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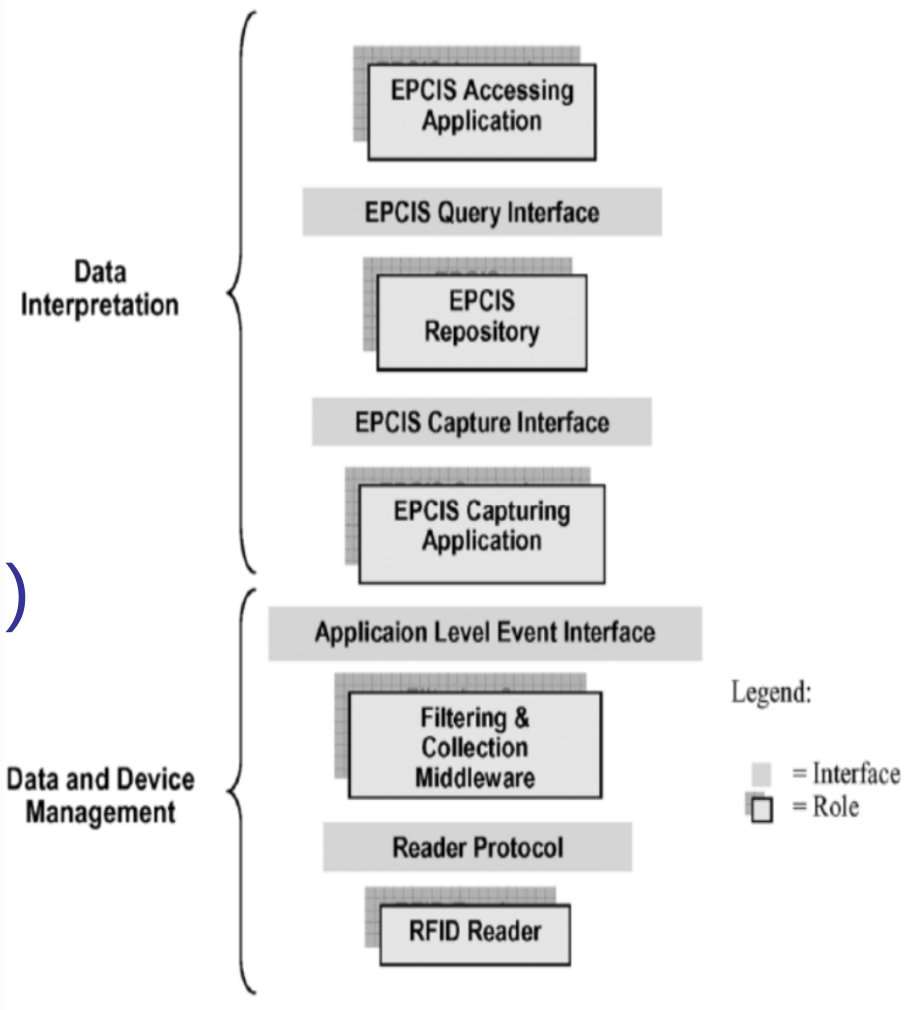
ASPIRE Architecture and Middleware

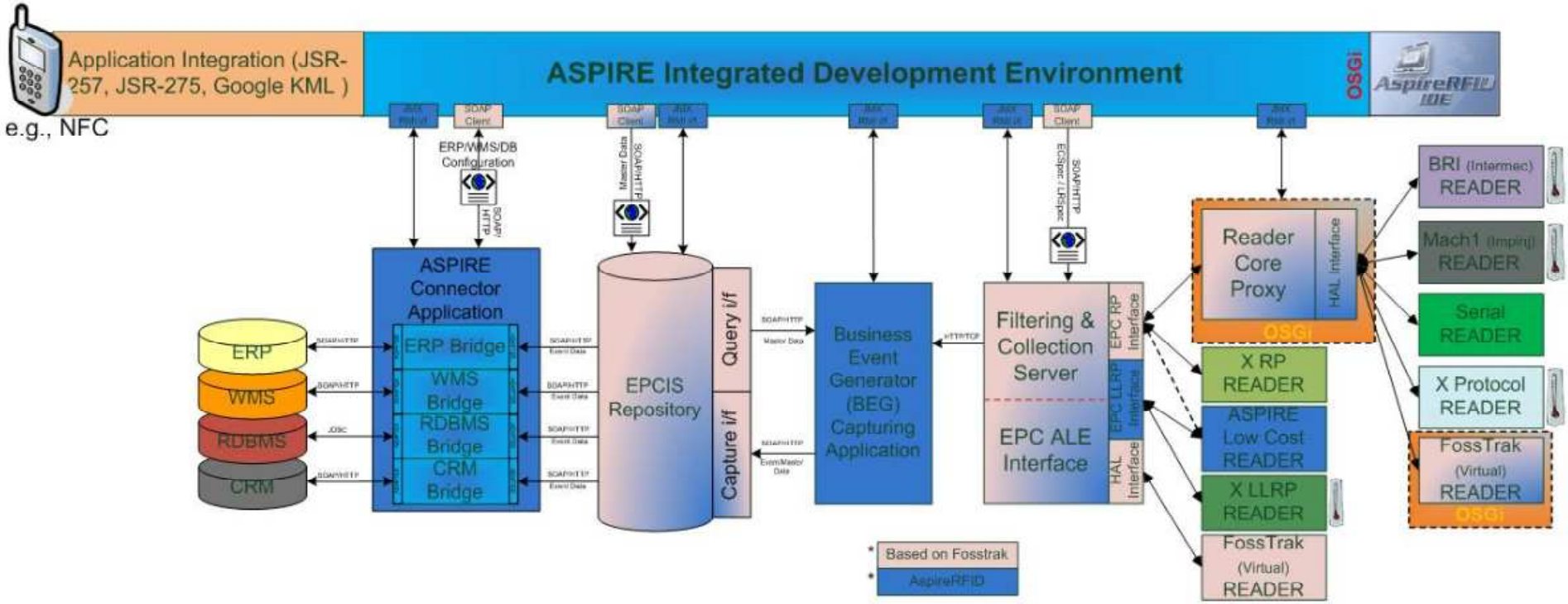
Athens Information Technology

EPC Specification (revisited)

- Electronic Product Code Information Services (EPCIS)
- Application Level Events (ALE)
- Reader Management (RM)
- Reader Protocol (RP)
- Low Level Reader Protocol (LLRP)



ASPIRE Middleware Architecture



Main Characteristics

- Standards-based
  - Mainly EPC Global
- Multi-Layered
  - Interfacing to readers
  - Filtering Data
  - Generating Business Events
  - Interfacing to Business Applications
- Seamless Integration with ASPIRE IDE
  - Configurable/Programmable

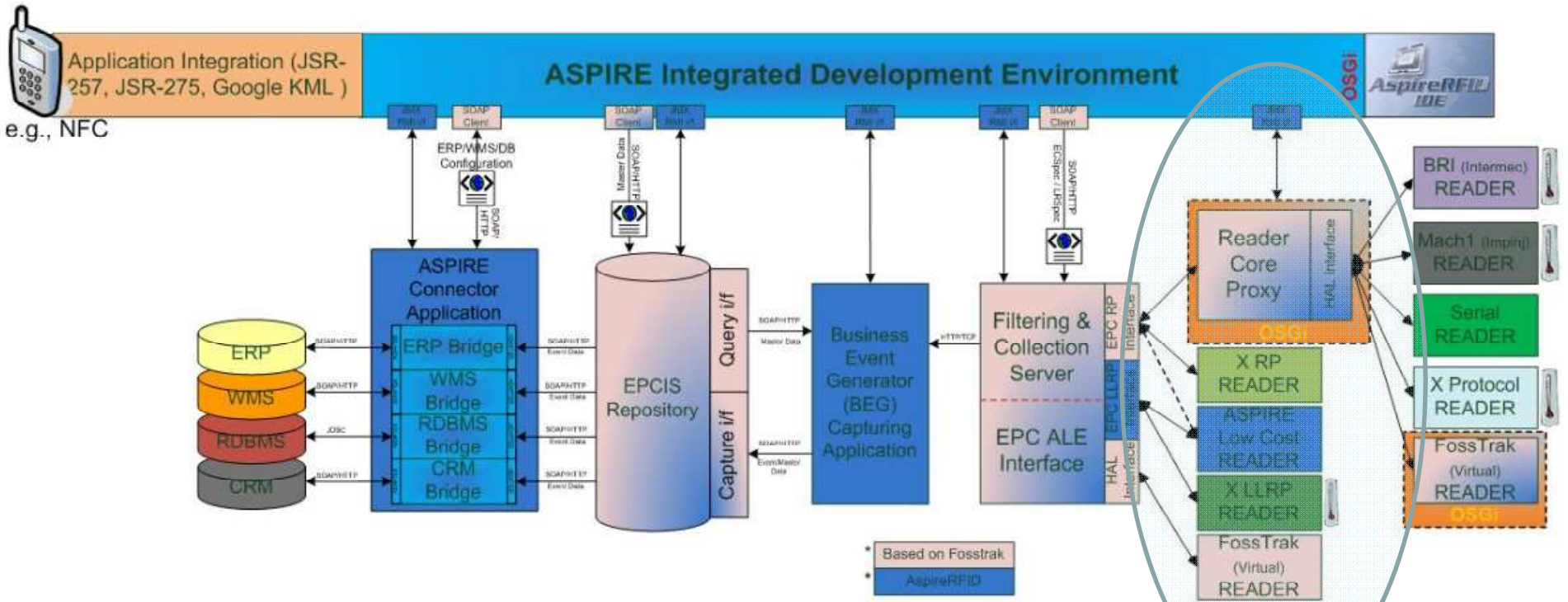
Overview of Middleware Components (1)

