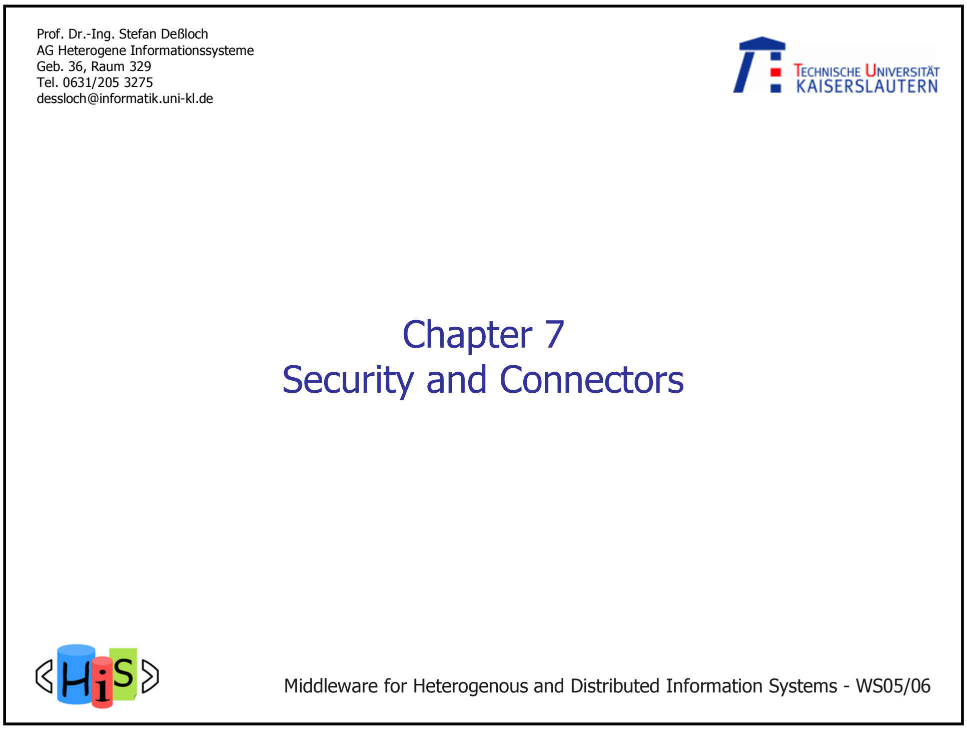

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