Oracle Complex Event Processing
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Agenda

• Technology Overview
• Architecture
• Fast Data Sales Play
• Packaging, Competition
• Use Cases for CEP
• Demo
Oracle Complex Event Processing
Lightweight, Low Latency, Extreme High Throughput, and Java-based Application Container

Event Sources
Database
Applications
Messaging
RFID

Event Distribution Network
CEP Processor
In-Memory Data Grid
Lightweight OSGI Server

SELECT S.stock, AVG(price) 
FROM SOME_STREAM S 
[range by 10 slide by 5] 
WHERE S.stock = ‘ORCL’
GROUP BY S.stock

“I want to look at 10 seconds worth of data”
“I want a result generated every 5 seconds”

Unmatched Performance and Scalability
1 Million Events Processed / sec (16 Intel Core)
<1 Millisecond Latency for 99% Events
Event-Driven Architecture

Event Sources

- Coherence
- Real Time Listeners
- Applications
- Databases
- BPM Processes

Response Services

- BAM Dashboards
- BAM Alerts
- BPM/BPEL Processes

Messaging

JMS

Event Sources

- Event sourcing
- Continuous query language to define event
  - Correlation
  - Sequencing
  - Window of time evaluation
- Pattern matching
- Event publishing
- Real time Java infrastructure

Closed loop
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Building Blocks

Event

– Defined by a schema: event-type
– Tuple of event properties

<table>
<thead>
<tr>
<th>StockEventType</th>
<th>Event properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>symbol</td>
<td>string</td>
</tr>
<tr>
<td>lastBid</td>
<td>float</td>
</tr>
<tr>
<td>lastAsk</td>
<td>float</td>
</tr>
</tbody>
</table>
Building Blocks

Stream

- Time ordered sequence of Events in time

- APPEND-only
  - One cannot remove events, just add them to the sequence

- Unbounded
  - There is no end to the sequence
  \{event1, event2, event3, event4, …, eventN\}
Building Blocks

Relation

– Collection of Events at some instantaneous time T
– Allows for INSERT, DELETE, and UPDATE operations
– Example:
  • At T=1: \{\{event1\}, \{event2\}, \{event3\}\}
  • At T=2: \{\{event1\}, \{event3\}, \{event4\}\}
    – No changes to event1 and event3
    – Event2 was deleted
    – Event4 was inserted
Application Model
Not JEE!

EVENT SOURCES

STREAM

EVENT SINKS

Contextual Data
What is a CEP Application?

OEP APPLICATION

Data Source

Adapter

<<Source>>

Event Processing Network (EPN)

Processor

Queries

Channel

<<Sink>>

Adapter

Data Source

<<Source>>

Channel

Queries

Channel

Channel

<<Sink>>
What is an Adapter?

Overview

• An adapter is an Event Source and/or Event Sink that interacts with external systems to:
  – Manage communication (e.g. connections and protocols)
  – Perform conversion between external data formats and events
  • Events are represented as Java Beans or Tuples
Adapters

Built-in Adapters

- **LoadGen (Inbound)**
  - Typically used for testing
  - Supports configurable duration, data rate, ramp up time
  - Predefined and user defined event types
    - `csvgen` – Sends CSV file rows over a socket to user defined event
    - `loadgen` – Sends randomized Level 2 stock ticks over a socket

- **JMS (Inbound and Outbound)**
  - Supports automatic mapping of Map based messages
  - Provides converter API for other message types (e.g. Text)
Adapters

Built-in Adapters (cont.)

• **HTTP Pub/Sub (Inbound and Outbound)**
  – Supports automatic mapping of events to JSON for basic types
  – Provides converter API for custom mapping to/from JSON strings

• **Socket framework**
  – API and examples for authoring socket-based adapters for optimal performance
What is a Processor?

Overview

- A Processor executes In-memory Queries on Streaming Data

Calculates aggregate values over a sliding 1 second window with output every half second
What is a Channel?

Overview

• A channel connects an event source to an Oracle CQL processor, and connects an Oracle CQL processor to an event sink. A channel is optional with other Oracle Event Processing processor types

• A Channel has two object types:
  – Streams
    • A stream is the principal source of data that Oracle CQL queries act on
  – Relations
    • A relation is a time-varying bag of tuples: in other words, an instantaneous relation
EDA is composed of several processing steps intermingled with user logic.

