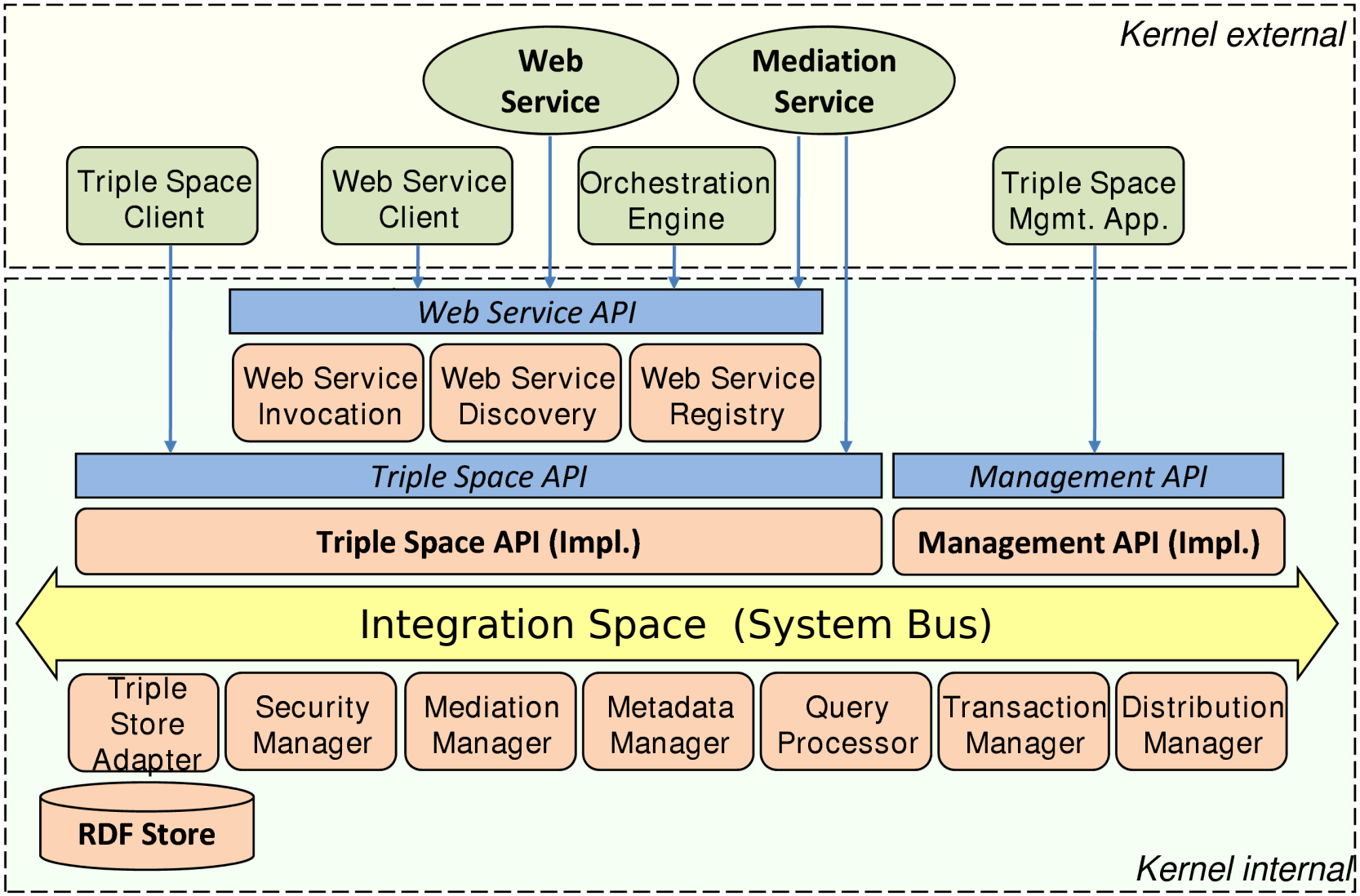
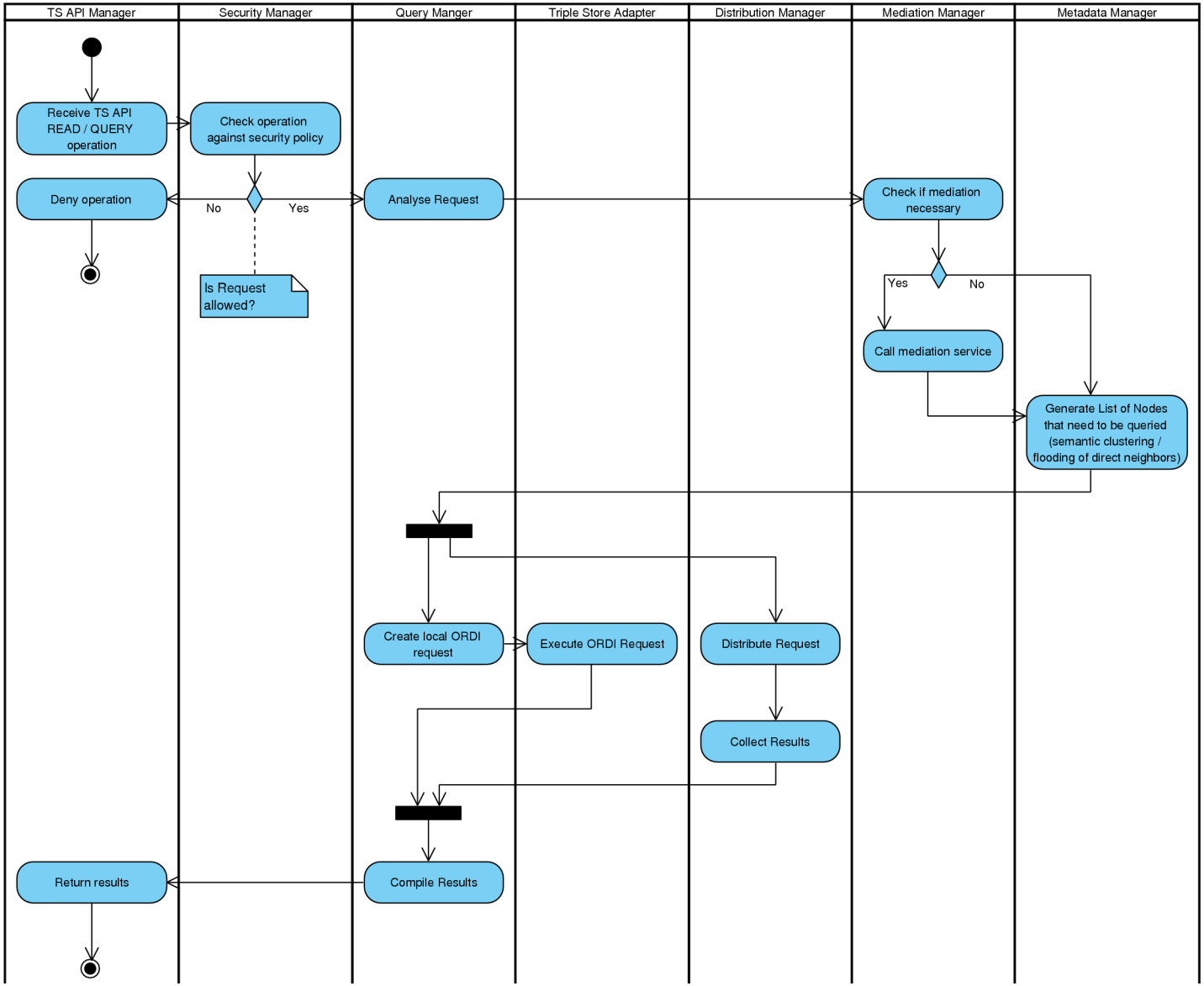
The 2nd TripCom prototype