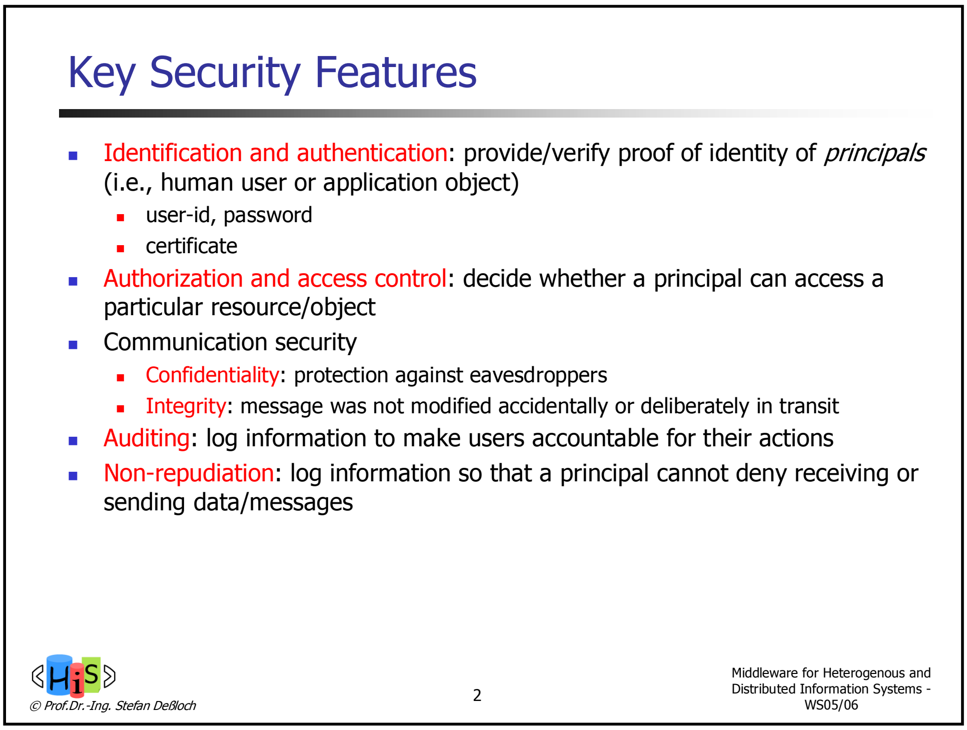
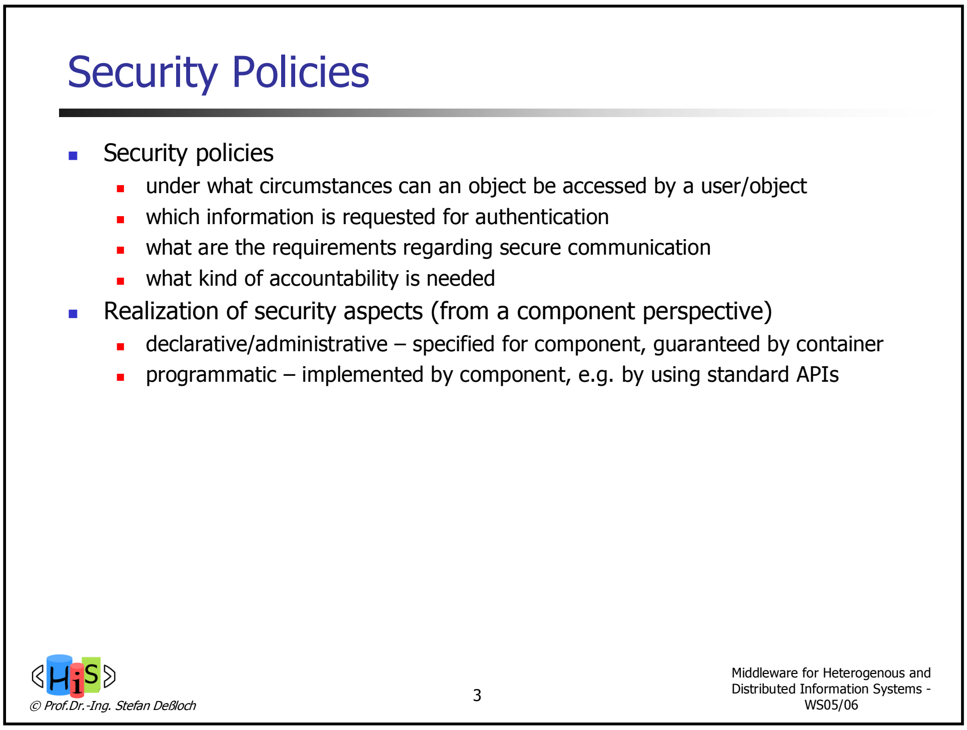
Chapter 7
Security and Connectors



