



Complex Event Processing Technology: Handling the RFID Avalanche

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Coral8 Overview

- **Company**
 - Founded in 2003
 - Based in Mountain View
 - Leverages research from Project STREAM (Stanford University)
- **Product**
 - First GA release in 2005
 - Coral8 Version 5.1
 - Industry-leading Complex Event Processing platform





The Biggest Problem in RFID:

- ... isn't the cost of RFID tags
- ... isn't attaching tags to items
- ... isn't reliably reading tags
- ...isn't privacy

BUT

- Intelligently analyzing and making sense of the avalanche of RFID data





Some examples

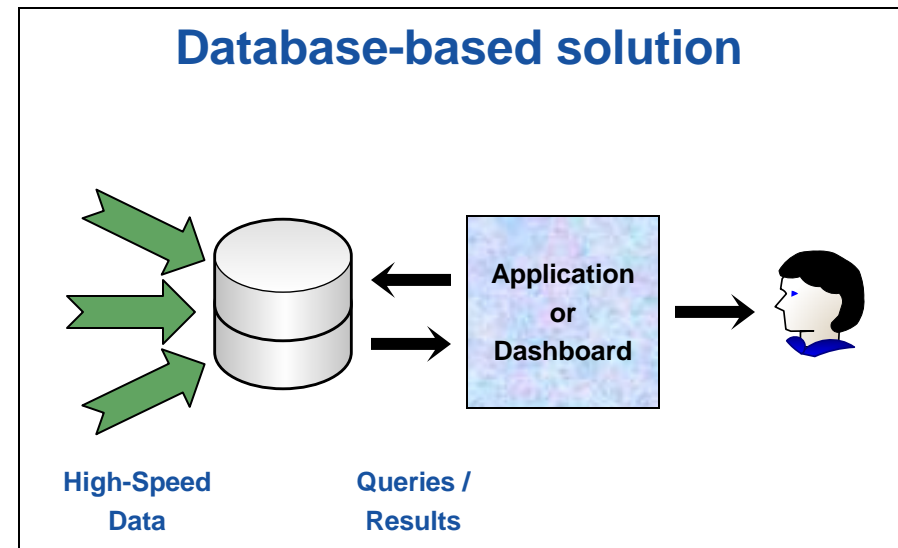
- Supply chain routing and optimization
- Retail product flow and stock-outs
- Hospital personnel and asset tracking
- Warehouse monitoring and optimization
- Manufacturing process flow monitoring
- Logistics optimization
- Workforce monitoring and optimization
- Tracking children in public places





Solution, 1st attempt:

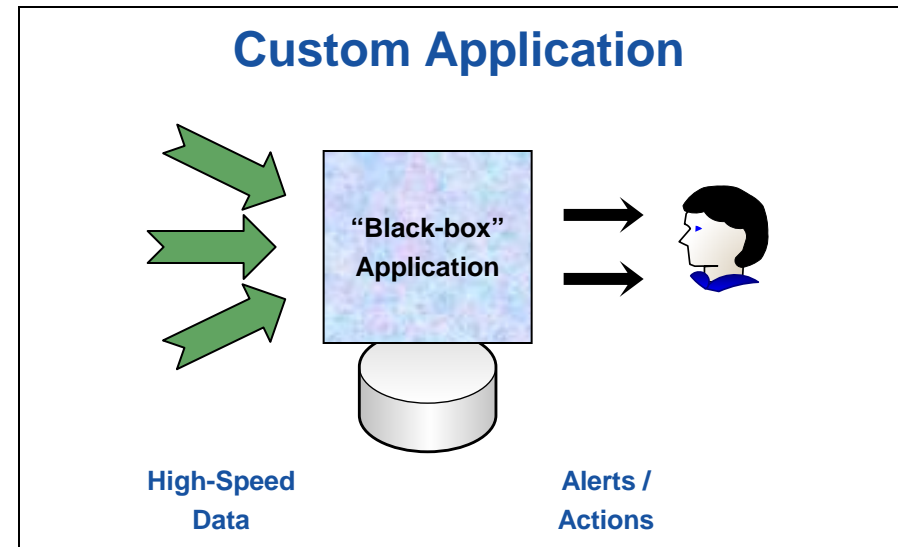
- Use good old database (Oracle, etc.)
- Good:
 - Familiar
 - Standard Relational Data Model
 - Structured Query Language (SQL) for complex analysis
- Bad:
 - Performance is orders of magnitude below the requirements
 - Reason: DBs are disk-centric. Everything must be stored on disk. Disks are slow