Sixth Framework Programme Priority 2
Information Society Technologies (IST)
Specific Targeted Research Project

Triple Space Architecture



Basic Component Interaction



Triple Space API component

- implements TS API operations
- client invokes a triplespace operation by submitting a request to the TS API implementation
- TS API operation is translated into an entry into the integration space that is communicated among kernel components.
- when the requested operation has been processed, the operation's result is returned to the client

TS and Management APIs
Functional Description (Black Box View)

- 1. Accepts requests from clients which conform to the given API
- 2. Returns responses to clients as defined by the given API
- 3. Handles grounding to concrete programming languages, transport protocols, data formats supported by client (abstracts from TS-internal implementation)
- 4. Handles exceptions caused by incorrect or inappropriate communication to the Triple Space

Triple Space API Interface

- required Entries
  - DataResultExternal
    - data result (triples) of a successful TS API rd or in operation optionally containing a security cookie
  - ErrorResultExternal
    - error information in case of erroneous execution of a TS API Operation
- provided Entries
  - WriteOpExternal
    - representation of a TS API out operation, including security information
  - ReadOpExternal
    - representation of a TS API rd or in operation, including security info

TS and Management APIs Component Interface

- Provided
  - Entry (1) writeop: to SecurityManager
    - Set<Statement> Data, URI Space, String ClientID, int OperationID, URI TransactionID, int Lease
  - Entry (2) readop: to SecurityManager
    - TupleExpr Query, URI Space, String ClientID, int OperationID, URI TransactionID, int Lease
  - Entry (3) transactionop: to SecurityManager
    - int OperationType, URI TransactionID
- Required
  - Entry (1) results: from SecurityManager
    - Set<Statement> Data, int OperationID
  - Entry (2) errors: from SecurityManager
    - Set<int, String> Error, int OperationID