This arrangement or network of event processing components is called an Event Processing Network (EPN).
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Big Data
Information Generation is Accelerating

Do we have the tools to store, manage and analyze such amounts of data?

Source: http://www.go-gulf.com/blog/60-seconds
What is Big Data? What is Fast Data?
The 3 V’s of Big Data

- VOLUME
- VELOCITY
- VARIETY

a principle of big data: when you can, keep everything

Good read: [http://radar.oreilly.com/2012/01/what-is-big-data.html](http://radar.oreilly.com/2012/01/what-is-big-data.html)
Big Data & Fast Data
New Problems, New Opportunities

Problems left unanswered:
1. Still too much data! (even for a Big Data warehouse)
2. How can we react in real-time?
Big Data & Fast Data
Adding real-time value/capabilities with OEP, RTD & BAM

1. Filter out & persist useless, redundant data, correlate; find and focus on events that matter
2. Analyze, predict and act; execute critical decisions in real-time, complementing historical approaches
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Packaging: Oracle Event Processing

- **Removal of EDA Suite** from price list
- **Addition of standalone “Oracle Event Processing” SKU** (same CEP product we’ve been selling since 2008)
- **Pre-requisite:** Oracle Coherence Enterprise Edition (no WebLogic requirement)
- **Recommended add-on/ Upsell:** Oracle Java SE Suite


Competition

1. **TIBCO**, TIBCO Business Events Enterprise Production-Bundle
   **Strength**: leader in complex event processing (CEP), over 40 percent market share (IDC Study). Significant presence in the transportation (airline) market and recently, telecommunications.
   **Weakness**: Despite overall company strength in FSI, TIBCO CEP seems not well adopted in financial services vertical.

2. **IBM**, InfoSphere Streams, *(Appliance)*
   **Strength**: very active marketing with an Event Streaming platform that claims low latency and performance to satisfy any industry use case
   **Weakness**: Late entry into ESP market (delivered only last year) with an inefficient and difficult SPADE event language implementation requiring significant customer investment in Global Consulting Services. 2 solutions and usual IBM ambiguities.

3. **Sybase Aleri Streaming Platform**
   **Strength**: Mature CEP technology acquired from Sybase (Aleri/Corel8). Significant traction in FSI resulting from existing Sybase database market share. Portfolio of targeted industry solution offerings and strong partnerships (Toshiba etc.)
   **Weakness**: Organizational changes and repackaging issues are affecting market credibility. Poor HA implementation.
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Use Cases for CEP

1. Customer Experience
2. Transportation, Logistics & Fleet Management
3. Utilities: Demand & Response, Smart Meter
4. Public Sector: Emergency Response, Intelligence
5. Telcos: RT billing & WiFi offloading, Mobile billboard

- Also: RT risk management (Credit Suisse), Digital Oilfield, Manufacturing
Customer Experience

Opportunities driven by:

• Industry focus on new buzzword: **Customer Experience**

• Desire to harness potential of **social networks** for better targeted marketing

OEP can help with:

• Monitoring in real-time customer activity (social networks, location (e.g. proximity to stores), etc) and identifying opportunities in real-time

• Correlating with existing information (customer/ shopping profiles, etc.)

• Generating real-time alerts
Customer Experience
The Location-based Temporal Mobile Billboard

Make an offer
Give information
Send advertisement

PROJECT OBJECTIVES
• Provide a Mobile Billboard temporal location based marketing platform for its subscribers, to make offers and advertisements, and send alerts at the right place and the right time

RESULTS
• New solution infrastructure exceeded expectations by processing over 800,000 subscriber related events per second (with 1.5 Billion Events Daily)
• Provide and execute over 50 simultaneous campaigns
• Ensured customer Responsiveness with less than 1 second times with a scalable architecture, ready to expand on demand
COMPANY OVERVIEW

• Apple leads the industry in innovation with its award-winning computers, OS X operating system and iLife and professional applications.
• Apple spearheading the digital media revolution with its iPod portable music and video players and iTunes online store, and has entered the mobile phone market with its revolutionary iPhone.

