

Introduction to RFID Middleware

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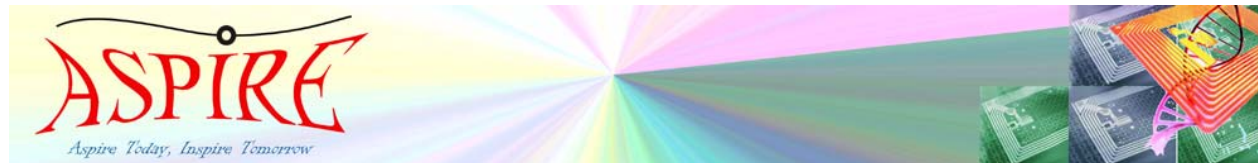
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Agenda

- RFID's operational benefits
- Need for RFID Middleware – What the middleware should do
- Middleware Vendors and offerings
- Levels of a middleware architecture
- Tiers of RFID Middleware



Uncover the RFID's operational benefits

- To uncover the operational benefits of RFID (reducing out-of-stock situations, decreasing labour requirements in the receiving process):
 - Must *process* the incoming RFID data and intelligently *integrate* it into your business applications.



Why is this process risky? (1)

- **Not all of the incoming RFID data is valuable**
 - Duplicate reads and excess information must be filtered out so as not to bog down the network and end up with confusing information inside your applications
- **Not all readers speak the same language**
 - Building custom integration logic for each brand of reader will quickly eat up your RFID deployment team's time and budget



Why is this process risky? (2)

- Different RFID information needs to be passed off to different applications and data stores.
 - For example, reads at the loading dock may need to be passed off only to the plant's local warehouse management application
 - Demand stream information coming from a retailer may need to be sent all the way up to the supplier's enterprise demand forecasting solution



Critical Notifications

- Capabilities mentioned before:
 - Heart and soul of a new breed of software called RFID middleware
- Forrester Research defines middleware as:
 - Platforms for managing RFID data and routing it between tag readers or other auto identification devices and enterprise systems





Understanding Middleware Needs

- The scope of what RFID middleware needs to do varies depending on whom you talk to
- Early RFID middleware solutions focused on features like:
 - Reader integration and coordination
 - Electronic product code (EPC)
 - Track-and-trace tools
 - Baseline filtering capabilities



RFID Middleware Functionality (1)

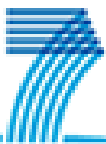
- **Reader and device management:**
 - RFID middleware needs to allow users to configure, deploy, and issue commands directly to readers through a common interface
 - For instance users should be able to tell a reader when to “turn off” if needed



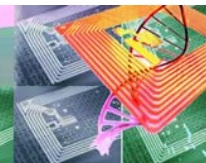


RFID Middleware Functionality (2)

- **Data management:**
 - After RFID middleware captures EPC data from readers, it must be able to intelligently filter and route the data to the appropriate destinations
 - Look for middleware that includes both low-level logic and more complex algorithms
 - Comprehensive solutions also offer tools for aggregating and managing EPC data in either a federated or central data source



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RFID Middleware Functionality (3)

- **Application integration:**
 - RFID middleware solutions need to provide the messaging, routing, and connectivity features required to reliably integrate RFID data into existing SCM, ERP, WMS, or CRM systems
 - Ideally through a services-oriented architecture (SOA)





RFID Middleware Functionality (4)

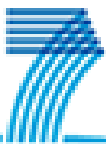
- **Application integration:**
 - A services-oriented architecture is essentially a collection of services
 - These services communicate with each other
 - The communication can involve either simple data exchange or two or more services coordinating some activity, such as order placement or inventory control





RFID Middleware Functionality (5)

- **Application integration:**
 - Middleware needs to provide a library of adapters to popular WMS and SCM applications (e.g., SAP or Oracle E Business Suite)
 - Application programming interfaces (APIs) and adapters for using standard technologies like JMS, XML, and SOAP to integrate with other third-party applications



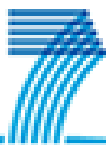
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RFID Middleware Functionality (6)