- Tag Data Translation
  - Communicates with tags using Tag Protocol
- Hardware Abstraction Layer
  - Allows communication with non EPC-compliant readers
- Filtering and Collection
  - Generates filtered reports
  - Based on programmable filters

Overview of Middleware Components (2)

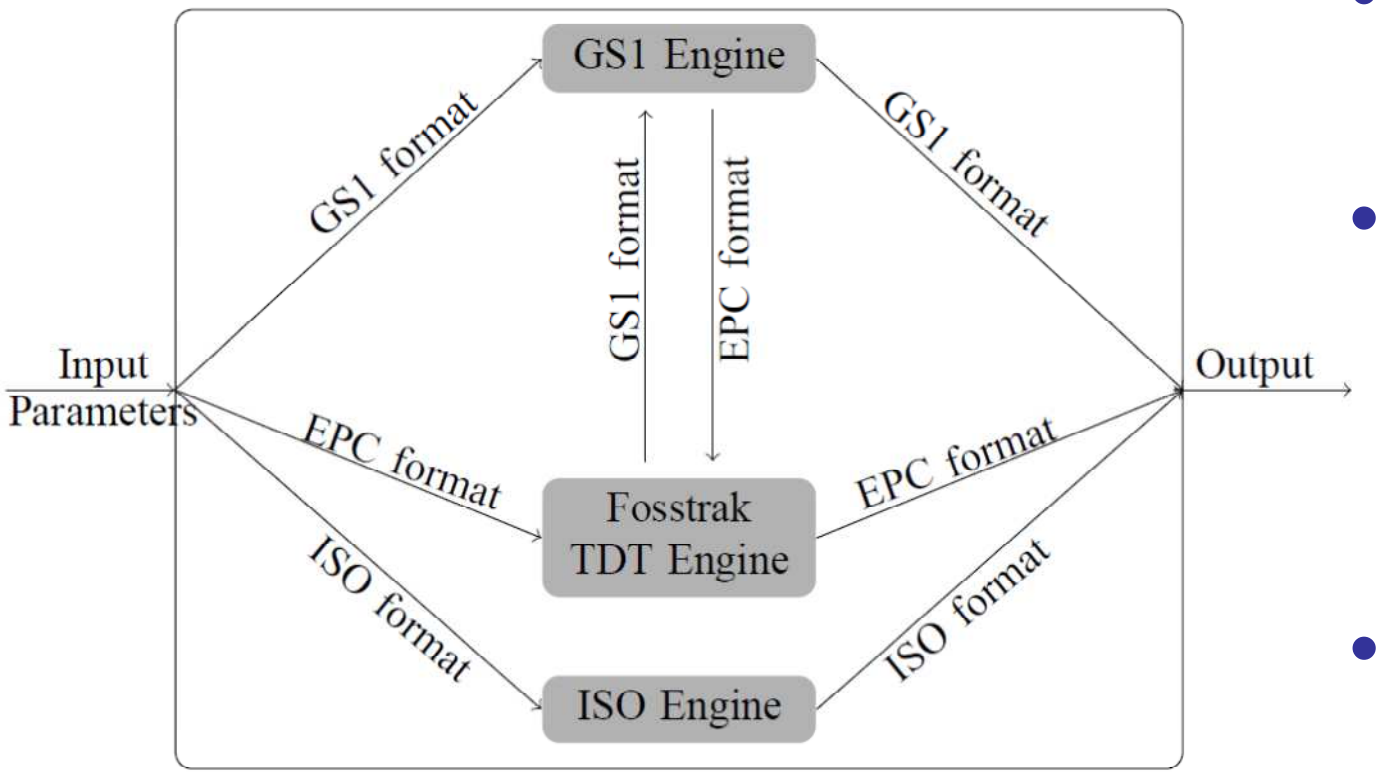
- Business Event Generator
  - Acts as an intermediary between the F&C and IS module
- Information Sharing module
  - Responsible for storing information and making it accessible

ASPIRE Middleware Architecture



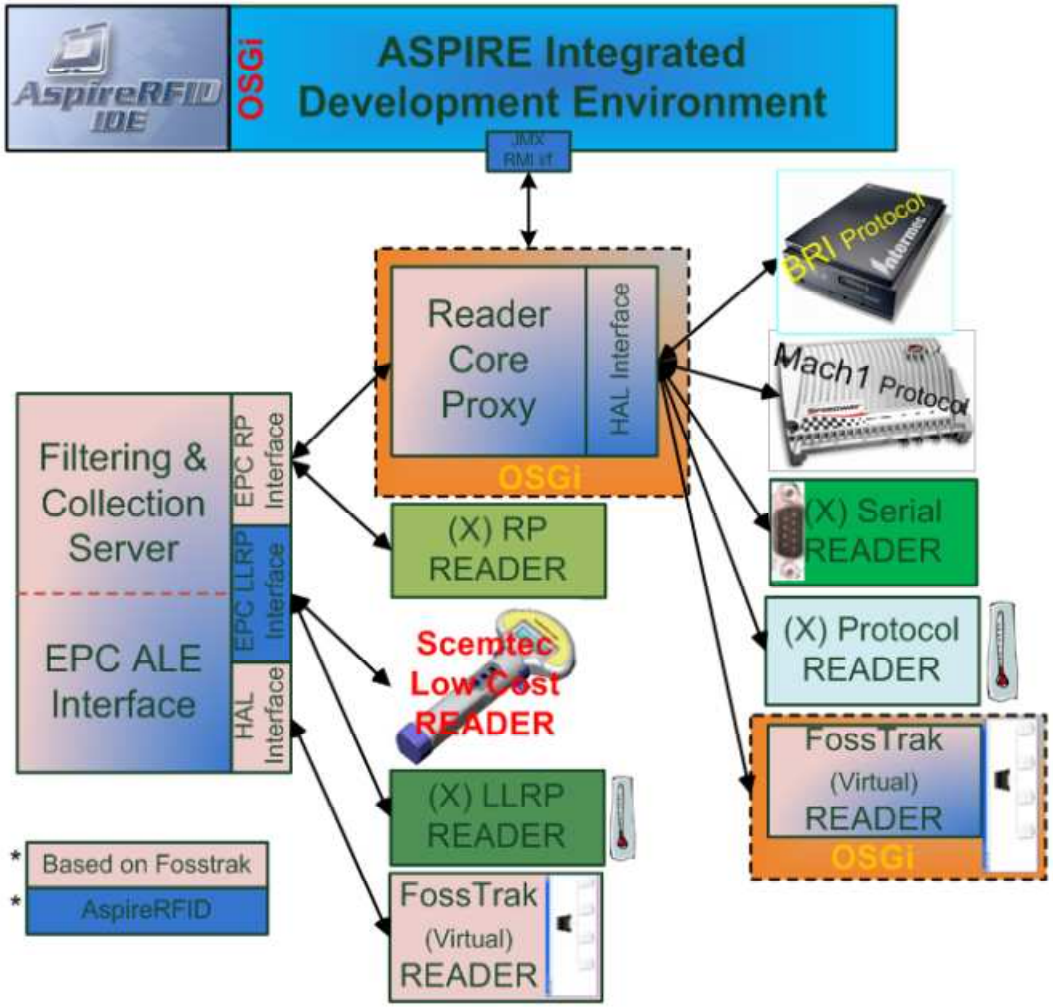
EPC-RP Implementation

ASPIRE TDT Engine



- Based on Fosstrak
- Part of the Reader Core Proxy
- OSGi-compliant

ASPIRE Reader Interfaces (1)