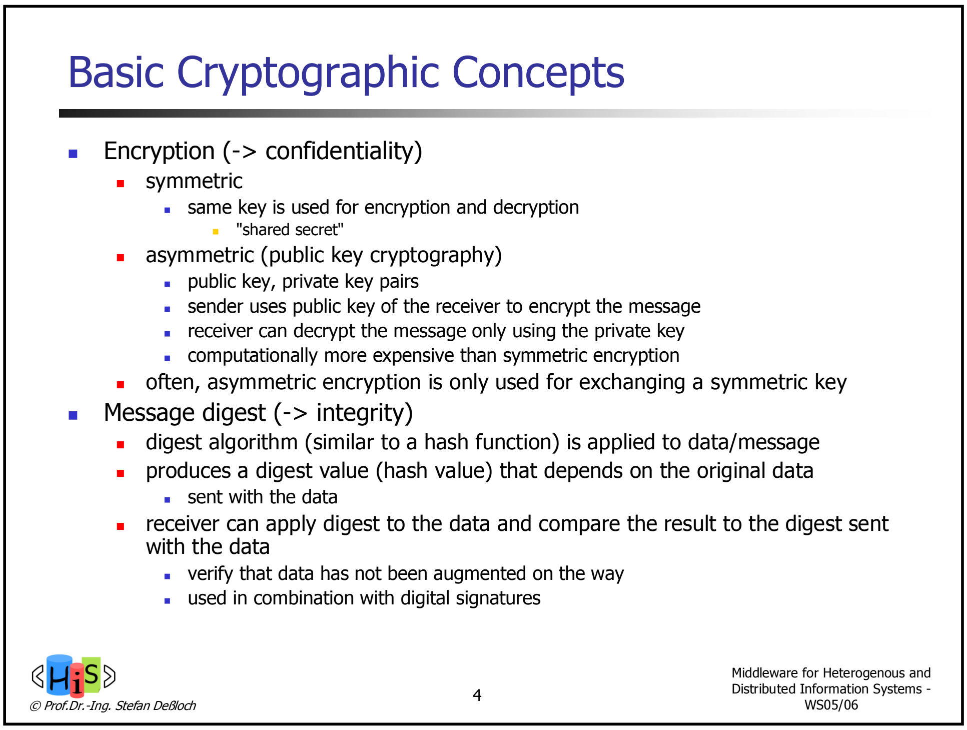
Key Security Features

- Identification and authentication: provide/verify proof of identity of *principals* (i.e., human user or application object)
  - user-id, password
  - certificate
- Authorization and access control: decide whether a principal can access a particular resource/object
- Communication security
  - Confidentiality: protection against eavesdroppers
  - Integrity: message was not modified accidentally or deliberately in transit
- Auditing: log information to make users accountable for their actions
- Non-repudiation: log information so that a principal cannot deny receiving or sending data/messages



Security Policies

- Security policies
  - under what circumstances can an object be accessed by a user/object
  - which information is requested for authentication
  - what are the requirements regarding secure communication
  - what kind of accountability is needed
- Realization of security aspects (from a component perspective)
  - declarative/administrative – specified for component, guaranteed by container
  - programmatic – implemented by component, e.g. by using standard APIs



Basic Cryptographic Concepts

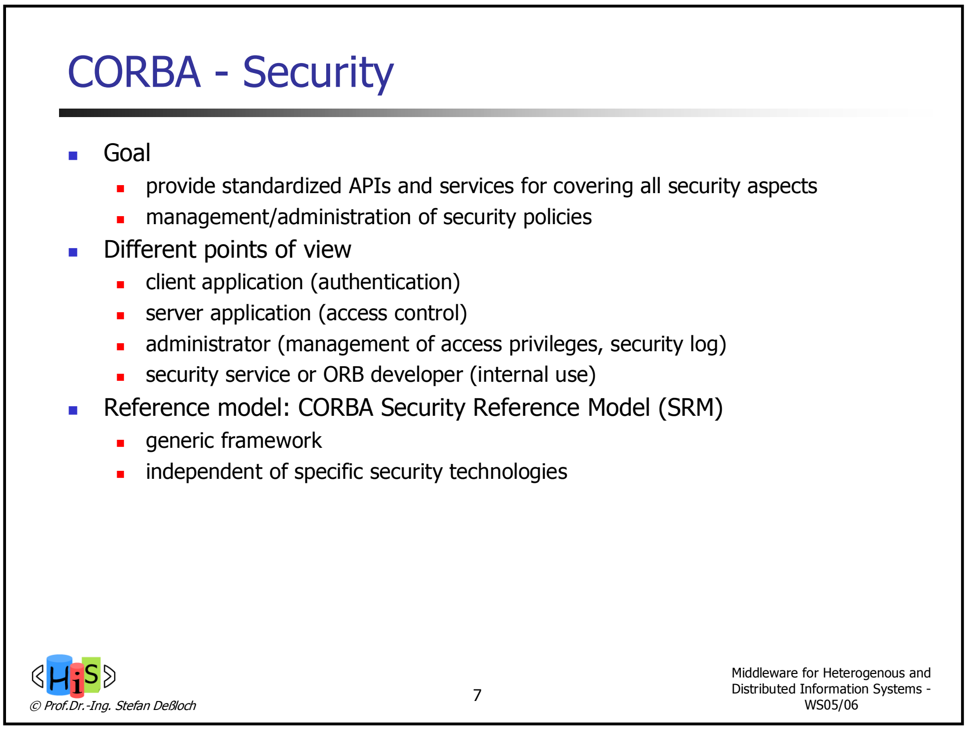
- Encryption (-> confidentiality)
  - symmetric
    - same key is used for encryption and decryption
      - "shared secret"
  - asymmetric (public key cryptography)
    - public key, private key pairs
    - sender uses public key of the receiver to encrypt the message
    - receiver can decrypt the message only using the private key
    - computationally more expensive than symmetric encryption
  - often, asymmetric encryption is only used for exchanging a symmetric key
- Message digest (-> integrity)
  - digest algorithm (similar to a hash function) is applied to data/message
  - produces a digest value (hash value) that depends on the original data
    - sent with the data
  - receiver can apply digest to the data and compare the result to the digest sent with the data
    - verify that data has not been augmented on the way
    - used in combination with digital signatures