- **Partner integration:**
 - Some of the most promising benefits of RFID will come from sharing RFID data with partners to improve collaborative processes
 - Example: Demand forecasting and vendor-managed inventory
- This means that RFID middleware must provide:
 - B2B integration features like partner profile management
 - Support for B2B transport protocols
 - Integration with a partner's data over communications such as EDI, Web-based systems like AS2, or a well engineered system specifically for EPC data



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RFID Middleware Functionality (7)

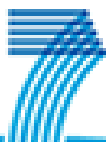
- **Process management and application development:**
 - Sophisticated RFID middleware platforms actually orchestrate RFID-related end-to-end processes
 - Instead of just routing RFID data to business applications: Touch multiple applications and/or enterprises.
- **Example Inventory Replenishment Scenario:**
 - Supposing that your system understands that you have a certain amount of one item coming through the door and the receiving process in the back of the store is tied to the point-of-sale data





RFID Middleware Functionality (8)

- **Process management and application development:**
 - You can accurately know when the inventory level becomes critically low and send a machine-generated message to the distribution centre to order more product
 - No human involvement needed
 - Key process management and composite application development features include workflow, role management, process automation, and UI (user-interface) development tools.
 - Specific tools help you create solutions that fit in with your existing applications
 - Benefit of machine-to-machine communication in a custom environment



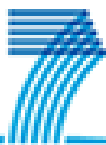
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RFID Middleware Functionality (9)

- **Packaged RFID content:**
 - RFID middleware platforms that include packaged routing logic, product data schemas, and integration with typical RFID-related applications and processes like shipping, receiving, and asset tracking are major assets
 - No one wants to start from a blank sheet of paper, and this content can give you a head start on your RFID projects



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RFID Middleware Functionality (10)

- **Architecture scalability and administration:**
 - RFID adoption is going to produce a lot of data, and RFID middleware is the first line of defence for reliably processing that data
 - This means that RFID middleware platforms must include features for dynamically balancing processing loads across multiple servers and automatically rerouting data (e.g., when a server fails)





RFID Middleware Functionality (11)

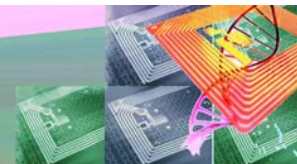
- **Architecture scalability and administration:**
 - Features need to span all tiers of the architecture even the devices that are located near or on the actual readers.





Middleware vendors and offerings (1)

- Vendors are flocking to the RFID middleware market, which is riddled with mandate-driven user companies whose RFID budgets are increasing.
- Vendor landscape is far from simple
 - There are small start-ups with unique solutions
 - Big companies with solutions only on paper
 - Everything in between
- AspireRfid
 - Training session devoted to AspireRfid middleware (<http://wiki.aspire.objectweb.org/>)





Middleware vendors and offerings (2)

- **Reader vendors:**
 - Some of the readers provide the previous mentioned middleware features, and it is expected many more to do so in the future
 - Middleware features that readers provide are very basic and typically limited to things like stripping out duplicate reads
 - To do more sophisticated filtering and routing, you need more contextual information, like data from multiple readers and business logic that may reside in existing business applications
 - This type of information is not available to individual readers



Middleware vendors and offerings (3)

- Vendors like ConnectTerra, GlobeRanger, and OATSystems emerged out of the early pilots sponsored by the Auto-ID Center
 - These vendors, along with some RFID hardware and software veterans like RF Code and Savi Technologies offer products that integrate with RFID readers filter and aggregate data and even incorporate business rules.
- Some vendors have come out of device management for the Department of Defense, like Cougar Software.
 - These vendors are still in their early stages, but their involvement in pilots and RFID standards development has turned them into valuable resources for practical RFID middleware know-how.