CHALLENGES/OPPORTUNITIES

• Augment the iTunes infrastructure to provide improved customer interaction monitoring and equipment viability alerting

PROJECT OBJECTIVES

• Empower Apple Business User with real time alerts for critical events occurring from iTunes applications, hardware/OS infrastructure
• Enable users to dynamically inject various KPI related temporal queries allowing future proactive marketing and analysis
• Support H/A requirements to ensure that no outgoing alert event is lost to unforeseen disruptions

RESULTS

• Now supports 12,000 Application Servers with 500,000 events per minute with scaling possible beyond 2,000,000 events per minute
• Solution successfully layered over existing Coherence implementation with 200 JVM’s holding millions of STAT objects (700,000 objects enter the instances cache each minute)
• $16M deal, in production deployment > 5 months
Customer Experience
Improving Customer Satisfaction in Retail Banking

COMPANY OVERVIEW
• Europe’s leading savings, Spain’s 3rd largest bank
• 5,500 branches, more than 8,100 ATMs
• 10.7 million customers

CHALLENGES/OPPORTUNITIES
• Big Data Smart Banking Project
  • Analysis at user’s fingertips
  • Customer sentiment Analysis on feedback collected from Internal Social Media
  • Automated Pattern/event recognition and customer behavior.
• Online Marketing Automation.
• Client profile enrichment
• Event Processing together & Expert System together with Big Data Infrastructure for “Customer Experience Management”

PROJECT OBJECTIVES
• Event processing to capture information about the movement of ATM users (geo-fencing), as well as patterns in their usage
• Capture all credit card movements and ATM operations (around 2,000,000 by day) and get the geo-position of candidates (filtering rules) to push a real time coupon through RTD (real time decision)

RESULTS
• Project against IBM InfoSphere Streams even though IBM owns infrastructure as outsourcer
• Project implementation has started
Transportation, Logistics & Fleet Management

Opportunities driven by:

• Constant industry pressure for greater **efficiency**
• Need to differentiate through **premium services** and **greater reliability and visibility**
• Availability of cheap wireless **sensors** (temperature, GPS, etc.) that can be included in packages/containers/trucks

OEP can help with:

• Real-time monitoring of inflow of data from sensors
• Trends detection / prediction (t° rise, etc.)
• Leveraging our unique spatial capabilities (inherited from Database team)
Sascar Fleet Management
Automotive Telematics infrastructure

PROJECT OBJECTIVES
• Automotive Telematics, essentially they need to manage their vehicles in terms of route, speed, time of arrival, etc

RESULTS
• Exalogic to consolidate all Java applications on WLS and SOA Suite (OEP, ESB, BPEL);
• Exadata as the HW for the DB tier;
• Systems: Media Servers, Switches, Tape Libraries;
• Software: ULA contract (WLS, EECS, SOA Suite, WebCenter Suite, Database EE, RAC, Partitioning, Advanced Compression, Spatial, ODI, BI EE, Secure Backup);
• First Exalogic deal driven by OEP
DHL Japan – demonstration at OOW Tokyo 2011

温度異常の予測監視

詳細情報の表示

温度急上昇
（現在温度 - 10分平均温度 > 3℃）

温度の移動平均

- Track journey of packages in real-time (GPS)
- Monitor environment (temperature, vibrations, etc.) of sensitive shipments and take corrective actions before critical conditions are met (ex: drug shipment about to go over max acceptable temperature)
Utilities

Demand/Response, Smart Meter Monitoring

Opportunities driven by:

- Adoption of **Smart Meters**: concerns about bandwidth / processing power required to handle the information they generate, desire to offer value-add services
- Ever increasing electricity demand
- Demand for real-time billing & analytics
- Greater customer expectations re: outage & response times
- Regulations

OEP can help with:

- Alerting of consumption trends in real-time, enabling “Demand/Response”
- Real-time detection of problems (abnormal spikes in consumption indicative of leaks, etc.)
- Filtering out redundant or nested (ex: tree fell on the line) outage errors and problems
- Tracking of resources and personnel
Sempra Energy

COMPANY OVERVIEW
• Southern California Gas Company
  (5.1 million natural gas meters, 535 cities, USA’s largest natural gas distribution utility)
• San Diego Gas & Electric
  (3.4 million consumers in San Diego region)