- Based on Fosstrak EPC-RP implementation

ASPIRE Reader Interfaces (2)

- LLRP
  - Uses open libraries by the LLRP-Toolkit open-source project
  - Part of the ALE server
- RFID reader drivers (by UJF)
  - TagSys Medio L100, TI Tiris 6350, ACR 122 (ie Touchatag), Violet Mirror
- Near-Field Communications Support

ASPIRE Reader Interfaces (3)

- Rely on Fosstrak's EPC-RP for compliant readers
- Otherwise, use a Hardware Abstraction Layer (HAL) implementation
- All components hosted as OSGi bundles

EPC-RP Interface

- XML RP reports over HTTP from the reader to the server
- Reader Core Proxy
  - Turns non-EPC-RP-compliant readers into compliant
  - Uses an existing or a new HAL wrapper

Hardware Abstraction Layer (HAL)

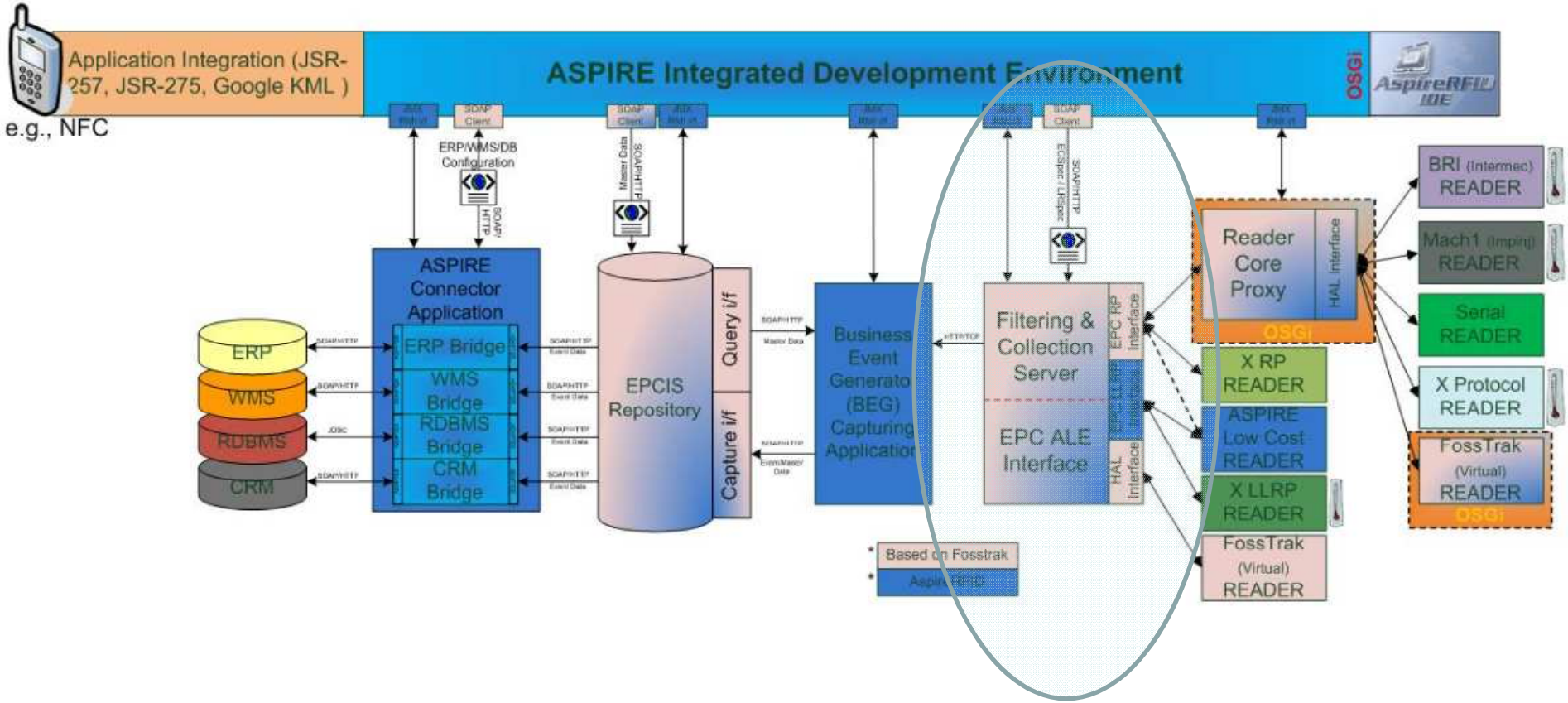
- Maps abstract vendor-independent commands to the low-level capabilities of the interrogator
- For readers not directly compliant with EPC standards
- Developers can contribute new HAL implementations

ASPIRE Supported Readers

Supported (HAL implementations)	Pending
Bar Code Tags (GS1 System)	ISO 15962
EAN/UPC	uCode Tags
ITF-14	MAC address for bluetooth and zigbee sensors
GS1 DataMatrix	Phone number (with country prefix)
GS1 DataBar	
GS1-128	
ISO Tags (14443, 15693)	

- For up-to-date information about supported readers refer to http://wiki.aspire.ow2.org/xwiki/bin/view/Main/Readers

Filtering and Collection (F&C)

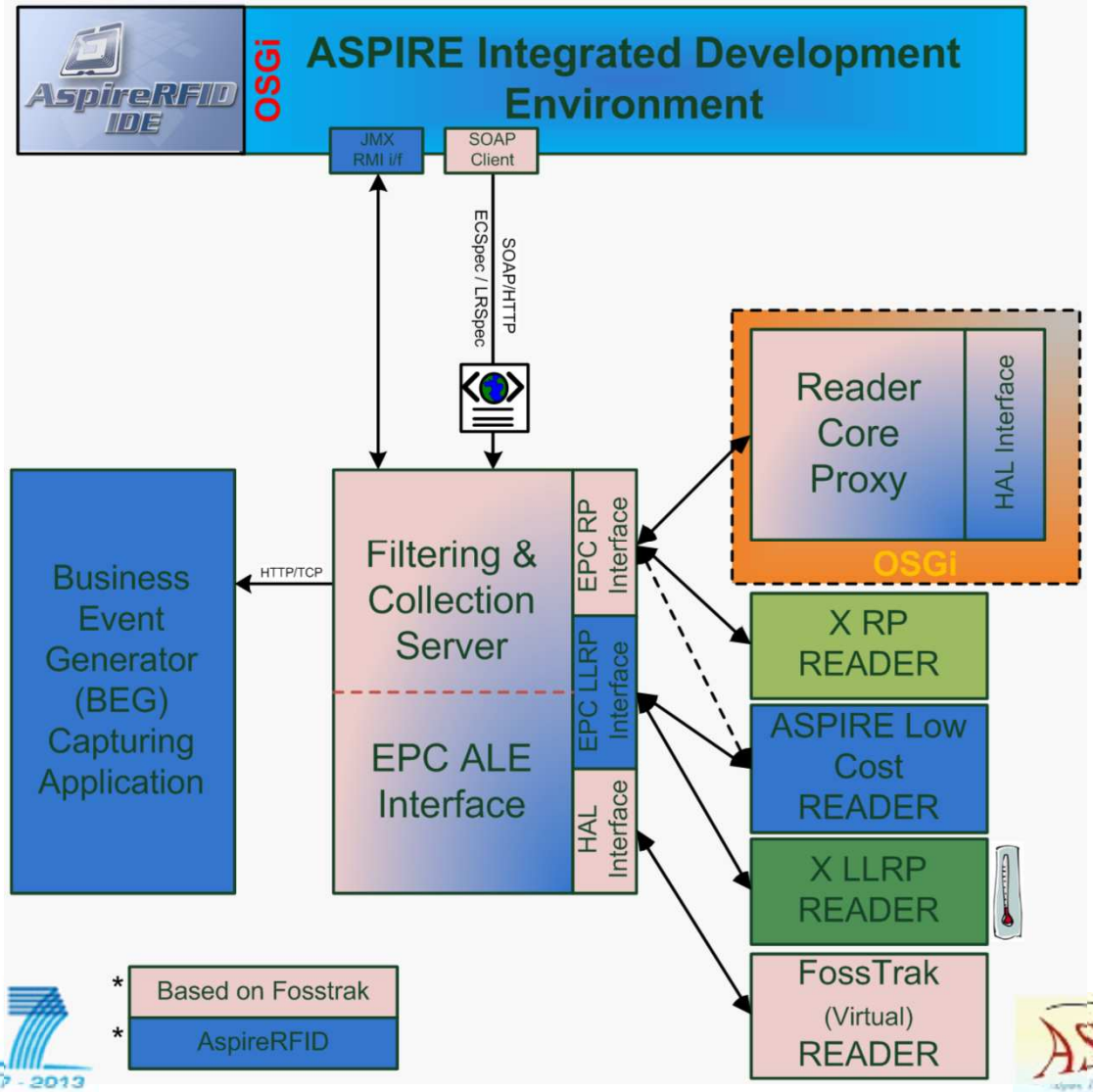


F&C module

Filtering and Collection (F&C)