Middleware vendors and offerings (4)

- **Application vendors:**
 - Provia Software
 - Manhattan Associates
 - RedPrairie
 - SAP
 - Oracle
 - Sybase
- **Offer software:**
 - RFID-enabled applications for warehouse and asset management
 - RFID middleware solutions (reader coordination, data filtering, and business logic capabilities)





Middleware vendors and offerings (5)

- **Platform giants:**
 - Vendors like Sun Microsystems, IBM, Oracle, and Microsoft are extending their application development and middleware technology stacks to handle RFID
 - Each of these vendors is working to amass RFID experience and bring a strategic RFID middleware architecture to market
 - Bring unparalleled experience with highly scalable application platforms





Middleware vendors and offerings (6)

- **Integration specialists:**

- Integration specialists like webMethods, TIBCO Software, and Ascential Software are adding RFID-specific features like reader coordination and edge-tier filtering to their existing integration broker technologies
- Extensive experience with high-volume data and process-integration scenarios
- Opportunity to capitalize on RFID adopters that have already invested heavily in their integration broker technology



Middleware vendors and offerings (7)

- The Auto-ID Center at MIT was the source of many early RFID standards
- Savant:
 - “a data router that performs operations such as data capturing, data monitoring, and data transmission”
- Auto-ID Center envisioned Savants working together in a hierarchical framework to manage EPC data throughout the enterprise.
- Savant standard is the basis for RFID middleware



EPCglobal Standards (1)

- EPCglobal, Inc., a joint venture between EAN International and the Uniform Code Council, Inc., carried forth the research completed by the Auto-ID Center
- EPCglobal's Software Action Group is defining standards for several RFID middleware functions, including :
 - Capturing, securing, and accessing EPC related data.
 - Obtaining filtered, aggregated data from several sources.
 - ALE (Application Level Events) standard
 - Exchanging data and commands between hosts and readers to do things like read tags, write to tags, and kill tags
 - Configuring, provisioning, and monitoring individual readers



EPCglobal Standards (2)

- EPCglobal doesn't actively use the Savant terminology anymore
- Because EPCglobal has not officially published new standards for all these functions, you still frequently hear the term *Savant* used interchangeably with *middleware*
- EPCglobal Architecture and Standards are covered in separate training sessions of this series



Middleware Architecture

- To develop a network architecture for your middleware, you need to follow three key steps:
 - Understand the RFID middleware architecture tiers
 - Evaluate your existing middleware investments
 - Prioritize your middleware needs according to your deployment plans



Levels of a middleware architecture

- RFID gives you visibility into what's going on across all points in your supply chain e.g.,:
 - Receiving dock, Production line, Transportation vehicles, Retail store shelves etc.
- A lot of data coming from a lot of sources
- To process RFID data efficiently, middleware functionality can't be confined to a centralized data center
 - Rather distributed with the right level of logic placed at the right location, or tier, in the architecture



Tiers of RFID Middleware (1)

<i>Tier</i>	<i>What It Does</i>	<i>Where It's Located</i>
<p>The Edge Tier: The primary function of the edge tier is to serve as the first line of defense from an overburdened network.</p>	<p>Very basic filtering to filter noise and superfluous data from the network, such as duplicate reads, which often still exist despite advances in reader technology. May also aggregate multiple reads into "packages" of data that can be passed up to local applications, rather than sending individual read information.</p>	<p>Close to — or even on — the readers themselves. In the past, this logic resided on separate boxes, placed as close to the readers as possible. As readers become more intelligent, they host this middleware logic themselves, nipping unwanted reads in the bud right at the source.</p>

Patrick J. Sweeney, "RFID For Dummies" April 2005



Tiers of RFID Middleware (2)

<i>Tier</i>	<i>What It Does</i>	<i>Where It's Located</i>
<p>The Operational Tier: The role of this tier is to do more context-based filtering that requires knowledge of other reads coming through the system.</p>	<p>Decides where to route the data — either to a local warehouse management system or up to the enterprise, for example. Raises flags when exceptions occur (like when a pallet tries to leave a distribution center without enough cases on it) using business-event management logic. Stores some RFID data in a database so that a monitoring application can track all traffic flowing through that site.</p>	<p>At individual sites, like warehouses, distribution centers, or retail stores.</p>