Entry WriteOpExternal

- representation of a TS API out operation
- including security information required by Security Manager to perform access control
- WriteOpExternal :=
  - tripleSet: Set<org.openrdf.model.Statement>
  - url: URL
  - time: Long
  - securityInfo: SecurityInfo :=
    - certificate (?)
    - Set<Assertion> (?)
    - cookie (?)
  - operationID: String
  - transactionID: URL

Entry ReadOpExternal

- representation of a TS API rd or in operation
- including security info
- ReadOpExternal:=
  - template: Set<Statement>
  - url: URL
  - time: Long
  - isTake: boolean
  - mutliple: boolean
  - securityInfo
  - operationID: String
  - transactionID: URL

Entry DataResultExternal

- data result (triples) of a successful TS API rd or in operation to be returned to the TS API
- optionally containing a security cookie to be used by the client in subsequent requests
- DataResultExternal :=
  - result: Set<Set<Statement>>
  - operationID: String
  - time: Long
  - transactionID: URL
  - cookie: ?

Entry ErrorResultExternal

- representation of error information in case an error occurred during the execution of a TS API operation
- ErrorResultExternal :=
  - operationID: String
  - errorNumber: int
  - errorDescription: String
  - cookie: ?

Security Manager component

- enforces security policies
- checks the identity of clients and giving them the appropriate permissions
- checks TS-API and Management-API requests (external entries) and transforms them into internal entries
- transforms „outgoing“ entries into external entries for the APIs

Security Manager
Functional Description (Black Box View)

- Client authentication
  - performing authenticity checks on clients credentials and attribute assertions
- Trust & attribute mapping
  - filtering clients supplied information (identity attributes) basing on trust relationships with asserting parties, and mapping these attributes to roles for access control
- Access control
  - taking access control decisions

Security Manager interface (1)

- provided Entries
  - DataResultExternal
  - ErrorResultExternal
  - WriteOperation
    - write operation which has been checked by the Security Manager
  - ReadOperation
    - read operation which has been checked by the Security Manager
  - ManagementOperation
    - Management API operation which has been checked by the Security Manager

Security Manager interface (2)

- required Entries
  - WriteOpExternal
  - ReadOpExternal
  - ManagementOpExternal
    - representation of a Management API request
  - DataResult
    - result of a TS-API operation
  - ErrorResult
    - error information in case of an erroneous termination of a TS-API operation

Security Manager Component Interface

- Provided
  - ext-data-result, ext-err-result: to TS API, Mgmt API
  - triplestore-req: to Triple Store Adapter
  - mgmt-op, write-op: to Metadata Manager
  - mgmt-op, read-op: to Query Processor
- Required
  - ext-read-op, ext-write-op: from TS API
  - ext-mgmt-op: from Mgmt API
  - triplestore-resp: from Triple Store Adapter

Entry ManagementOpExternal

- represenation of a Management API call
- ManagementOpExternal:=
  - operationID: String
  - operation: MgmtOperation[1]
  - opParameters: List<Object>
  - securityInfo

[1] enum with all management API operations

Entry ReadOperation

- An authorized TS-API read opeation
- ReadOperation:=
  - template: Set<Statement>
  - url: URL
  - time: Long
  - isTake: boolean
  - multiple: boolean
  - clientInfo
  - opertionID:String
  - transactionID:URL
  - allowedSubspaces: Set<URL>

Entry WriteOperation

- An authorized TS-API write operation
- WriteOperation:=
  - triples: Set<Statement>
  - url: URL
  - time: Long
  - clientInfo
  - operationID: String
  - transactionID: URL

Entry ManagementOperation

- An authorized Management API request
- ManagementOperation:=
  - operationID: String
  - operation: MgmtOperation
  - opParameters: List<Object>

Entry DataResult

- The result of a TS-API request
- needs to be authorized by the Security Manager
- DataResult:=
  - result: Set<Set<Statement>>
  - operationID: String
  - time: Long
  - transactionID: URL

Entry ErrorResult

- erroneous result of an operation
- needs to be authorized by the Security Manager
- ErrorResult:=
  - opertionID:String
  - errorNumber:int
  - errorDescription: String

Management API component

- provides management functionality
  - kernel startup and shutdown
  - kernel and data administration (access rights, ...)
- client invokations are translated into entries and written to the integration space
- when the operation has been performed, the API implementation reads the result and returns the result to the client

Management API interface

- required Entries
  - DataResultExternal
  - ErrorResultExternal
- provided Entries
  - ManagementOpExternal

Triplestore Adapter component

- abstraction of the underlying storage infrastracture
- offers components possibility to query and store information (e.g., security policy, ...)
- consumes TriplestoreRequest entries and creates TriplestoreResponse entries of processed requests