CHALLENGES/OPPORTUNITIES
• Greater Demand for and Dependency on Electricity
• New Micro Grids and Power generation sources
• Complexity in managing electric transmission and distribution grids
• Standards/Compliance/Communication/Awareness
• Monitor/Detect/Respond/Prevent
• Real-Time Access Requirements
• Increasing Cost of Distribution and Management
• Aging IT Technology Falling Behind

PROJECT OBJECTIVES
• Install Smart Meter End Points and Wireless Network
• Replace over 2.1 million end point devices (electric meters and retrofit gas modules)
• Establish two-way communications infrastructure
• Replace manual meter reading with AMI
• Process interval energy use data in fifteen (15) minute and hourly increments
• Improve operational efficiencies and enable demand response
• Reduce peak energy use with demand response programs (load control)
• Collect load data for analytics and load profile metrics
• Mobility Workforce (Monitoring Maintenance Vehicles)

RESULTS
• System now live 24/7
• Looking at replacing other systems with OEP/SOA
COMPANY OVERVIEW

- EnerNOC help commercial, institutional and industrial organizations use energy more intelligently, pay less for it, and generate cash flow that benefits the bottom line
- EnerNOC’s technology-enabled energy management solutions are responsible for maintaining the real-time balance between supply and demand.
- EnerNOC’s world-class energy management applications unlock the full value of energy management for utilities, commercial, institutional, and industrial customers

CHALLENGES/OPPORTUNITIES

- The need for an application platform built from the ground up to support high-volume, real-time streaming data
- The ability to perform complex real-time calculations and decision processing on streaming data
- Provide an application framework that is scalable and can easily integrate with legacy applications and systems

PROJECT OBJECTIVES

- Detect event pattern fluctuations in streaming energy data from a potentially unlimited collection of commercial event source venues (Manufacturing, Medical and Educational facilities)
- Increase the effectiveness and dynamic aspects of the solution infrastructure to detect disconnected devices / meters based on real time event patterns within dynamic temporal conditions
- Enhances the solution by the detection of non-conforming curtailments from clients after an “demand and response” event, immediately monitoring for transgressions over thresholds for the program duration generating and visualizing alert events

RESULTS

- Successfully in production for 2 years with 6 more projects now planned
Emerson
Smart Data Centers & Energy Management

COMPANY OVERVIEW
• Leading global manufacturing and technology company
• Provides products and services in the industrial, commercial and consumer markets through Process Management, Industrial Automation, Network Power, Climate Technologies, and Commercial & Residential Solutions businesses
• Approximately 133,000 employees and 235 manufacturing locations worldwide.

CHALLENGES/OPPORTUNITIES
• Fast Data for Big Data, Smart Data Center Infrastructure Management Platform (DCIM) - Trellis
  • Event Processing not only deployed at the Enterprise Tier but on an innovative new custom Universal Management Gateway (UMG) Appliance – Embedded Eventing Edge

PROJECT OBJECTIVES
• Reduce the total cost of ownership (TCO) of data centers
• Proactively manage energy usage
• Predict infrastructure failures before they occur
• Optimize server and power chain headroom
• Communicate with and control heterogeneous equipment with different communication protocols and physical interfaces
• Automate policies and heuristic procedures to reduce operational costs
• Extend the useful life of existing data centers

RESULTS
• Project completed and announced worldwide – 3500 Units predicted for first 3 months
• http://www.datacenterdynamics.com/focus/archive/2012/05/emerson-adds-major-applications-trellis-dcim-framework

Sensor Networks Top Social Networks for Big Data
http://www.businessweek.com/technology/content/sep2010/tc20100914_28495b.htm
Telco
RT billing & WiFi offloading, Mobile billboard

Opportunities driven by:

• Overloaded data networks and new strategies to offload traffic: real-time billing vs unlimited, offloading to WiFi, degradation of service from 4G to 3G, etc.