Patrick J. Sweeney, "RFID For Dummies" April 2005



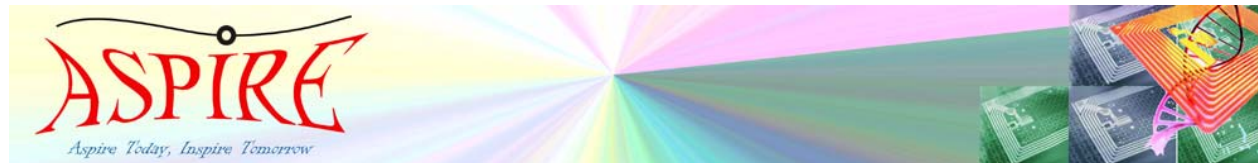
Tiers of RFID Middleware (3)

<i>Tier</i>	<i>What It Does</i>	<i>Where It's Located</i>
<p>The Enterprise Tier: The highest level in the architecture is similar to existing enterprise integration tools from vendors like TIBCO, webMethods, and so on. The goal of this tier is to accept data from the operational tier and incorporate it into enterprise-wide processes and/or applications.</p>	<p>Connects with common enterprise applications and data stores, like SAP or a centralized product information database. (Advanced systems will actually have process-management capabilities and some prepackaged logic for this task.) Communicates data to external business partners, like an advanced shipping notice that needs to be sent from a manufacturer to a retailer.</p>	<p>Oftentimes at one central data source where the information can be mined and acted upon for business decisions.</p> <p style="text-align: right;">Patrick J. Sweeney, "RFID For Dummies" April 2005</p>