Solution, 2nd attempt:

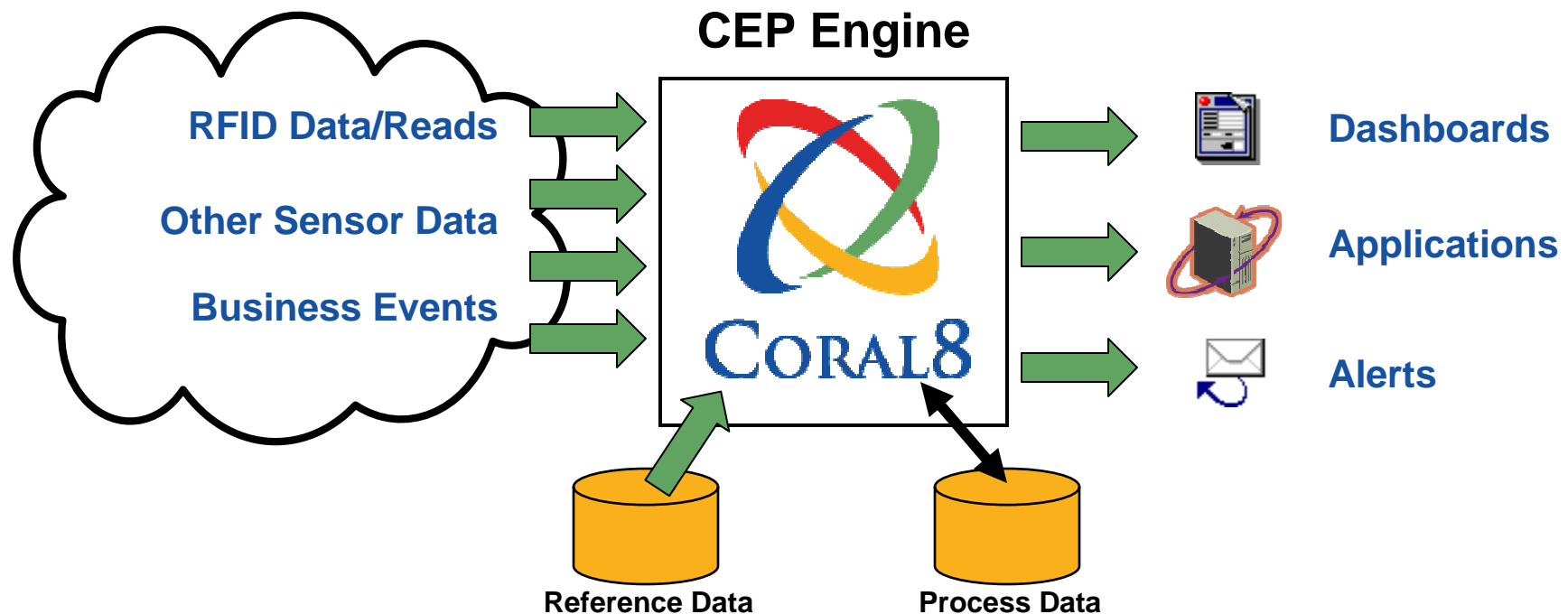
- Just write the whole thing in C/C++/Java/C#/...
- Good:
 - Can be fast if you know what you are doing
- Bad:
 - Few people know what they are doing
 - These people are expensive
 - Writing in C/C++/Java/C# is slow
 - Changing & managing low-level code is hard
- Thought:
 - What if we could combine the performance of C/C++ code with the ease of use of a database?





Solution: Complex Event Processing Engine

- Software platform for applications which:
 - Use high-speed event streams (100-1,000,000 msg/sec)
 - Integrate multiple data streams and stored data
 - Continuously process this data to drive business processes