• GPS-enabled phones offer new location-based marketing opportunities: “mobile billboards”

How can OEP help:

• OEP can handle the massive amounts of data generated by mobile devices, filter out, correlate and aggregate in real-time to only retain valuable information

• OEP can plug into all types of feeds, from devices to social networks

• OEP is integrated with Oracle spatial technology to understand location information
NTT DoCoMo

Enabling Real-Time Data Billing

COMPANY OVERVIEW
• The largest telecommunication company (60 million subscribers) in Japan and they have adopted Oracle Database for many mission critical systems for years
• 23,671 employees

CHALLENGES/OPPORTUNITIES
• Trying to shift the packet measured rate from packet flat-rate services due to the smartphone market is rapidly growing in Japan’s mobile market
• Introduction of 4G services brings new requirements (for instance to downgrade service from 4G to 3G after reaching cap)
• Increased need for flexible and accurate real-time billing
• Telco hardware vendors (Cisco, Grapevine, etc.) offer software billing solutions that are prohibitively priced and not very flexible

PROJECT OBJECTIVES
• Correlate data usage to allocated IP addresses and eventually user account in near real-time
• Receive data from Cisco Deep-Packet Inspection (DPI) devices and IP servers, then insert results in Big Data Warehouse (Hadoop)
• Handle existing 10M smartphones users (800,000 records/s) and demonstrate ability to scale to 60M

RESULTS
• Handling all 10M smartphone users since Nov. 2011!
• Over $4M of OEP + Coherence already booked, another $4.5M revenue arriving as smartphone adoption grows
• “Many new doors opening” with other opportunities for OEP across the NTT DoCoMo divisions
Telecom Italia
Complete Real Time Telecommunication Infrastructure Visability

COMPANY OVERVIEW

• Leader in fixed line and wireless telecommunication services in Italy and majority owner of Telecom Italia Mobile, Italy’s leading provider and operating in fixed-line and wireless communications for Latin America/Mediterranean region

• 2010 revenues for 27,571 million euros, 11,412 million euros of EBITDA, 3,121 million euros of profit and had capital expenditures for 4,583 million euros

• Fixed line network physical accesses were about 15.4 millions, 31 millions accesses on TIM mobile lines

CHALLENGES/OPPORTUNITIES

• Quickly pinpoint component performance issues across the enterprise-level IT infrastructure with many different applications coming from many different suppliers

• Analyze event streams generated from different IT sources and produce markers, real-time and progressive, to provide full visibility of the business and infrastructure agility

PROJECT OBJECTIVES

• Provide an Enterprise Infrastructure Monitoring event-driven platform

• Provide a Service Chain Monitoring event-driven Platform

RESULTS

• Created new flexible multi-layered architecture solutions called CEM and MODELS

• Providing High throughput, High configurability, Real-Time monitoring of heterogeneous systems, Easy integration
Public Sector
Emergency Response, Urban Optimization, Intelligence

Opportunities driven by:

- Heightened security requirements
- Ever increasing population in urban areas drives optimization requirements
- Increasing number of real-time data: video feeds, GPS data, traffic data, etc.
- Applications: Security Intelligence, geofencing, “Smart Cities”, traffic control, gateless tolls

How OEP can help:

- OEP has unique spatial/geolocation capabilities inherited from database
- OEP can plug in any data feed such as video / face recognition / OCR
- OEP meets rigorous performance & availability requirements in this space
City Platform re-engages Constituents with City

- **Collaboration**
- **Harmonization**
- **Modernization**

City Service:

- Citizen Empowerment

City Operation:

- Business Productivity

City Infrastructure:

- City Livability

Social Network:

- Entrepreneurs
- Sensors
European Aeronautic Defense and Space Company N.V.

Automated, Optimized Emergency Services Geospatial Operations

COMPANY OVERVIEW

• Delivers Multiple High Profile Government Projects including:
  • National Shield Security (NSS) Qatar: High performance sensors and state-of-the-art IT tools to secure more than 900 km of Qatar’s coastline, land borders and the Qatar Area Of Responsibility
  • FiReControl (UK): Providing England’s Fire and Rescue Services with new networked control capability

CHALLENGES/OPPORTUNITIES

• Deliver complex large systems integration projects with Heterogeneous environments
• Deliver large government projects that typically have stringent system performance and availability requirements