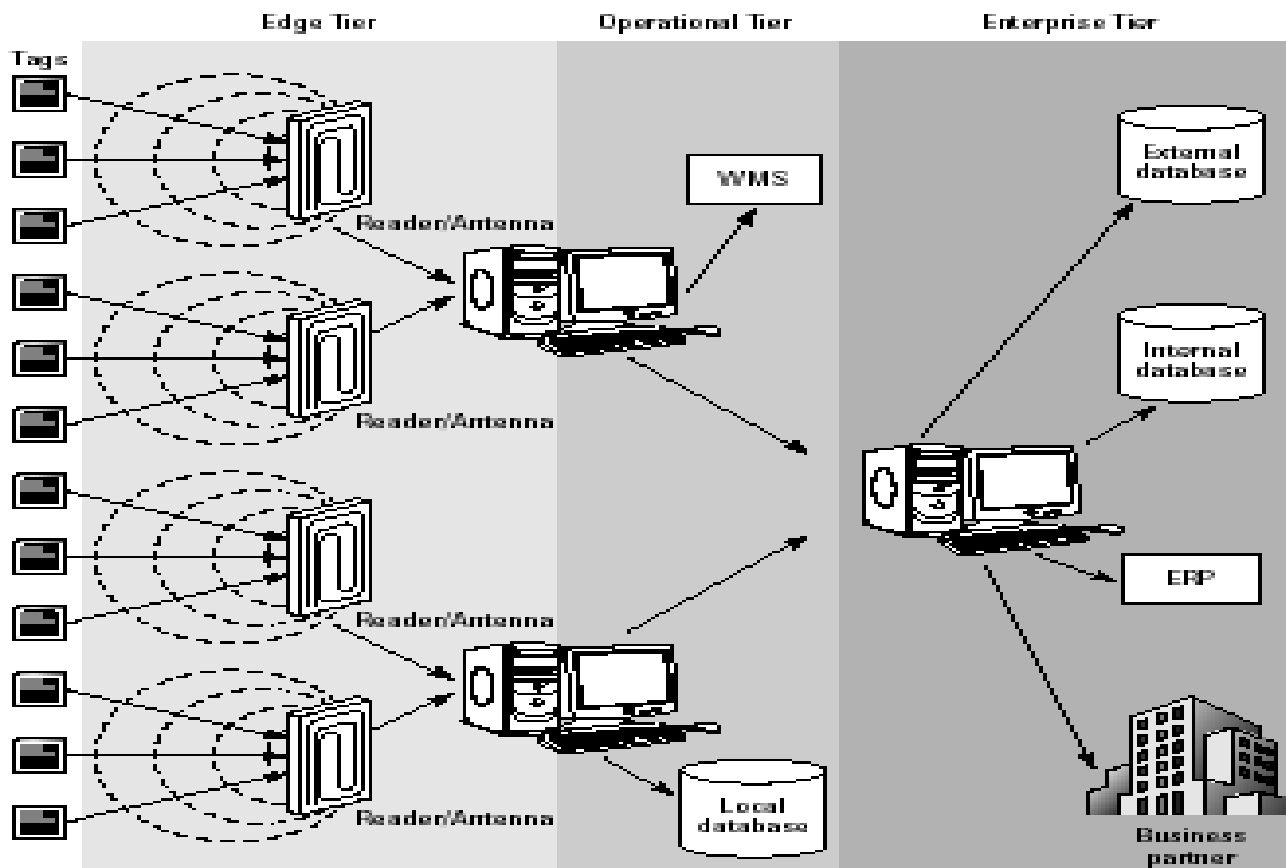


Tiers of RFID Middleware (4)

- Every company's number-specific business requirements are different and shape the definition of the optimal RFID architecture
 - Need to build a flexible architecture that can support the right level of logic at the right location



Three-tier architecture



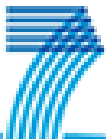
Patrick J. Sweeney, "RFID For Dummies" April 2005





Existing Investments and Skills (1)

- Identify which tiers, if any, can be accomplished with technology that you already have in-house:
 - Existing investments in middleware e.g., Application servers, Integration brokers, Data management and integration tools
 - IBM WebSphere Application Server, Oracle/BEA WebLogic Application Server, JBoss
 - TIBCO's BusinessWorks, SeeBeyond's eGate Integrator, IBM's WebSphere Business Integrator, Microsoft's BizTalk Server, SAP's Exchange Integrator, WebMethod's Integration Platform
 - Oracle database, Microsoft SQL Server, IBM's DB2 and/or WebSphere Product Center, Data-integration tools from Ascential Software.



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Existing Investments and Skills (2)

- Integration servers:
 - Offer content-based routing, data transformation, application integration, process management, and good reliability and scalability features
 - Can take on the middleware responsibilities that are needed at the enterprise tier
- What the infrastructure architecture will look like?
 - Interrogation zones, reader devices and communication and control needs
- Identify how you need to expand upon those existing technologies.



Architecture Tips (1)

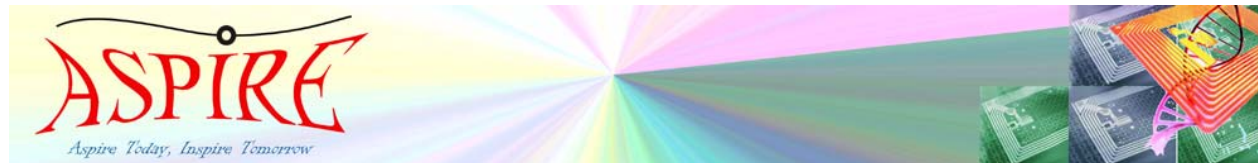
- Research which RFID vendors your existing middleware providers have partnerships with:
 - Clues to which solutions will work well with your existing investments
 - Most of the integration broker vendors have partnerships.





Architecture Tips (2)

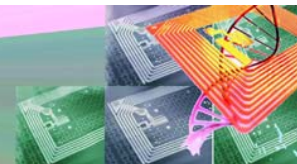
- Staff technology skills – Human Resources
 - Java shop or a .NET (Microsoft)
 - Each vendor tends to excel in one environment over the other
 - Most RFID middleware tools are still quite immature
 - Need to delve into the code and do some customizations





Architecture Tips (3)

- Ask for real-world use cases of your chosen hardware solutions with the various middleware players you are considering
 - Many middleware providers claim interoperability with all hardware, readers, printers, and hand-helds.
 - Important to install a test version in your or your partner's lab.