Basic Cryptographic Concepts (cont.)

- Digital signature (-> integrity, authentication, non-repudiation)
  - The digest is encrypted with the private key of the signer, producing the signature
  - To verify the signature, anyone with access to the public key of the signer can
    - Decrypt the signature (original hash) using the public key
    - Apply the hash function to the original data
    - Compare the two hash values to make sure they are identical
  - Allows to make sure that
    - the data has not been modified
    - the data was actually sent by the owner of the public key
- Certificate
  - Data structure that holds at least the following information
    - identification (name, address, …) of the certificate owner (person, company)
    - public key of the certificate owner
  - Issued by a certificate issuing authority
    - authority signs the certificate with its own private key

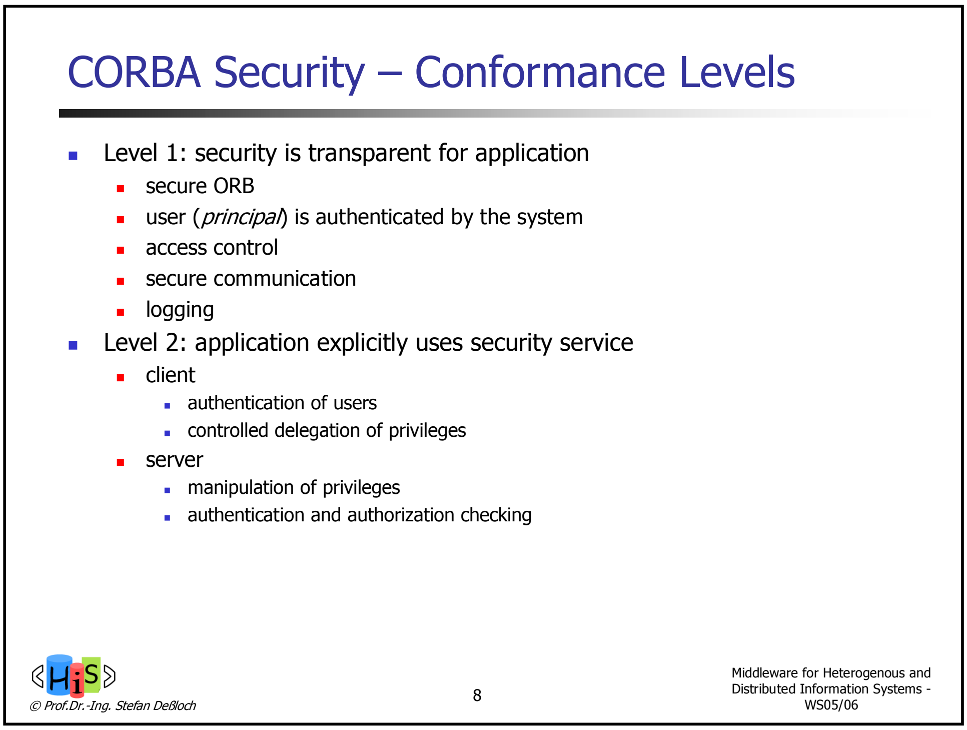
Transport Security

- HTTP Basic Authentication
  - UserID, Password authentication on the web
    - Initial HTTP request results in error "401 Unauthorized"
    - Browser opens dialog to request user, password info, resubmits the request
      - Userid/password are encoded in Base64, NOT encrypted
  - Web server verifies permissions based access control list (ACL)
- Secure Sockets Layer/Transport Layer Security (SSL/TLS)
  - Protocol for transmitting data in a secure way
    - point-to-point secure sessions
    - Can provide confidentiality, authentication, integrity
  - Located between application layer and transport layer (TCP)
    - Other protocols can be performed over SSL
      - HTTPS is HTTP over SSL
  - Supports server authentication and client authentication via certificates
    - The latter is rarely used, requires client to possess a certificate issued by a certificate authority
      - HTTP authentication frequently used here