PROJECT OBJECTIVES

• Real Time Situation Awareness Monitoring and Visualization providing immediate Emergency response determination reducing response times
• Intelligent Dynamic Analysis of critical resource availability and applicability eliminating human error and improving efficiency
• Immediate definition of critical boundaries that define Geo-fenced Areas with integrated geographical spatial technology

RESULTS

• $3M Deal for New Solution empowers and facilitates Border Security implementations leveraged in the FRS modernisation & resilience programme with the consolidation of multiple FRS Control Rooms
Motorola Smart Cities

COMPANY OVERVIEW
- Motorola Solutions connects people through technology
- Motorola Solutions serves both enterprise and government customers with core markets in public safety government agencies and commercial enterprises
- Global presence with 23,000 employees worldwide in 65 countries with sales in over 100 countries

CHALLENGES/OPPORTUNITIES
- Provide a Fast Data intelligence layer for Big data streaming video feeds
- Event Processing analyzes Real Time Video meta-data for distinct patterns of interest to Government agencies and law enforcement
- Centralized Exalogic implementation

REAL-TIME VIDEO INTELLIGENCE
THE POWER OF REAL-TIME VIDEO – IN THE OFFICE, IN THE CAR AND ON THE STREET

PROJECT OBJECTIVES
- Projects worldwide using a reusable scalable architecture supporting 2800 or more cameras
- Streaming video meta data interfaces with IOmniscient processing for Face recognition and License plate monitoring
  - Event patterns for duplicate plates within temporal period beyond distance capabilities
  - Speeding analysis with driver recognition

RESULTS
- Ongoing partner relationship delivering planned projects in Mexico, Oman
- Prototyping successfully completed with live video feed data
- Foundational technology for Smart Cities platform solutions

How Much Data Will Humans Create & Store This Year (2011)?
1.8 zettabytes being created and replicated (Streaming Video)
57.5 billion 32 GB iPads, How much is that? About $34.4 trillion worth.
## Fast Data

### Target Segment / Account Profile
- Companies, government agencies dealing with large amount of data at high rate (telcos, internet retailers, smart utilities, homeland security etc.)

### Triggering Events / Needs
- **Need to accelerate, get real-time insight into business.** Ex: customer experience, billing, fraud detection, smart meters etc. (most of these are done today in a historical data mining fashion)
- **Adoption of Big Data as Data Warehouse and need to add real-time analytics on top of it** (keywords: Hadoop, NoSQL, etc.)
- **Buy-in into Gartner’s “in-memory computing” vision**
- **Interest in Exalytics**

### Questions to ask
- Can you detect and exploit changes in customer behavior/buying patterns etc.?
- Can you keep up with huge amounts of data coming from your sensors (smart meters, network equipment, ATMs, etc.)?
- Can you detect fraudulent behavior in real-time or only when it’s too late?
- Track location and **movement** of key assets (packages, trucks, …)
- Can **real-time decision making** be a differentiator for their company?

### Value Proposition
- Oracle Event Processing can help you with 2 things:
  - to **eliminate/consolidate/correlate data** before it clutters your data warehouse
  - to **analyze in real-time massive data streams**, as they get inserted in your big data warehouse
- Spot in real-time specific patterns (ex: customer buying patterns, asset movements and environment, fraud patterns, etc.)
- Real-time customer insight is a recognized competitive differentiator – but it can be hard without the right tools

### Product Components
- Oracle Event Processing, Coherence

### Competition
- IBM InfoSphere Streams
- SAP / Sybase Aleri
- TIBCO Business Events
- Apama
- StreamBase

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<table>
<thead>
<tr>
<th>Fast Data</th>
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• Product Installation
• Monitoring and Management (CEP Visualiser)
• Simple Vehicle Tracking and Alerting Demo
Oracle Event Processing on Exalogic

Oracle Complex Event Processing Exalogic Performance Study

An Oracle White Paper
September 2011

Resources for CEP

GLOBAL:

• website: http://my.oracle.com/site/pd/fmw/products/integration/CEP demos & movies, slides, etc.

• PM: Robin Smith, Demed L’Her, Peter Belknap, Lloyd Williams

EMEA:

• BD: Thrasos Thrasyvoulou

• PM: James Allerton-Austin

APAC:

• PM: Ken Ng
Hardware and Software

Engineered to Work Together