Triplestore Adapter interface

- provided Entries
  - TriplestoreRequest
    - request to read or write triples
    - can be written be any other component
  - TriplestoreQuery
    - Request to the Query Processor to process a query
- required Entries
  - TripleStoreResponse
    - the answer to a TriplestoreResponse
  - QueryString
    - the answer to a TriplestoreQuery request

Triplestore Entries

- TriplestoreRequest
  - structure needs to be specified
- TriplestoreResponse
  - structure needs to be specified
- QueryString:=
  - queryID: Long
  - queryString: String
- TriplestoreQuery:=
  - queryID: Long
  - data: Statement
  - space: URL
  - tripleSet: Set<URL>

Query Processor

- decomposing a query into parts that are satisfiable by the local data store and to parts that must be forwarded to other kernels
- pre- and postprocessing of queries
- reads TriplestoreQuery request from the integration space and produces QueryString

Query Processor Interface

- provided Entries
  - QueryString
    - a processed triplestore query which can be executed by the Triplestore Adapter
- required Entries
  - TripleStoreQuery
    - a request to process a triplestore query

Mediation Manager component

- Semantic mediation of incoming and outgoing data
- no input/output description has been provided
- possible solution:
  - reads WriteOperation and ReadOperation requests
  - creates entries with the transformed information
  - extra field in the entry determines if the entry is already in the correct format and can be processed by the other components

Metadata Manager component

- creates and provides metadata
- provides routing information for the distribution manager
- reacts on Management-, Read- and WriteOperations and enriches them with (routing) information

Metadata Manager
Functional Description (Black Box View)

- listening on the bus for published triples or stored structural data – create metadata.
- try to find distributed data via the semantic routing/distribution manager.
- use the query processor to retrieve the metadata already stored in the md space.
- use the storage adapter to persistently store md into a seperate metadata space.
- provide a rule engine to resolve relations according to the ts ontology.

Metadata Manager interface

- required Entries
  - ReadOperation
  - WriteOperation
  - ManagementOperation
- provided Entries
  - ReadOperation
  - WriteOperation
  - ManagementOperation
  - The operations enriched with routing information
    - What is the structure of this routing information?

Metadata Manager Component Interface 1st iteration

- Provided
  - StructureEntry: to Storage Adapter ... inform the storage adaptor to read/write some structural metadata to the storage
  - CreatorEntry: to Storage Adapter ... inform the storage adaptor to read/write some metadata to the persistent storage
- Required
  - PublicationEntry: from ts api ... inform the mm about a published data-triple.
  - ManagementEntry: from management api ... inform the mm about the creation of structural md

Transaction Manager component

- handles functionality of transactions
- no input/output description has been provided
- possible solution
  - entry for each transaction API request which is answered with a entry containing the transactionID
  - on commit or rollback a entry is written to the core. Components can react on this entry if they have to compensate operations

Distribution Manager component

- connects a single kernel to the global space infrastracture
- takes care of request routing and retrieval of distributed, semantically clustered data
- communicates with other kernels using the TS-API
- reacts on Read-, Write- and ManagementOperations which have to be routed to another kernel and writes the answer to the integration space

Distribution Manager interface

- required Entries
  - WriteOperation
  - ReadOperation
  - ManagementOperation
  - RoutingInformation
    - required information to route the request
    - should this be part or the Operation request?
- provided Entries
  - DataResult
  - ErrorResult
  - dist-kernel, dist-descr, dist-rel
    - what is this?

Component-Component Matrix

to / from	Triple Space API	Managment API	Triple Store Adapter	Security Manager	Mediation Manager	Metadata Manager	Query Processor	Transaction Manager	Distribution Manager
Triple Space API			TriplestoreRequest	WriteOpExternal ReadOpExternal					
Managment API			TriplestoreRequest	ManagementOpExternal					
Triple Store Adapter	TriplestoreResponse	TriplestoreResponse		TriplestoreResponse	TriplestoreResponse	TriplestoreResponse	TriplestoreQuery TriplestoreResponse	TriplestoreResponse	TriplestoreResponse
Security Manager	DataResultExternal, ErrorResultExternal	DataResultExternal, ErrorResultExternal	TriplestoreRequest			ManagementOperation, WriteOperation, ReadOperation			
Mediation Manager			TriplestoreRequest						
Metadata Manager			TriplestoreRequest						WriteOperation, ReadOperation, ManagementOperation, RoutingInformation
Query Processor			QueryString, TriplestoreRequest	DataResult, ErrorResult					WriteOperation, ReadOperation
Transaction Manager			TriplestoreRequest						
Distribution Manager			TriplestoreRequest	DataResult ErrorResult		dist-kernel, dist-descr, dist-rel			

Security Manager sequence diagram for OUT operation

(the diagram is similar to the ones fo RD and Management operations)