Other CEP Uses

Financial Services

- Algorithmic Trading
- Compliance Monitoring
- Risk Management

Network Management

- Server/App Monitoring
- Load Balancing
- SLA management

Manufacturing

- Process Monitoring
- Yield Management
- Exception Monitoring

Security Applications

- Network intrusion detection
- Host intrusion Detection
- Spam detection

Web Applications

- Real-time personalization
- Real-time ad targeting
- Real-time ad management

Military / Homeland Security

- Battlefield monitoring
- WMD sensor monitoring
- Intelligence gathering





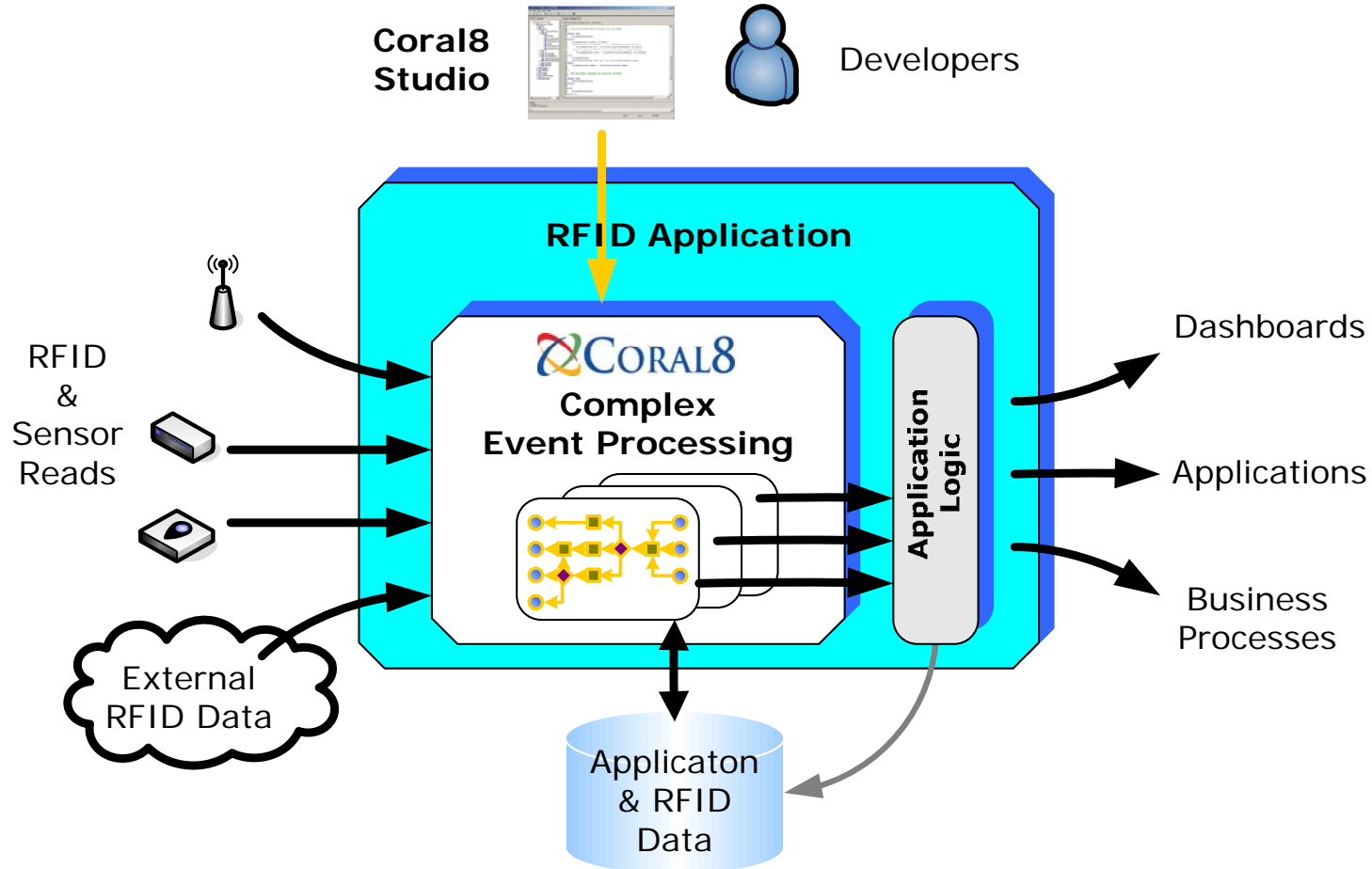
Coral8 CEP Engine

- High performance continuous processing engine
 - 10,000 – 500,000 msg./sec. on a single CPU
 - submillisecond event processing latency
- SQL-based language
- High Availability, Scalability, Deployment, Security