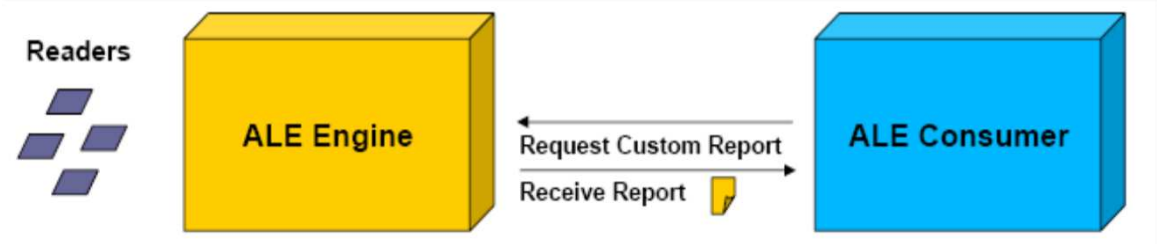
- Uses the Fosstrak implementation of the EPC-ALE standard
- Responsible for:
  - Data collection
  - Data filtering

F&C Interfaces

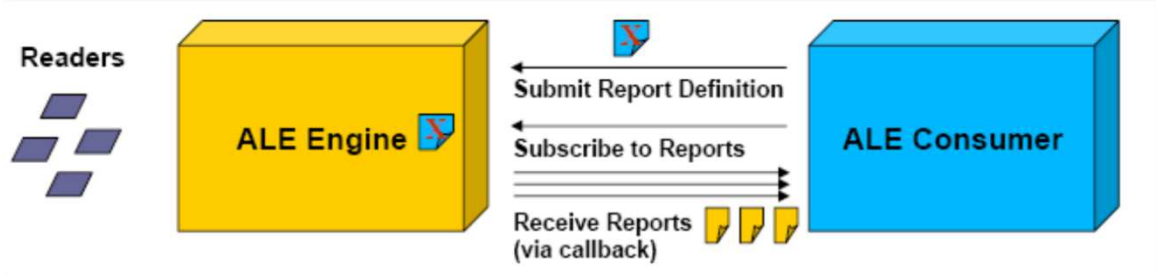


- Accumulate and aggregate reports
- Provide filtered, consolidated EPC data

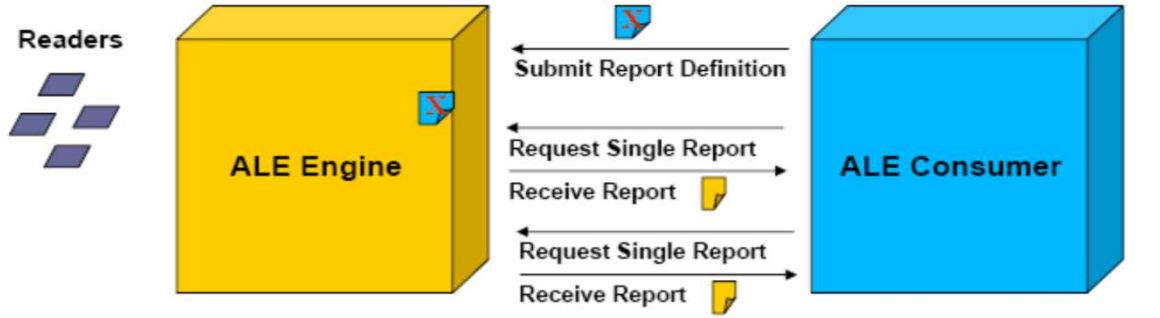
F&C Subscribe Modes



- Immediate mode



- Subscribe mode

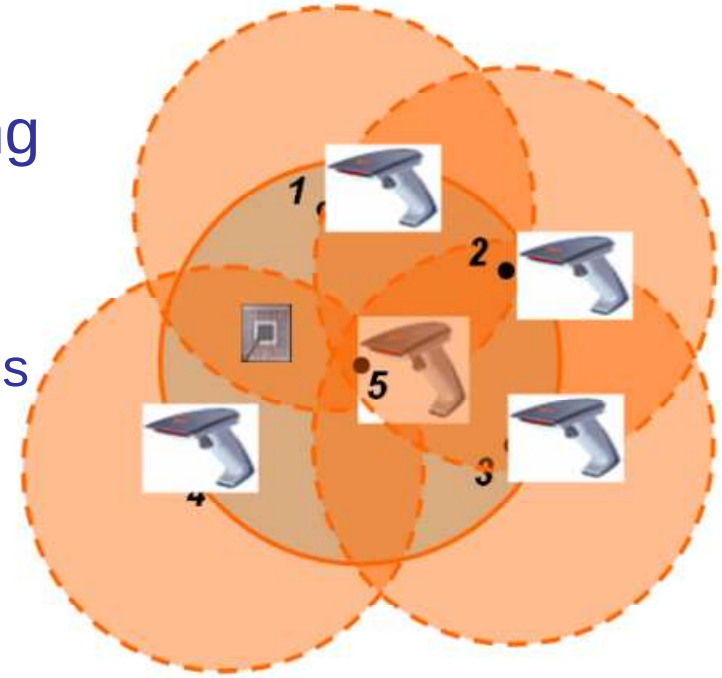


- Poll mode

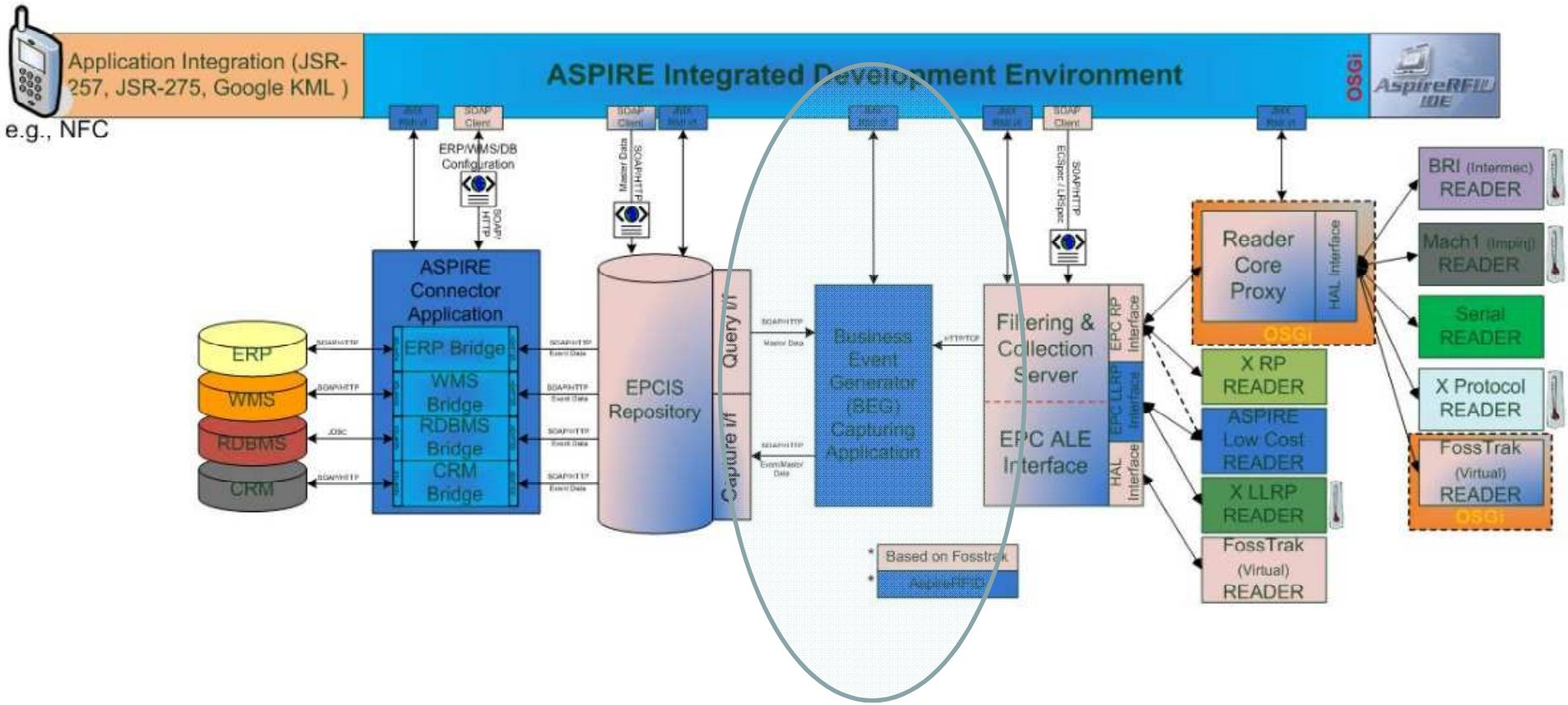
Image Sources: EPCglobal

F&C Anti-collision Protocol

- Avoid reader collision in multi-vendor environments
- Schedule the readers to avoid working simultaneously