CORBA - Security

- Goal
  - provide standardized APIs and services for covering all security aspects
  - management/administration of security policies
- Different points of view
  - client application (authentication)
  - server application (access control)
  - administrator (management of access privileges, security log)
  - security service or ORB developer (internal use)
- Reference model: CORBA Security Reference Model (SRM)
  - generic framework
  - independent of specific security technologies



CORBA Security – Conformance Levels

- Level 1: security is transparent for application
  - secure ORB
  - user (*principal*) is authenticated by the system
  - access control
  - secure communication
  - logging
- Level 2: application explicitly uses security service
  - client
    - authentication of users
    - controlled delegation of privileges
  - server
    - manipulation of privileges
    - authentication and authorization checking

Secure Object Invocation

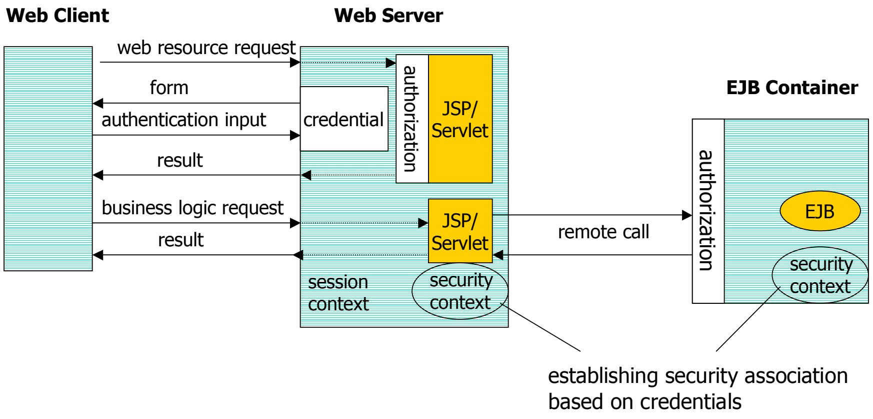
- Establishing a security association
  - mutual authentication
  - making client credentials available to the server
    - *Credential* object
      - security attributes: identity, role (e.g., administrator), group, authorization level (e.g., confidential), *capabilities* (right to invoke specific methods on an object) ...
  - establishing a security context
  - ensure communication security
- Secure protocols
  - Secure Inter-ORB-Protocol (SECIOP)
  - SSL/TLS
- Access control, logging
  - client-side and server-side
  - performed by ORB, possibly by application

Authorization

- Client
  - Level 1
    - automatic association of credential at user login
  - Level 2
    - flexibility regarding security attributes included in the credentials
    - (de-)activation of security functionality
- Server
  - Level 1
    - objects are associated with a *security domain* with fixed *policies*
      - control attributes describe *policy details* for the respective target objects
        - *Access Control Lists* (ACLs)
        - *Labels* (confidential, ...)
    - ORB controls access regarding these policies, based on the presented credentials and target object/method
  - Level 2
    - *Current* object contains security context (incl. caller *Credentials*)
    - support for modification of access policies for object (i.e., self)
    - access control implemented by server object (more flexible)

J2EE Server Security

- Example scenario



Container-based Security

- Programmatic security
  - application components implement security aspects
  - standardized interfaces
    - web components
      - isUserInRole (HttpServletRequest)
      - getUserPrincipal (HttpServletRequest)
    - EJB components
      - isCallerInRole (EJBContext)
      - getCallerPrincipal (EJBContext)
- Declarative security
  - deployment descriptor supports specification of security aspects
    - security roles
    - access control
    - authentication requirements
  - mapping of security aspects to the security environment of J2EE server during deployment phase

Authorization in EJB

- Based on security roles
  - logical group of users
    - e.g. administrator, readOnly, ...
  - defined in deployment descriptor of each component (by application provider)
    - security-role
    - method-permission
  - mapped to user (group) during deployment phase
    - security-role -> user group(s)
- Credentials used for access control
  - name – if role is mapped to individual users
  - group attribute – if role is mapped to user group

