



 **HIC: a Multimodal Adaptive Interaction Platform
for Complex Systems**

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- Human Interaction Container (HIC) paradigm
- Interaction Middleware
- Interaction Container
- Focus on Multimodality Processing
- Application to Air Traffic Management

The challenge for THALES systems:

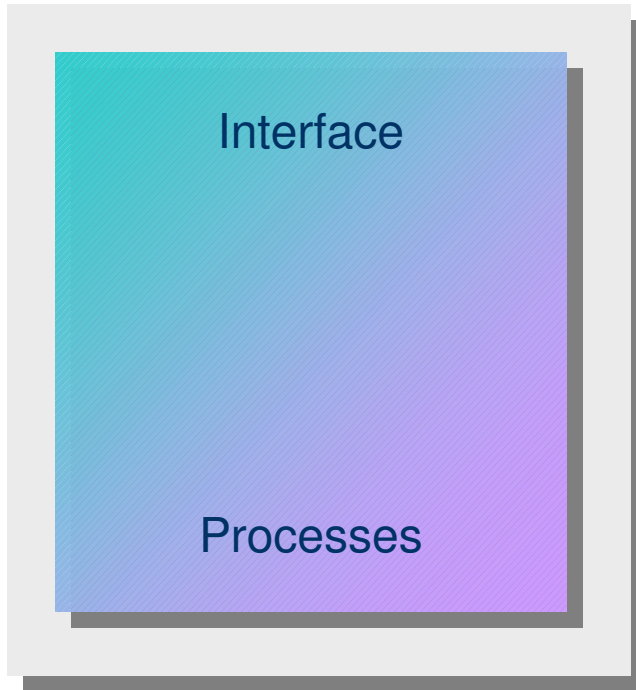
Make the move from application-centric to user-centric interfaces

- Objective: investigate, develop, experiment and transfer the technology required for the next generation of intelligent user interfaces offering dynamic adaptation to user
- Solution: Make the interaction logic explicit and make it independent from other logics (application/business logic and interface/presentation logic)
- Main issues:
 - Implement the separation between the various logics
 - Build models for the representation of the interaction context:
 - User (profile, preferences, role, task or mission, ...)
 - Domain (application services, application state, business rules, ...)
 - Devices (workstation PC, laptop PC, PDA, mobile phone, tablet PC, ...)
 - Modalities (graphical, speech-based, gesture-based, ...)
 - Propose generic interaction processes that can be easily instantiated upon specific business domains

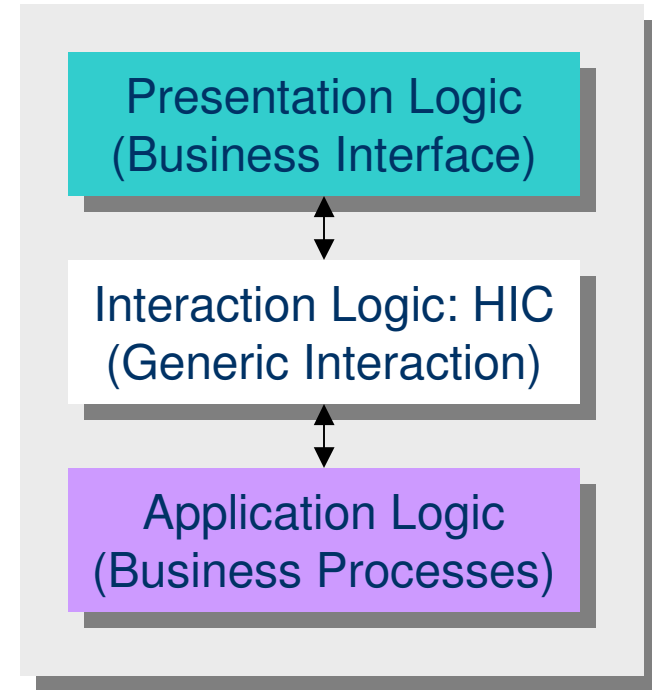
Human Interaction Container (HIC) Paradigm



