Clouds

- **Private Cloud**
  - SaaS
  - PaaS
  - IaaS

- **Hosted Cloud**
  - SaaS
  - PaaS
  - IaaS

- **Public Cloud**
  - SaaS
  - PaaS
  - IaaS

### Essential Characteristics
- Broad Network Access
- Resource Pooling
- Rapid Elasticity
- Measured Service

### Common Characteristics
- Massive Scale
- Homogeneity
- Resilient Computing
- Geographic Distribution
- Virtualization
- Service Orientation
- Low-Cost Software
- Advanced Security
Event volume

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Millions of senders
Variable rates
unpredictable
Halo 4 game data (1 week)

Large amounts of data
Predictable and
bursts
Event velocity

Device telemetry
Thermostats report data every 15 minutes
Cars send telemetry data every minute

Application telemetry
Application perf counters are measured every second per server
Mobile app telemetry is captured for every action on your app!

App and operational events
Halo game engine estimate 1,000,000 msg/s
Event source variety

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Connected/ Smart TVs
1B

Personal computers
2.5B

Smartphones and tablets
>5B

Connected internet of things
>10B

Revenue engines

Content

Applications

Apps and services

Services by verticals

Source: Gartner, IDC, Strategy Analytics, Machina Research, Company filings, BI Intelligence, Accenture analysis
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Event veracity

1. Devotion to the truth: truthfulness
2. Power of conveying or perceiving the truth
3. Conformity with truth or fact: accuracy

Record the confidence a source system has in the event value

Use a large enough N to confident in the value
Event impact

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Grid
Renewables
Oil/Gas/Coal Recovery and Distribution

Points of Sale
Restaurants
Hotels

Fuel Stations
Vessels
Cargo Ships

Aircraft
Cars
Trains
Bikes
Buses
Trucks

Remote Servicing
Predictive and Reactive Maintenance
Manufacturing Integration and Automation

Patients
Clinics
Hospitals
Nursing Homes

Patient Care
Clinic
Hospital
Nursing Home

Safety
Security
Comfort
Lighting

Automation
Integration and Automation
Remote Servicing
Predictive and Reactive Maintenance

Water
Waste
Pollution Control
Fire
Emergency

Public Safety
Law Enforcement

Public Safety
Law Enforcement

Smart Health-care
Smart City
Smart Cities

Smart Energy
Grid

Smart Retail
Smart Factory
Smart Logistics

Games
Events
Sports
Streaming
Television

Smart Entertainment
Smart Entertainment

Smart Building / Home
Smart Building / Home

Automation
Lighting
Security
Safety

Smart Building / Home
Smart Building / Home

Smart Cities
Smart Cities

Smart Energy
Smart Energy

Smart Factory
Smart Factory

Smart Logistics
Smart Logistics

Smart Retail
Smart Retail
Scenarios for operational performance management

Predictive Maintenance
• Avoid costly asset downtime and reduce maintenance costs
• Reduce warranty claims due to unexpected failures
• Improve inventory management of spare parts by predicting failures

Performance Management
• Improve Production Quality Assurance and Yield

Event and Incident Management and Monitoring
• Better protect Health, Safety and Environment
• Improve Situational Awareness, Security and Tracking

Route and Capacity optimization
• Optimize Power grids and networks
• Optimize Traffic and Goods movement
Process

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Design
- Business Objectives
- KPI’s
- Information requirements

Emit
- Exhaust data

Transport
- Communication
- Store-and-Forward?

Ingest
- Fast and scalable

Consume
- Exception alerting
- Query predictive analytics models

Insights
- Business Intelligence
- Train predictive analytics models

Visual Studio
- Visual Studio (device dependent)

ISS
- Reykjavik
- Event hug
- Azure NRT
- Azure ML

PowerBI
- HDInsight
- Azure ML
Operational Intelligence Reference Architecture
Capture, aggregate and analyze real-time machine data streams to enable faster insights for optimization and downtime prevention.