Prioritizing Middleware needs (1)

- Immediate demand for a wide spectrum of RFID middleware functionality
- Standards bodies like EPCglobal are constantly updating middleware standards
- Many of the vendors have adopted accelerated product release schedules to stay current with changing standards and get enterprise-class products to market as quickly as possible



Prioritizing Middleware needs (2)

- Coordinate your RFID middleware investments with your expected RFID rollout timeframe
- Understand the physics first and then design the middleware solution around your infrastructure and rollout for best results
- The middleware space is only getting more and more competitive, so take your time and make the right decision





Prioritizing Middleware needs (3)

- Long-term multi-tiered RFID middleware architecture
- Path to reach that end state varies:
 - Early adopter?
 - More conservative RFID adoption timeframes?



Early RFID Adopters (1)

- Need to meet fast approaching deadlines from retailers
- Start with middleware products that have:
 - Sophisticated reader coordination
 - Data management tools
 - Application features (EPC commissioning and track-and-trace tools.
- Look for middleware vendors that have a strong commitment:
 - Not only ensures that your initial implementations hit the ground running but also offer the opportunity to integrate with a more scalable platform as RFID deployments grow



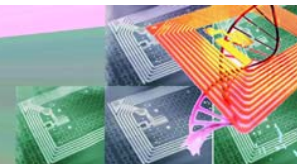
Early RFID Adopters (2)

- RFID adopters with large-scale RFID deployment plans should look to larger vendors that can provide scalable infrastructure and integration features
 - Vendors will provide the backbone for creating for a flexible, multi-tiered architecture that supports high-volume data and process integration scenarios.



More Flexible timeframes

- Long-term application strategy:
 - Plan several years out
 - Create a middleware strategy that is as scalable as your enterprise architecture strategy
 - Evaluate large-scale offerings from some new players in the RFID space who are highly experienced in the enterprise space
 - SAP, Oracle,
 - Consider TCO benefits of AspireRfid and OSS RFID Middleware



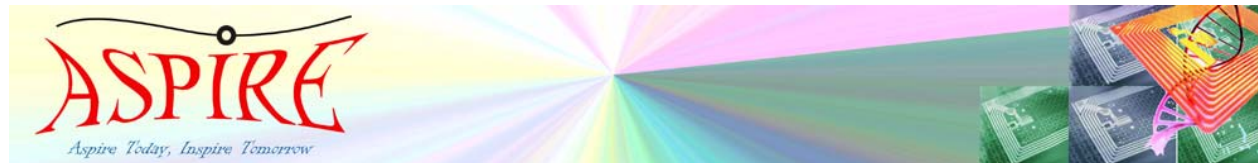
RFID Middleware benefits (1)

- Minimized network traffic through intelligent filtering
- Lower reader-management costs through centrally coordinated readers
- Immediate visibility to pertinent RFID data through routing, filtering, and track-and-trace tools
- Minimized on-going integration costs through standard APIs and prepackaged application integration tools
- Well-architected RFID middleware can enable more strategic opportunities that go way beyond these initial, rather obvious benefits



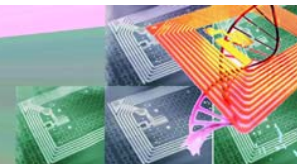
RFID Middleware benefits (2)

- Conventional goal of RFID middleware:
 - Intelligently pass RFID data from readers to enterprise applications
- More exciting application of RFID middleware:
 - Serve as the foundation for building new applications that take advantage of real-time, item-level data
 - Support new ways of doing business.



RFID Middleware and Business Processes

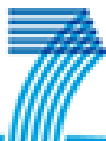
- Leverage the ability of RFID to create rules and actions in a true machine-to-machine communication format.
- The system should be able to do everything from inventory forecast cycles to creating pricing strategies.
- Admittedly, RFID middleware alone can't provide everything that's needed to build this new breed of applications.
- See **AspireRfid BPM (Business Process Management)** features





Middleware Depends on Deployment Scenario(s)

- Forrester evaluated leading RFID middleware vendors using approximately 75 criteria that spanned everything from edge-tier features to enterprise-level process management.
 - www.forrester.com/Research/Document/Excerpt/0,7211,34390,00.html
 - 13 RFID middleware vendors in the assessment
- Results varied across vendors:
 - Impossible to compare
- Evaluation separated into two components:
 - one for early adopters and
 - one that focused on features most important for supporting longer-term, high-scale deployments.



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