  - Leverage less traffic
  - Save bandwidth and computing resources
- Solution Implementation
  - Specify Neighboring readers on LRSpec
  - Allocate non-overlapping read cycles in each neighboring reading
    - Based on a static value (e.g., 500ms per reader) or
    - Other technique based on the Event Cycle interval defined in ECSpec

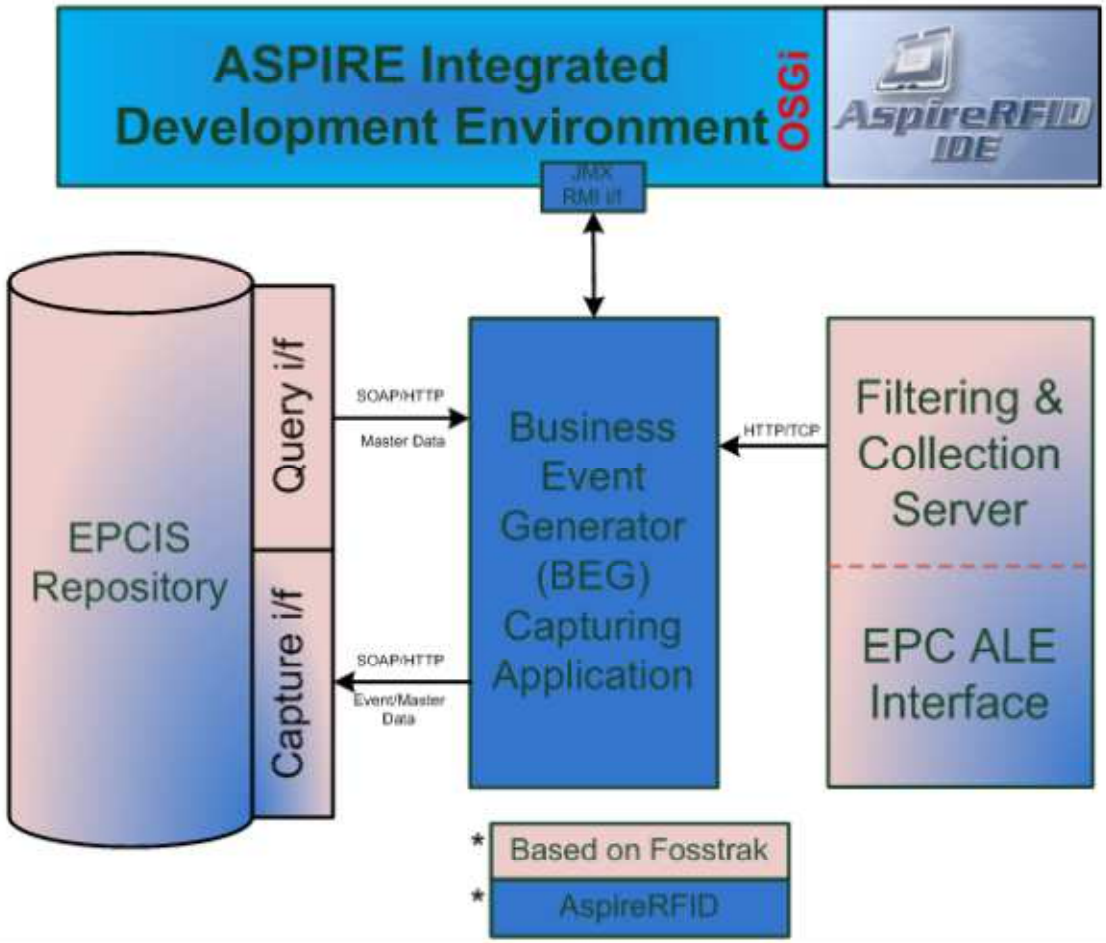


The Business Event Generator (1)



Business Event Generator

The Business Event Generator (2)

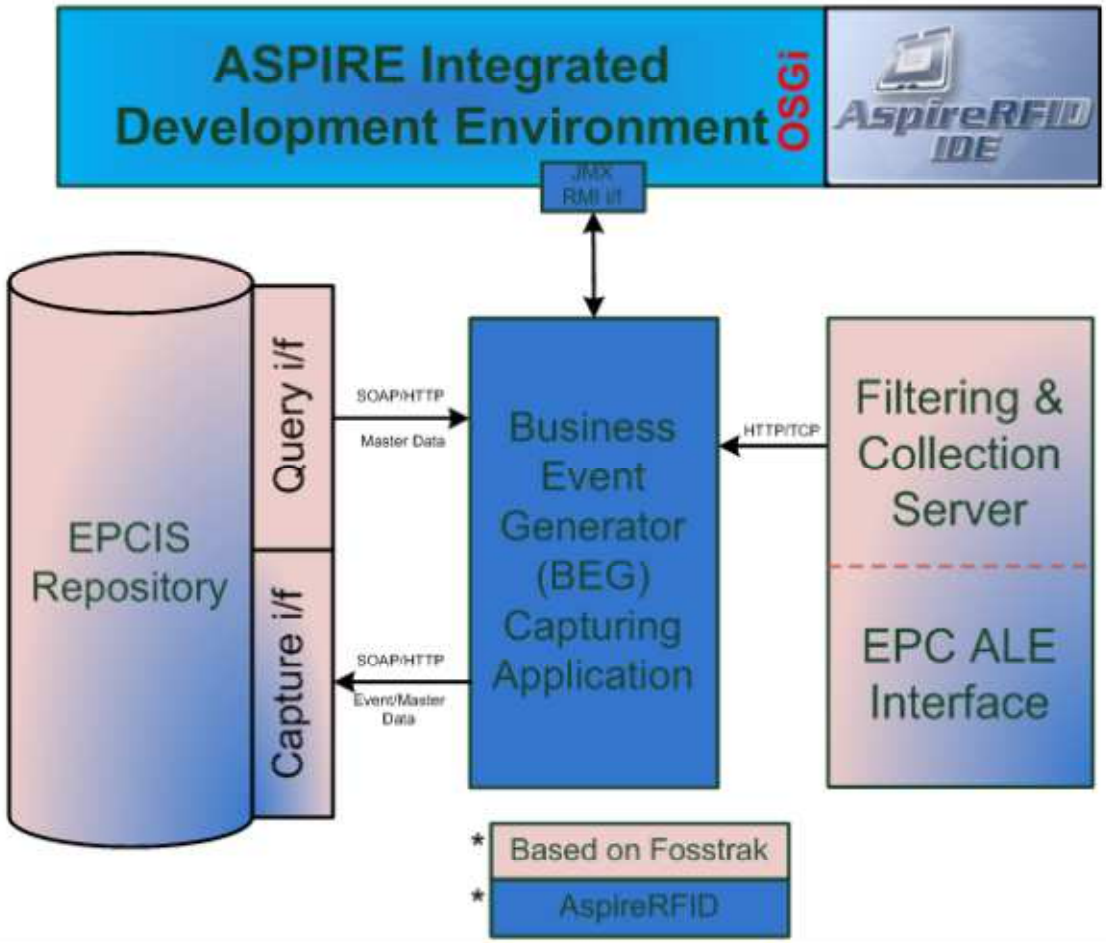


- Receives reports from the F&C
- Maps them to IS events

The Business Event Generator (3)