Current Systems



HIC-based Systems



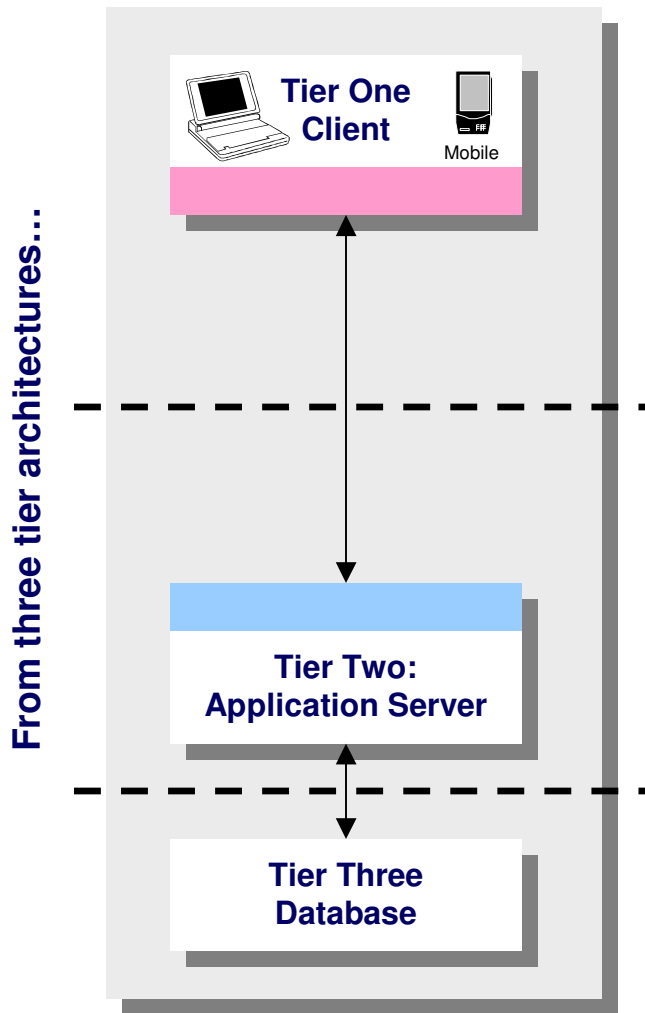
Human Interaction Container Paradigm:

Decouple the interaction from both the application and the interface

HIC applied to Multi-tier Architectures



Current Architectures

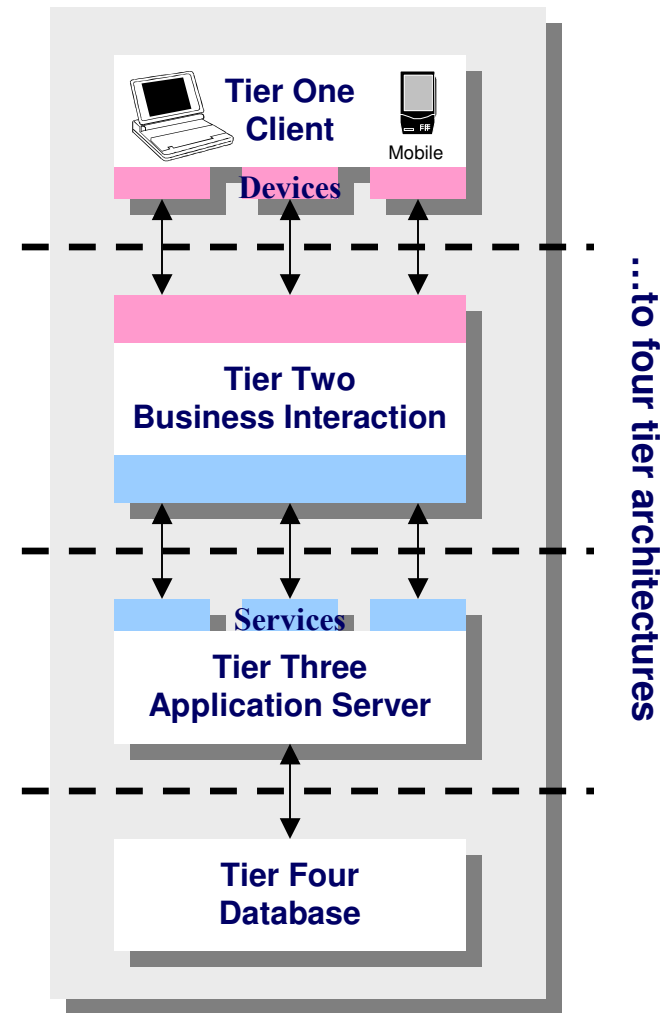


Make
Interaction services
independent of
Terminal
specific use



Make
Application services
independent of
Organization
specific use

HIC-based Architectures



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C4I/ISR

For which the challenge is to identify critical information

Technology required:

- Speaker identification
- Language identification
- Audio (speech) filtering
- Topic detection
- Information filtering

Control/Command

For which the challenge is to enhance the realism of interaction

Technology required:

- Speech & natural language processing
- Multimodality
- Engineering for multimodal interfaces

**The HIC paradigm impacts THALES domains
where the mission and the environment of the user can be formally described**

Business Intermediation

For which the challenge is to render collaboration effective

Technology required:

- Timely and accurate data gathering, sharing & dissemination
- Data filtering
- User profile & preference management
- Collaboration support
- Business rule processing

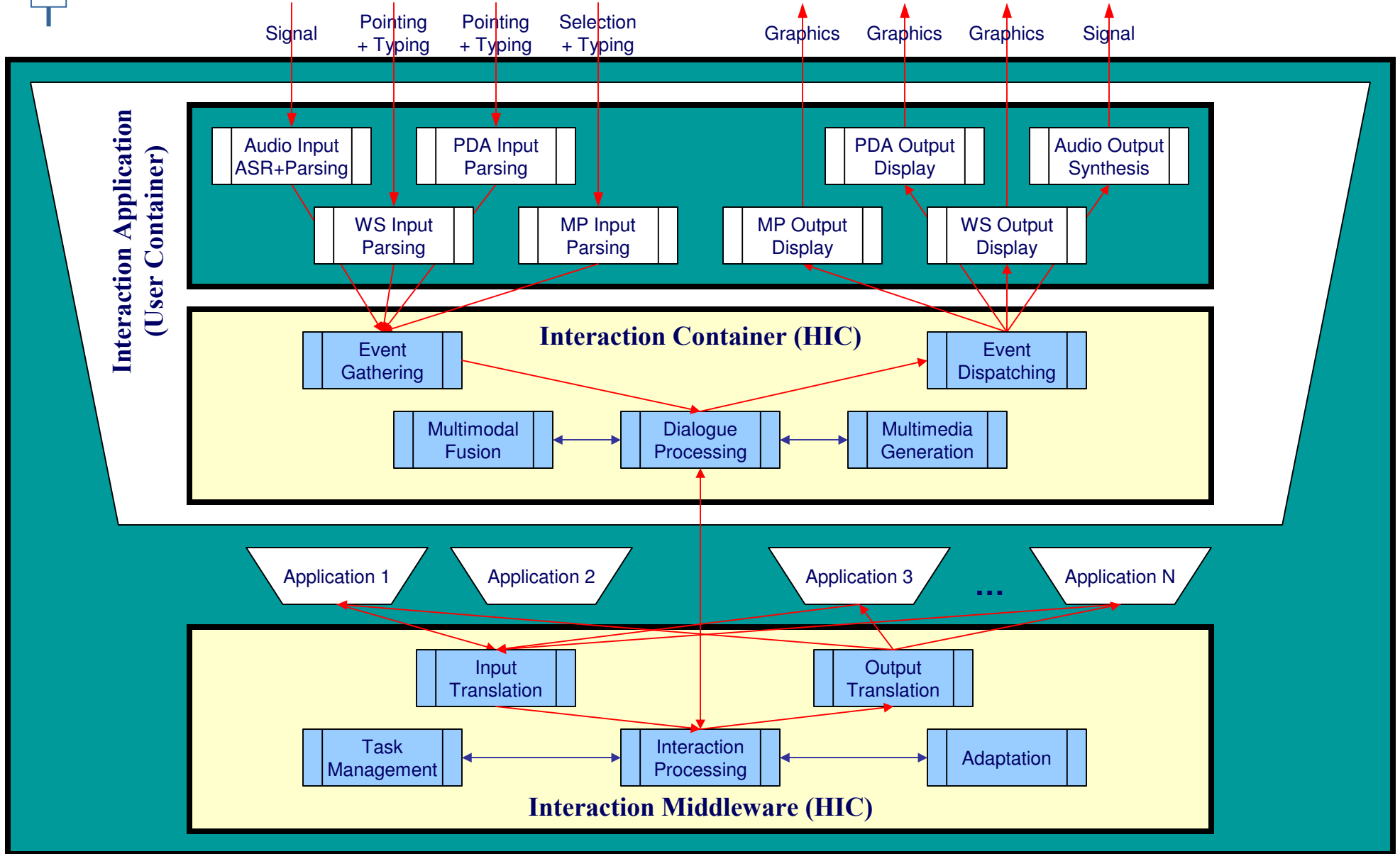
Homeland Security

For which the challenge is to enhance safety of the citizen

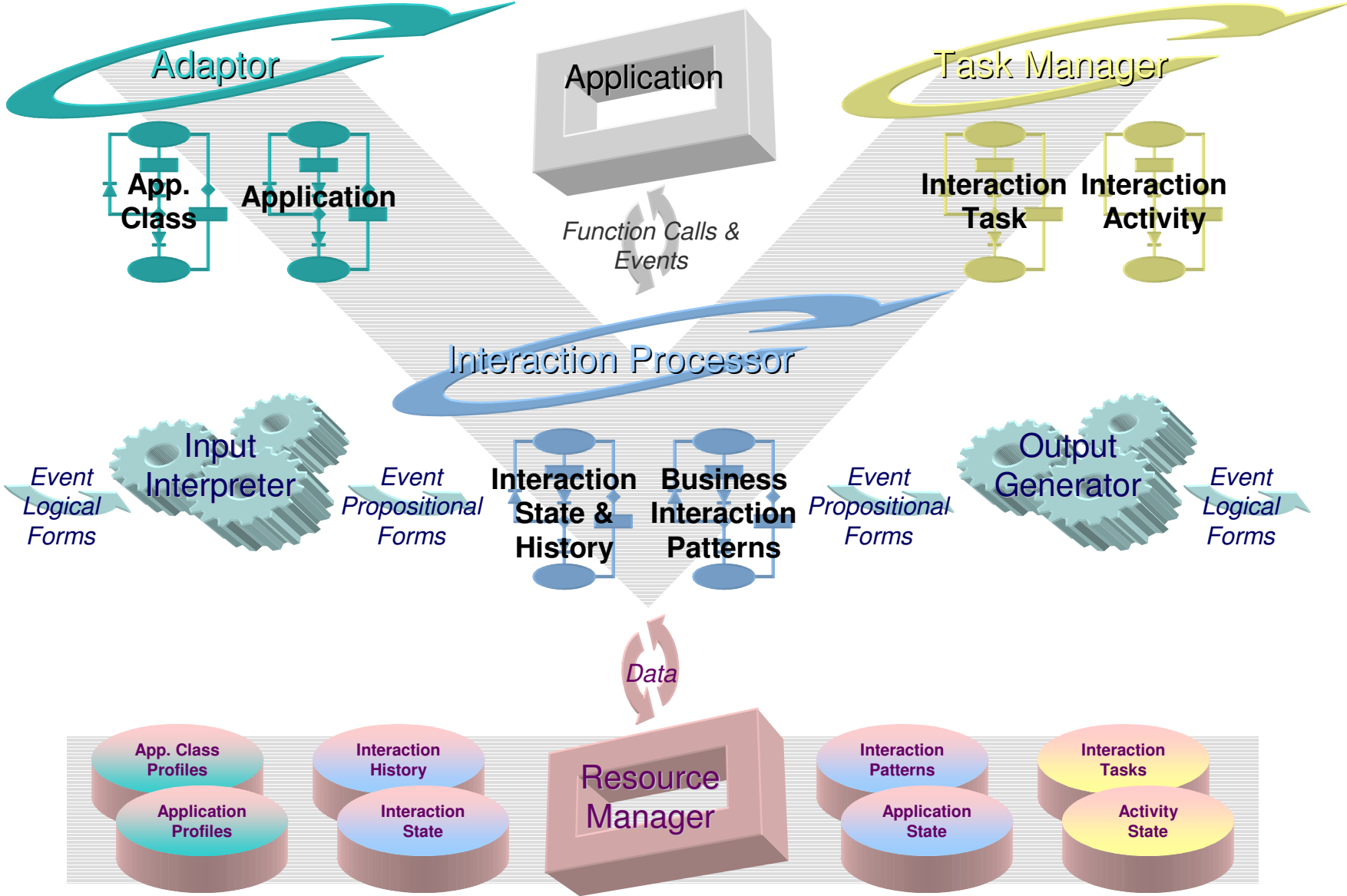
Technology required:

- Person identification
- Person and system tracking
- Situation awareness
- Emotion detection