Security and Distribution

- Requires establishing security association
  - secure communication
  - joint security context
- Established automatically by participating containers
  - distribution here only in the scope of single J2EE server product
- Involving resource managers requires more complex measures
  - authentication across security policy domains
    - preconfigured security identity
    - programmatic authentication
    - additional capabilities are desirable (principal mapping, caller impersonation, credentials mapping)
  - additional capabilities defined in the scope of the J2EE Connector Architecture

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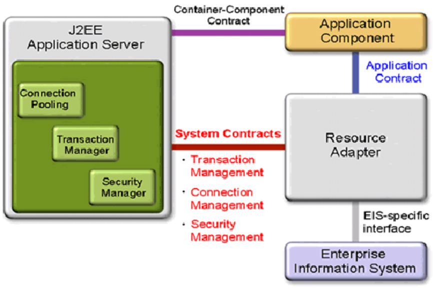
Connectors

Accessing Enterprise Information Systems

- Accessing (SQL) data bases is based on standardized (DB-gateway) interfaces
  - e.g., SQL + JDBC/SQLJ, or EJB CMP
  - interoperability at the system level supported through well-defined interfaces
    - XXXDataSource for Connection Pooling, transaction coordination, ...
- Accessing/interacting with enterprise information systems?
  - Examples
    - Enterprise Resource Planning (ERP), Customer Relationship Management (CRM)
      - SAP, Baan, Peoplesoft, Siebel, Oracle, ...
    - Transactional systems based on TP-monitors
      - CICS, Encina, Tuxedo, ...
    - Non-relational DBS
      - IMS, ...

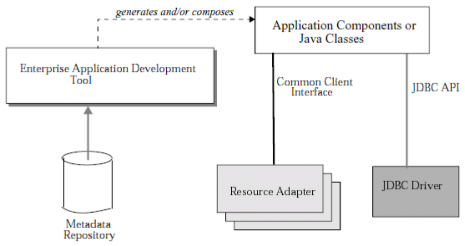
J2EE Connector Architecture (JCA)

- Standardised Interoperability with EIS
- Resource Adapter (Connector)
  - EIS-specific component
  - implements client interface (application contract) for EIS, used by EJBs, web components
    - either standardised (Common Client Interface, CCI)
    - or EIS-specific
  - cooperates with J2EE application server via system-level contracts
    - connection management, transactions, security, …

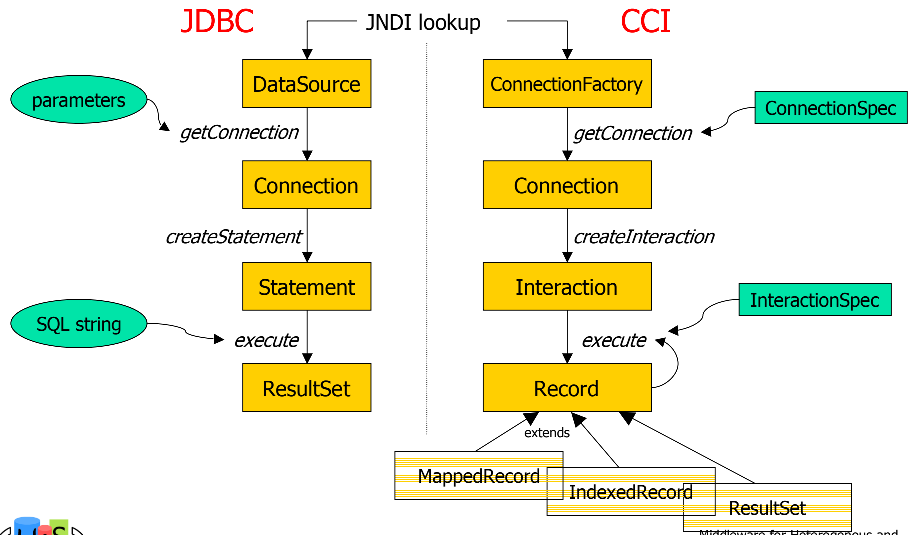


Common Client Interface

- Generic interface for invoking EIS functions (remote function calls)
- Useful for application development tooling, EAI frameworks
  - generating EJB wrapper classes for EIS functions (similar to EJB CMP tooling)
  - required standardized representation of EIS meta data, in addition to CCI
    - not defined as part of the JCA