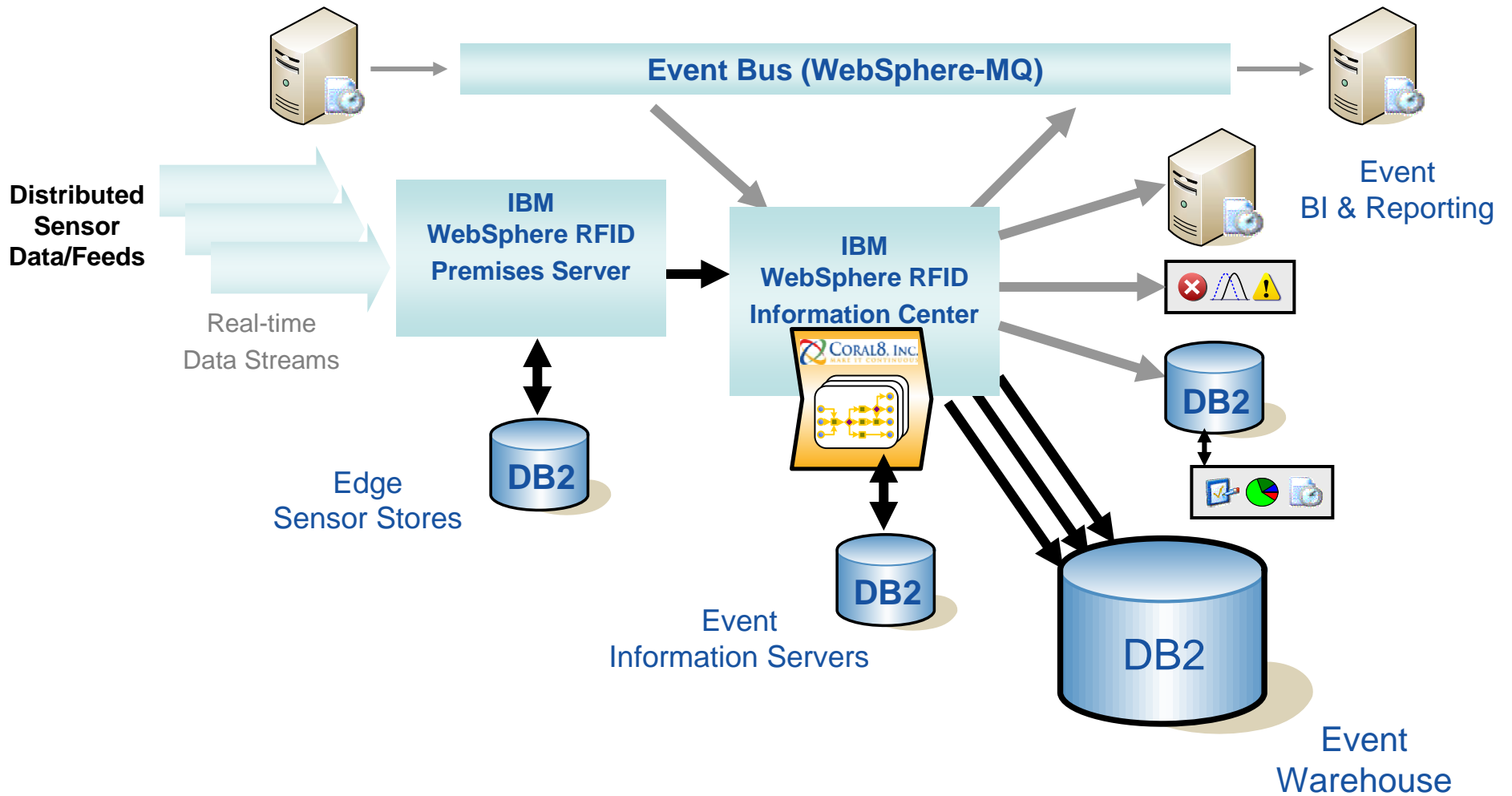


Coral8 Inside an RFID Application





IBM RFIDIC With Coral8





Key Operations

- Filtering
- Aggregation over windows
- Stream joins
- Event enrichment
- Compare to history
- Pattern matching
- Process Monitoring