- The role of EPCIS Capturing Application
  - Parse ALE reports
  - Fuse it with business context data
  - Prepare EPCIS compliant events
  - Submit the events to the IS Repository
- BEG Spec: generic configuration description
  - Static or Dynamic submission (adaptable)

Creating Business Logic (1)



- From real-world events to the EPCIS repository

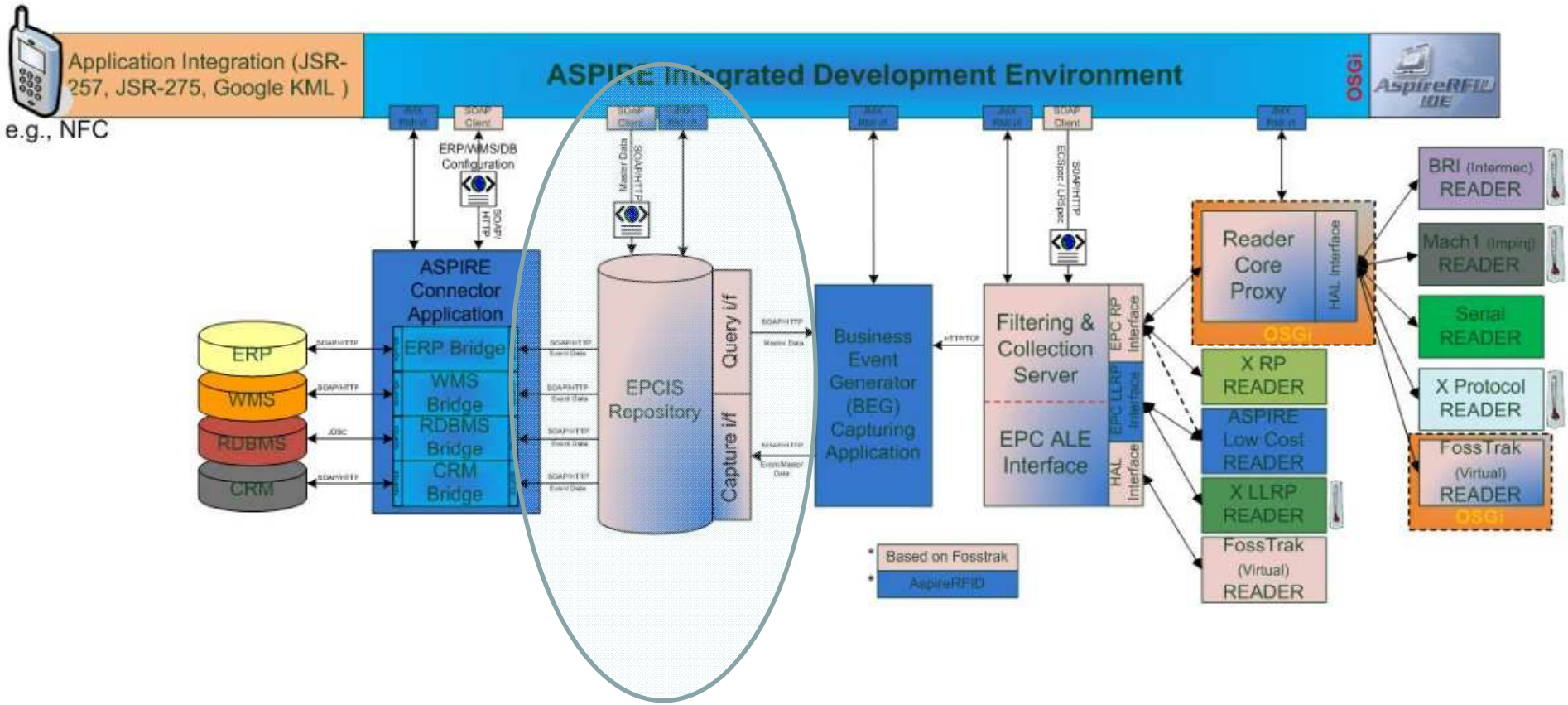
Creating Business Logic (2)

- The F&C module
  - receives raw readings from the Logical Readers attached
  - produces a report based on predefined specifications
- The BEG module
  - Receives the report
  - Takes into account the predefined Master Data

Creating Business Logic (3)

- The BEG module (cont'd)
  - Sends the processed data to the IS Capturing interface
- The IS module
  - Receives the report from the BEG module
  - Exposes the data through a Query interface

The Information Sharing Level (1)

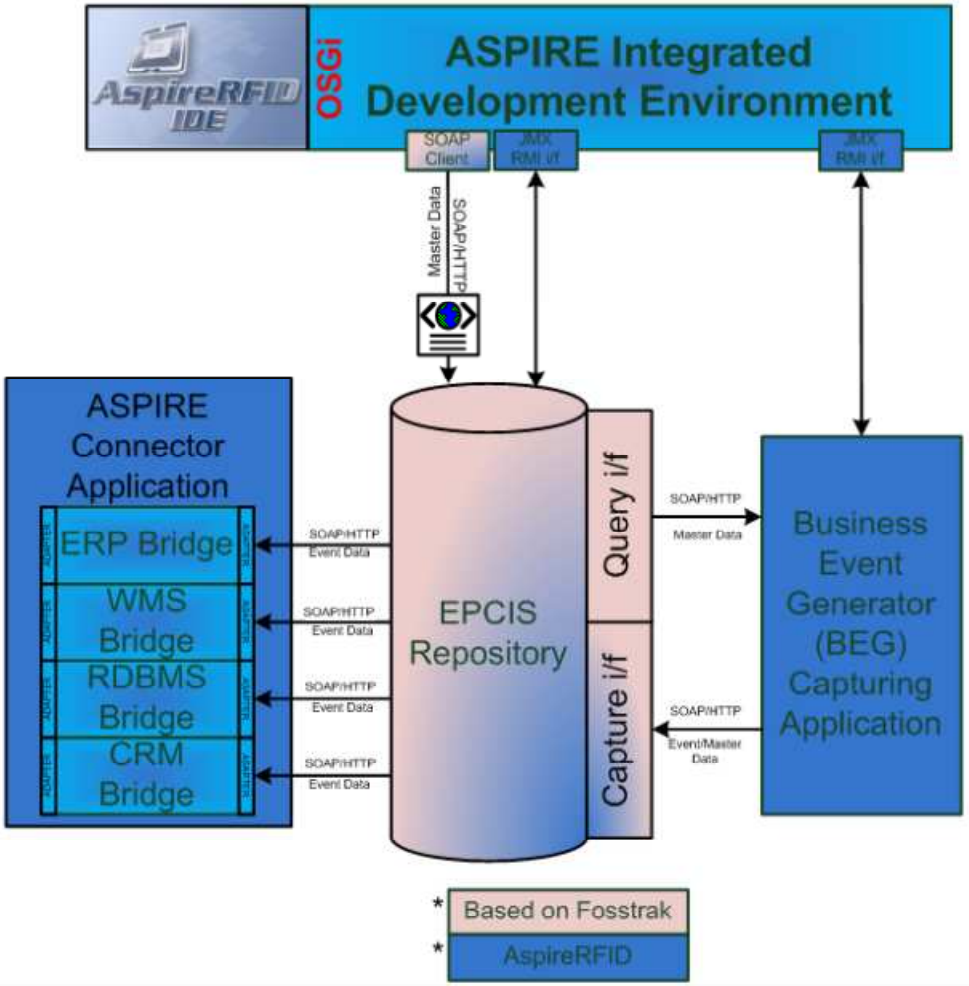


EPC-IS Implementation

The Information Sharing Level (2)