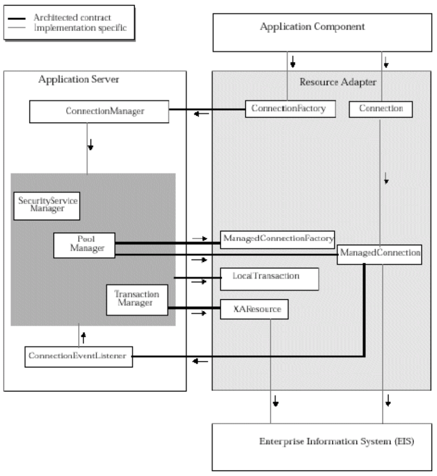

generates and/or composes
Application Components or Java Classes
Enterprise Application Development Tool
Common Client Interface
JDBC API
Metadata Repository
Resource Adapter
JDBC Driver

CCI vs. JDBC Interfaces



JCA System-Level Contracts

- Application server implements ConnectionManager
  - generic, for arbitrary EIS connections
  - interacts with other AS services
    - connection pooling, transactions, security
- Resource Adapter (RA) creates connections (ConnectionFactory)
- Application connection request flows via ConnectionFactory to ConnectionManager
  - PoolManager selects suitable connection in the pool or initiates creation of a new connection
    - RA helps with selection process
  - RA informs ConnectionManager about connection state (ConnectionEventListener)



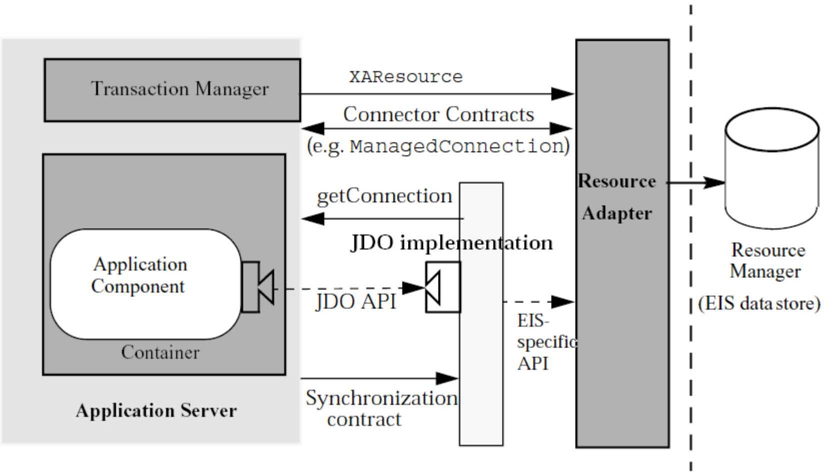
JCA – Transaction Management

- Resource Adapter (or RM of EIS) may support
  - global transactions
    - coordinated by TA manager of application server
    - XA-compliant (RA implements XAResource interface)
      - one-phase optimization possible, if only one resource is involved
  - local transactions
    - permits bypassing global TA manager for performance reasons, if it is known at deployment time that global TAs are not required
  - no transactions

JCA – Security

- Security architecture supports alternatives for determining the so-called *resource principal*
  - component-managed sign-on
    - application component determines resource principal (e.g. dynamically)
    - container-managed sign-on
    - resource principal, sign-on information (e.g. userid, password) defined for EIS at deployment time
      - configured identity: resource principal fixed, independent of initiating principal
      - principal mapping: resource principal determined based on initiating principal through a mapping, does not inherit any additional security attributes from initiating principal
      - caller impersonation: identity, credentials of caller are delegated to EIS
      - credentials mapping: mapping across security domains
- Choice of authentication mechanisms
  - BasicPassword, KerbV5, ...
- Access contol can be performed by EIS or application server
- Secure communication supported by establishing security association with RA

Example: J2EE Integration for JDO



Connectors - Summary

- Goal: Integration of existing EIS as additional resource managers in distributed component-based environments through a so-called resource adapter
  - unified connection/security model for calling application components
  - uniform interface to arbitrary EIS
    - tooling support, combined with meta data management
- Standardised interfaces, interactions
  - same RA can be installed in any J2EE-conforming server implementation
  - J2EE server realizes the required infrastructure only once, for arbitrary EIS
- Important architecture concept for Enterprise Application Integration
  - numerous J2EE connectors are commercially available