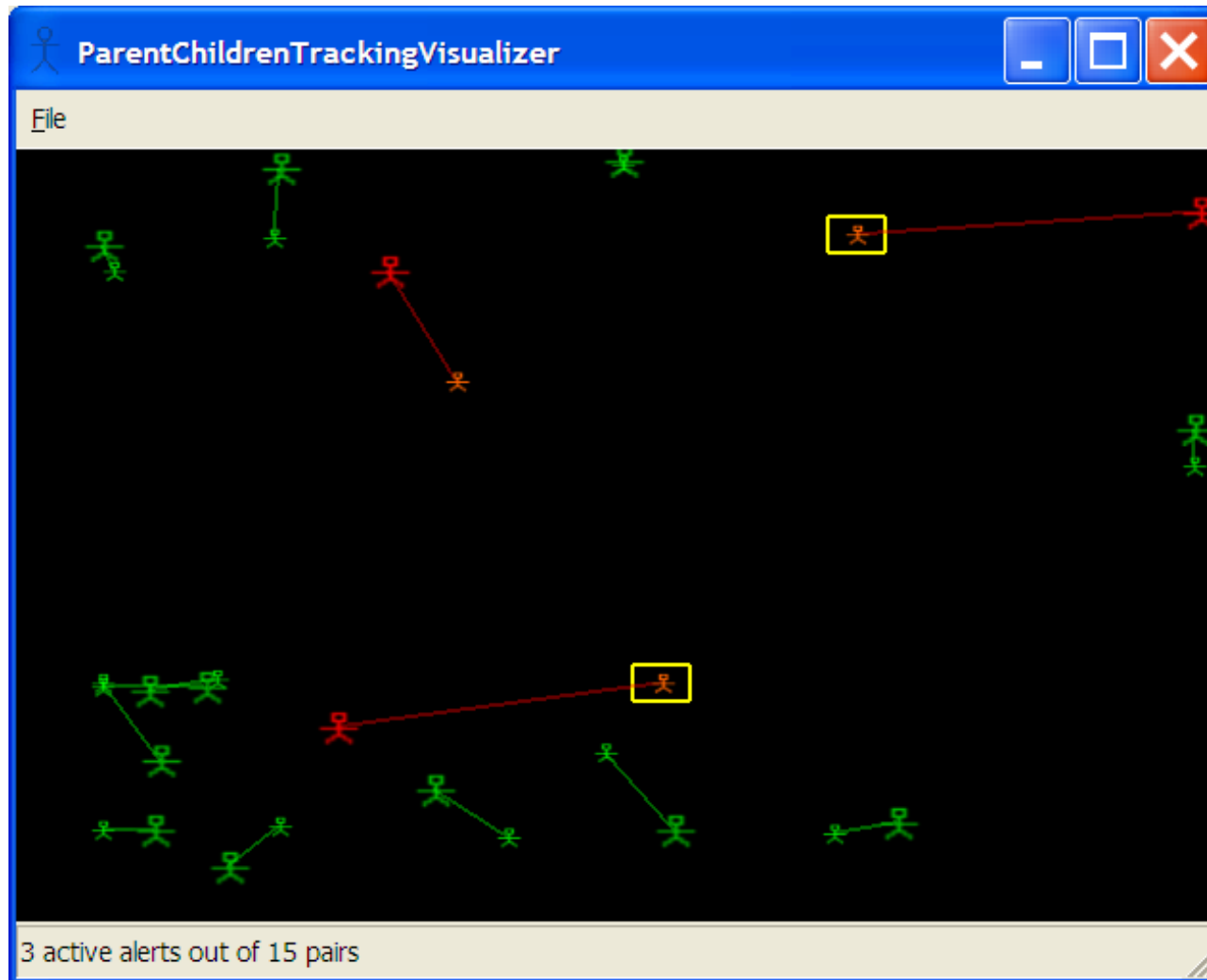
Easy to Develop: CCL

Use Case	Continuous Computation Language (CCL) Queries
Aggregation over Windows	<pre>INSERT INTO PharmaOutput SELECT COUNT(a.tagID), a.drugID FROM ReadStream a KEEP 30 MINUTES GROUP BY a.drugID WHERE a.loc = 'pharma'</pre>
Data Enrichment	<pre>INSERT INTO DrugDetails SELECT PharmaOutput.*, Drug.Name, Drug.Type, Drug.Trial FROM PharmaOutput, (database "Drugs" schema (Name String, Type String, Trial Boolean) [[select Name, Type, Trial from drug_data where drugID = ?PharmaOutput.drugID]]) as Drug;</pre>
Event Pattern Matching	<pre>INSERT INTO DrugTheftAlerts SELECT ReadStream.tagID FROM ReadStream a, ReadStream b, ReadStream c, ReadStream d MATCHING [30 MINUTES: a, b && !c, d] ON a.tagID = b.tagID = c.tagID = d.tagID WHERE a.loc = 'pharma' AND b.loc = 'office' AND c.loc = 'examroom' AND d.loc = 'door'</pre>





Demo: Tracking children in public places





Conclusion

Complex Event Processing technology is the answer to the RFID avalanche problem!

- Questions?
- Comments?
- Suggestions?

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