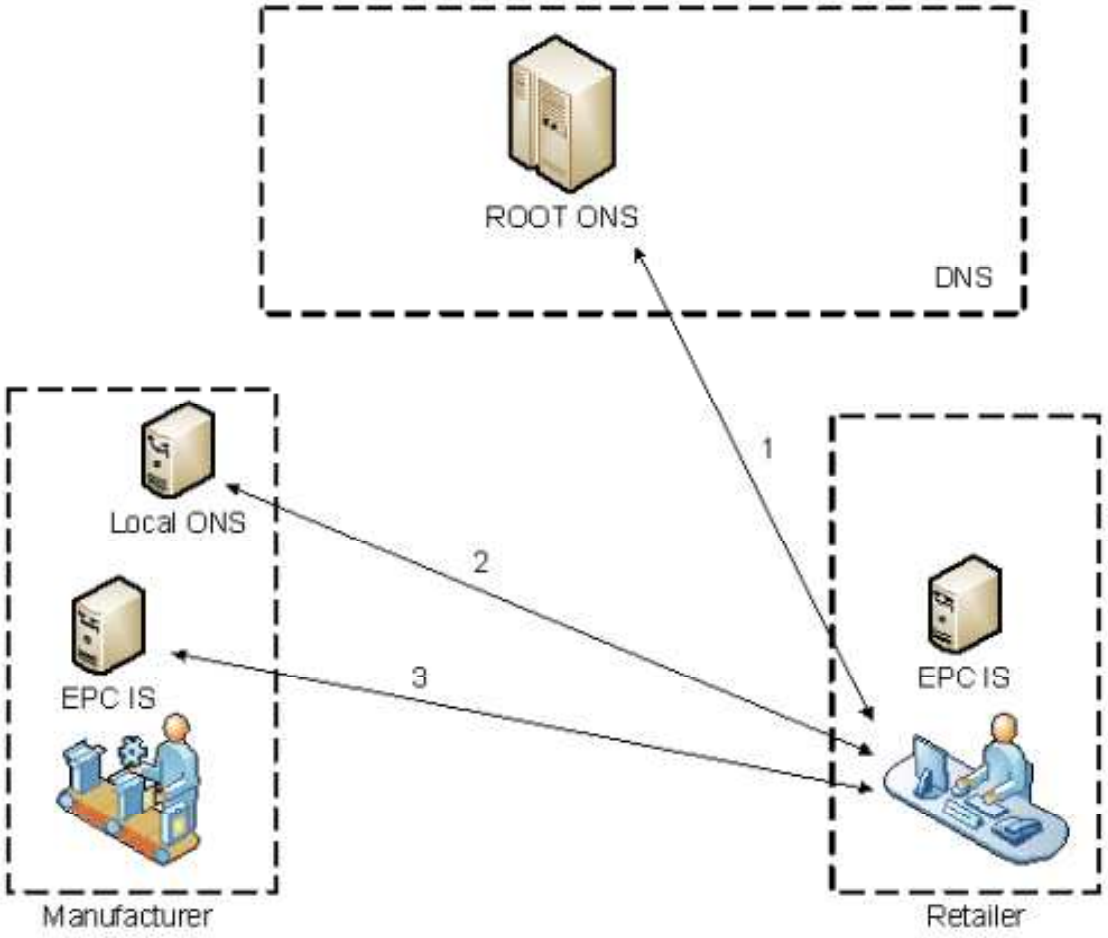
- Component responsible for receiving application-agnostic RFID data
- Translates RFID data in business events
- Captures and expose business events through standard interfaces
- Comprises
  - A repository
  - A Capture application
  - A Query application

The Information Sharing Level (3)



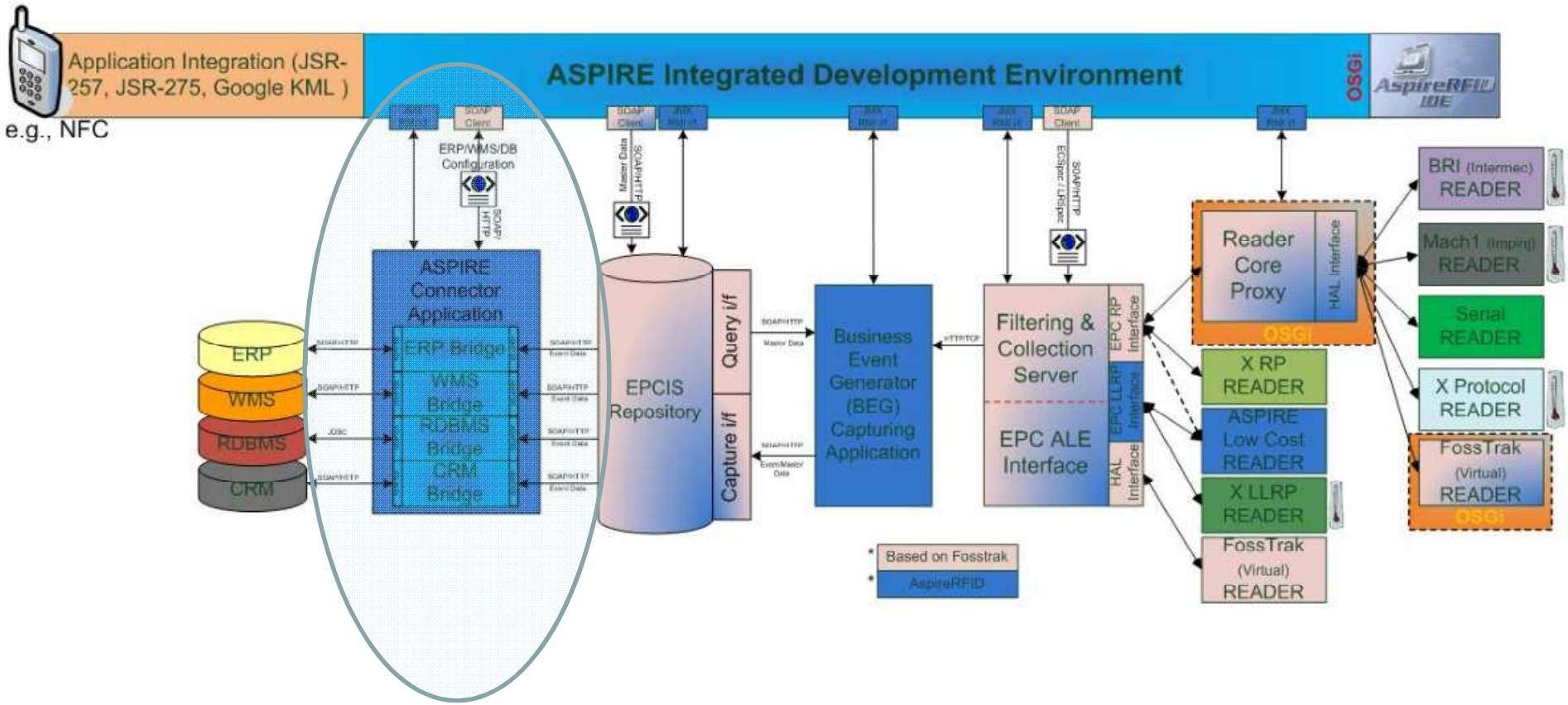
- Well-defined connectors
- SOAP/HTTP Communication

The Object Name Service (ONS)



- Returns Service endpoints for specific EPC's
- TDT converts EPC's to URI's
- Uses DNS
- Work in progress

Connector Component (1)