1. Machine / application telemetry streams are securely consumed via a large-scale, durable event processing service.
2. Machine Metadata is persisted and referenced to enrich operational analytics and maintenance prediction.
3. CEP enables temporal aggregations and queries for critical pattern or outlier detection in real-time.
4. Predictive Analytics enables real-time or periodic insights to potential machine downtime or adverse behavior.
5. Operators can derive deep insights from visualizations as well as perform ad-hoc "what-if" analysis through Self-Service BI tools.
6. Custom alerts can notify operators of potential issues, what endpoint enable additional application integration to satisfy machine-to-machine scenarios.

Events / Stream
- Batch
- Hybrid
Device communication patterns

Telemetry

Notifications

Inquiries

Commands
Device communication styles
Device communication scope
Selecting the right components

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Buy

Focus on Business Result and Time To Value

Mix and Match
• Custom protocols & security models
• Custom analytics and data processing

Buy Some, Build Some

Build

Core Competency in building software & Services
• Focus on flexibility & control
• Strategic investment in service platform
Azure ISS, no custom code

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- Limited experience in software and service development
- Very sensitive to time to market and budget
- Connect remote kiosks to ISS via Windows agents for basic device management

Scenarios and Workloads:
- Entire System Management
- Station Management
- Mobile Maintenance Worker Tasking and Support
Custom devices & portal on Azure ISS

- Depth and experience in software and service development
- Very sensitive to time to market (more buy than build)
- Connect sensors to ISS agents, push data to ISS
- Command and control from ISS
- Other Azure services used - AAD

Scenarios and Workloads:
- Entire System Management
- Station Management
- Mobile Maintenance Worker Tasking and Support
Custom protocol, to cloud gateway to ISS

- Limited depth and experience in software development
- Good fit for turn-key service platform
- Front end connectivity and data flow with Reykjavik
- Flow data into ISS for processing, device management
- ISS publishes data to customer storage account for batch processing
- ISS publishes copy of live data stream to customer Event Hub for custom processing
Custom protocols and Azure building blocks

- Depth and experience in software and service development
- High demand for control and flexibility (more build than buy)
- Needs custom protocol support for extant devices
- Build out on Azure services using Reykvavik components to streamline delivery
The right strategy

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Start by connecting the devices you already have

Utilize services and the cloud to jump-start your efforts

Combine the data you already collect

Generate new insights to create new business value

Expand by adding new devices, new services, new data
Intelligent (cognitive) systems

Russell and Norvig: AI An Agent-Based Approach
Lidberg’s law

Data born in the cloud, stays in the cloud. Data born on premised stays on premises.

Simon Lidberg, Microsoft
Homan’s law

Think carefully about where you place your data: it forms a gravity well. A data storage mechanism will attract other data in direct proportion to the amount of data it currently holds.

Uli Homan, Microsoft
Murphy’s law of distributed data

Don’t distribute your data. 😊

Compute locally, to join globally.

Delbert Murphy, Microsoft
Heuristics

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Synthesis  Heuristics  Analytical

Mystery  Heuristics  Algorithms and Data
Questions and answers
## Microsoft’s data platform stack

### BI & ANALYTICS

- **Self-service**
- **Corporate**
- **Collaboration**
- **Mobile**
- **Predictive**

### DATA ENRICHMENT AND FEDERATED QUERY

- **Single query model**
- **Extract, transform, load**
- **Data quality**
- **Master data management**

### DATA MANAGEMENT & PROCESSING

- **Relational**
- **Non-relational**
- **Analytical**
- **Streaming**
- **Internal & External**

### INFRASTRUCTURE

- **Scalability**
- **Virtualization**
- **Security and Identity**
- **Quality of service**
Microsoft’s modern data platform

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Microsoft data platform and types of data

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<table>
<thead>
<tr>
<th>DATA TYPES</th>
<th>DATA SOURCES</th>
<th>INFRASTRUCTURE</th>
<th>TOOLS</th>
<th>USERS</th>
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<td>Business</td>
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<td>ETL → SQL Server → DM</td>
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<td>web logs, RFID, “the internet of things”</td>
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<td>HDInsight, Map reduce, Hive, Pig, SQOOP, Flume, ..., R, machine learning</td>
<td>Data Scientists Quants</td>
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<td>Machines and other devices</td>
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<td>text, video, audio</td>
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<td>CloudML</td>
<td>Everyone</td>
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<td>Indexing / Search</td>
<td>Bing API, CloudML</td>
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