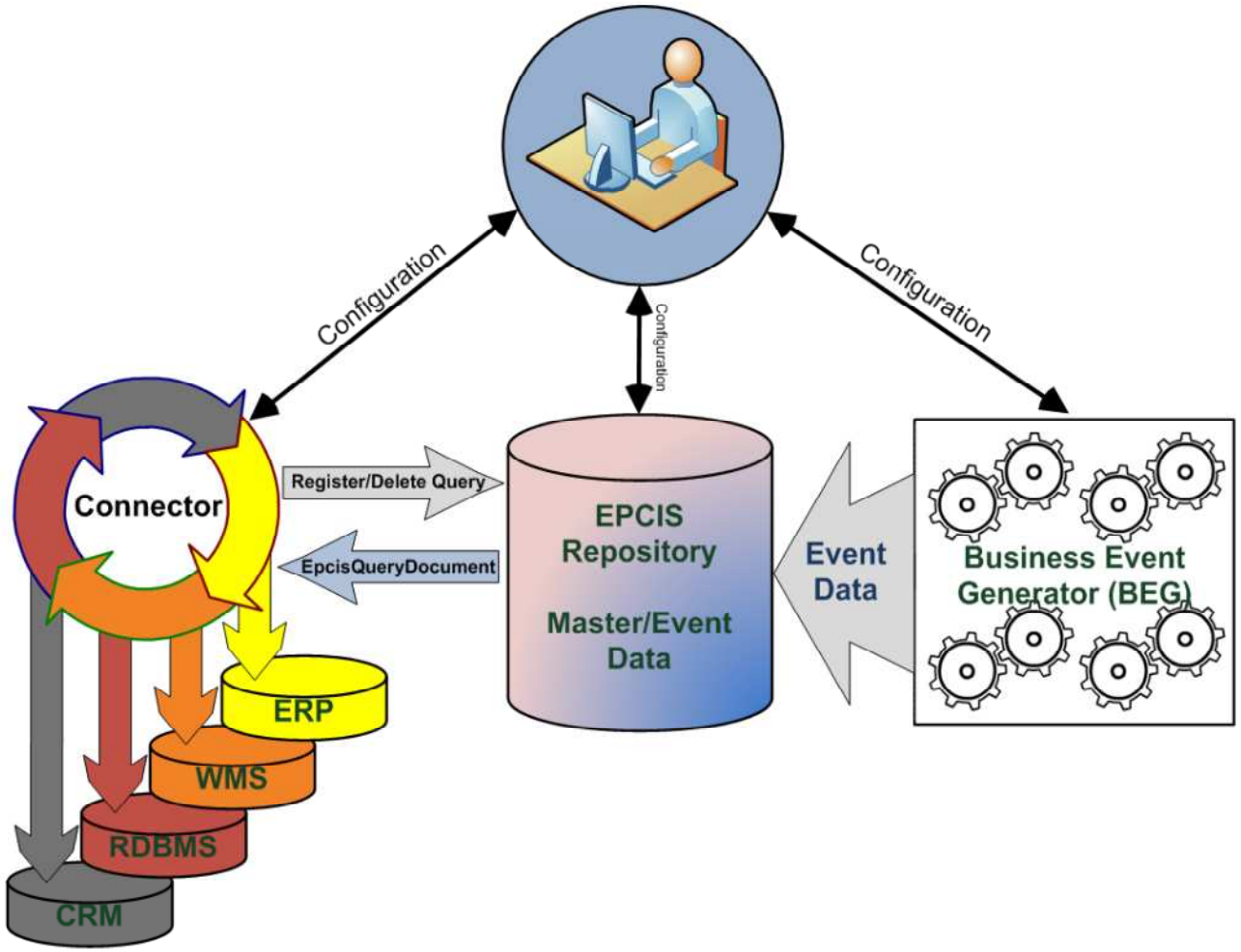


ASPIRE Connector Component

Connector Component (2)

- Interfacing with legacy systems
  - e.g. ERP, WMS, corporate databases
- Comprises
  - The Connector Engine
    - Exposes a Web Service interface
  - The Connector Client
    - Submit queries, receive responses

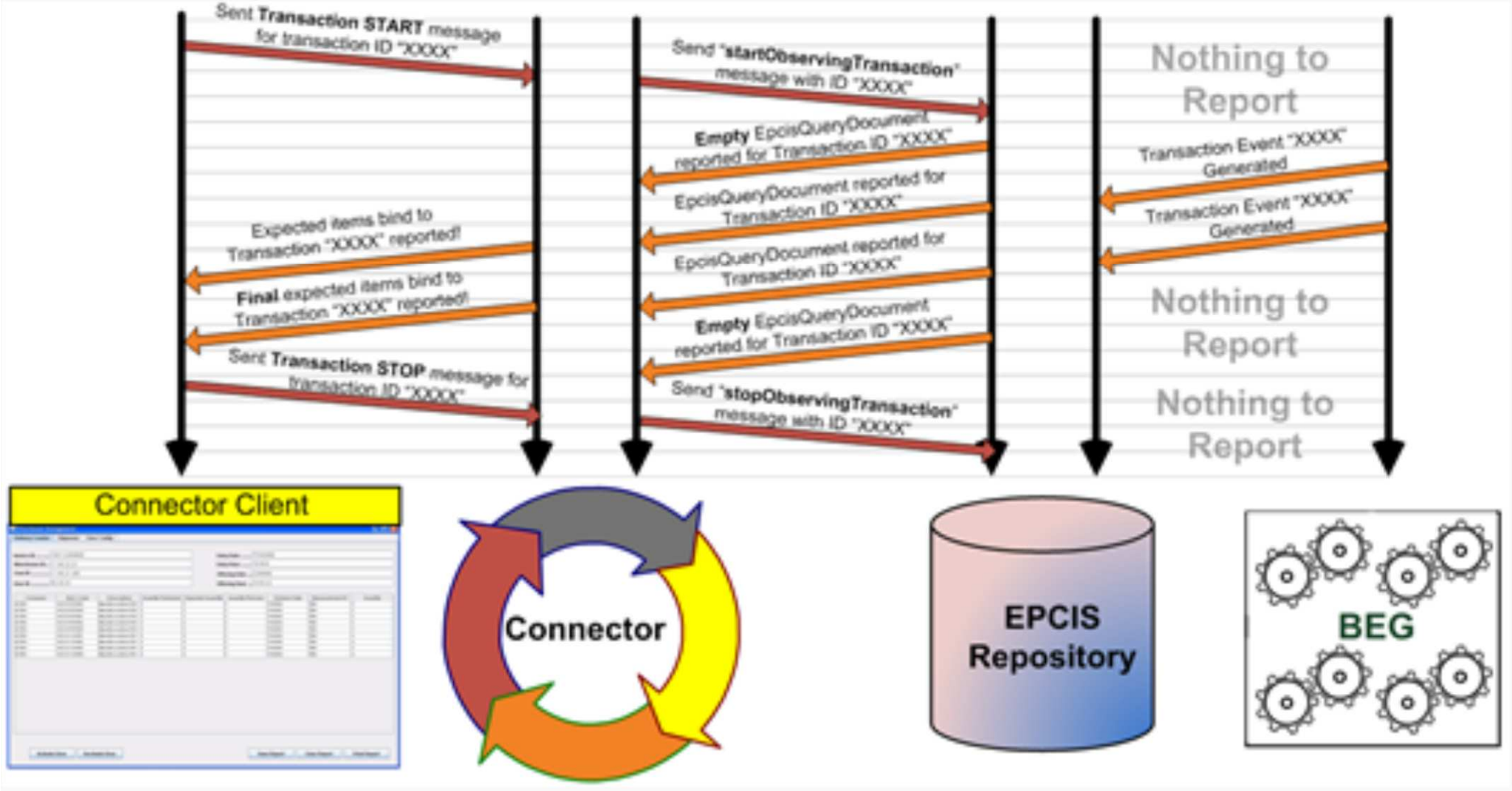
Connector Component (3)



Connector Component (4)

- Provides
  - Support for services and events
  - Service abstraction
  - Functionality abstraction
  - Process management

Connector Engine Message Flow



Bugfixes and enhancements to Fosstrak (1)

- Created common libraries for all modules
- ALE Module
  - Created 2 EPC-LLRP-compliant interfaces
  - Created a HAL interface for the TagSys Medio L100 L200 + HF RFID reader
  - Added ability to clear ADDITONS and DELETIONS history
    - as specified at the EPC ALE 1.1 specification
  - Numerous bugfixes

Bugfixes and enhancements to Fosstrak (2)

- EPCIS module
  - Created Master Data Capture Web Service API
- Reader Core module
  - Made implementation OSGi-compliant and deployable
- Hardware Abstraction Layer
  - Support INTERMEC readers
  - Made implementation OSGi-compliant and deployable

Bugfixes and enhancements to Fosstrak (3)

- TDT Library
  - Expanded Tag Type support to also support
    - Bar Code Tags (GS1 System)
    - EAN/UPC
    - ITF-14
    - GS1 DataMatrix
    - GS1 DataBar
    - GS1-128
    - ISO Tags (14443, 15693)

Bugfixes and enhancements to Fosstrak (4)

- Modules Developed
  - BEG: Add Business Context
  - Connector Module: Connects to Legacy Applications

Bugfixes and enhancements to Fosstrak (5)

- Supported Readers:
  - Reader Protocol v1.1 compliant readers
  - TagSys Medio Lx100 +
  - Intermec IF5 (BRI protocol)
  - Impinj Speedway (Mach1 and LLRP protocol)
  - FEIG ID ISC.LRU1000 (Ethernet, TPC/IP)
  - FEIG ID ISC.MR101-A (RS232/485, COM)

Summary (1)

- Middleware Modules
  - Tag Data Translation
  - Filtering & Collection
    - TDT Completely implemented in the scope of the project
    - Based on Fosstrak EPC-ALE
  - Business Event Generator

Summary (2)

- EPCIS
  - Connectors implemented
- Numerous enhancements and bugfixes over Fosstrak EPC- ALE and EPC-IS
- Provisions for Integration with ASPIRE IDE, Programmable Language and Engine

References – Additional Reading

- ASPIRE Public Deliverable D3.2
- ASPIRE Public Deliverable D3.4a