Architecture of the HIC



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■ Why

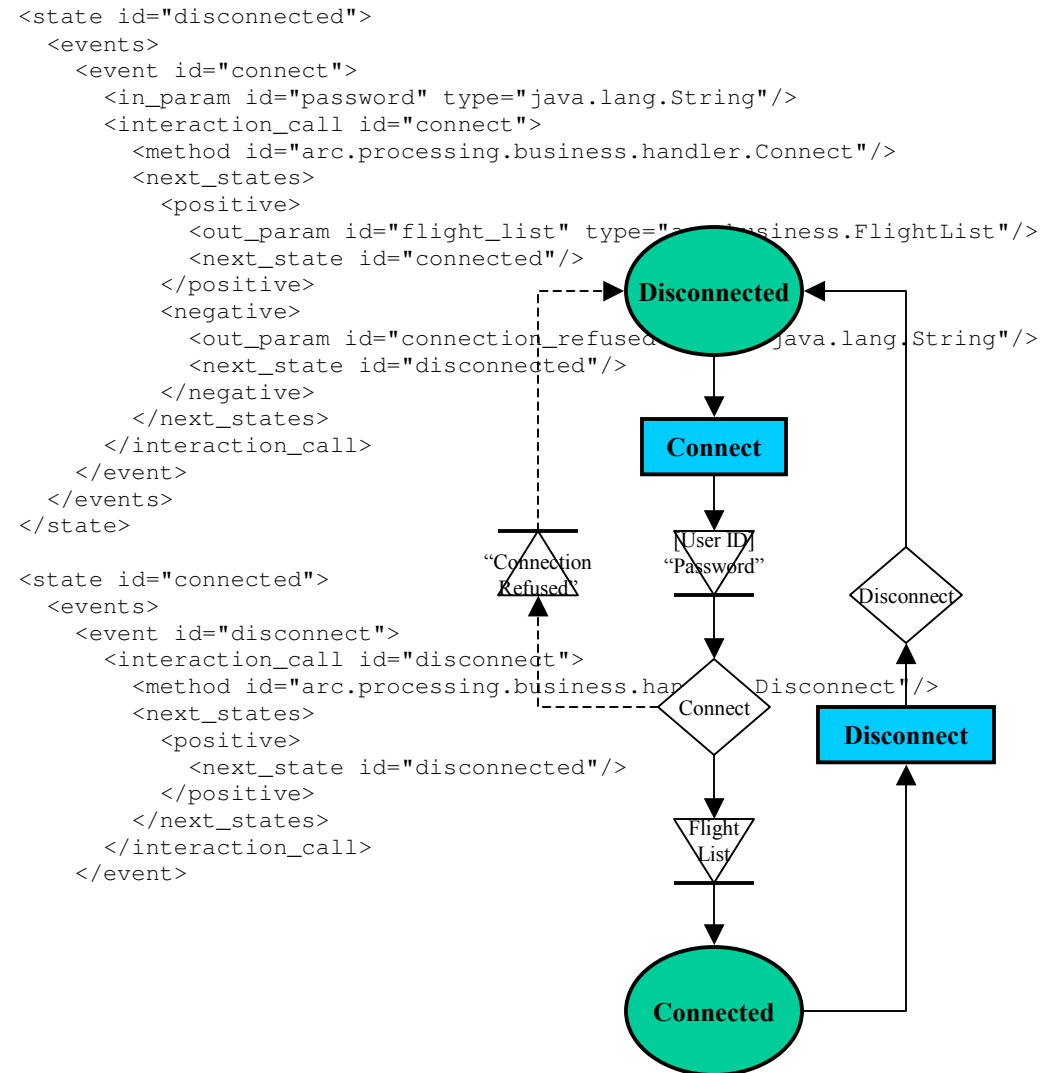
- To plan and control the processing of interaction
- To ensure interaction consistency

■ How

- Using XML representation
- Using generic task representation and processing technology

■ With

- A task model
- An activity model





■ Why

- To implement business interaction constraints for application classes
- To enable adapted interaction between applications

■ How

- Using XML representation
- Using data filtering
- Using dynamic adaptation

■ With

- A hierarchy of static application profiles (interaction and business)
- Dynamic adaptation rules

```
<profile>
  <BusinessProfile id="handler" localisation="LFPG" classe="0"
    affiliation="DA">
    <AccessRights>
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          <to/>
          <subject/>
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        </message>
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    </TemplateList>
  </BusinessPrefs>
  <LookAndFeel/>
</profile>
```



■ Why

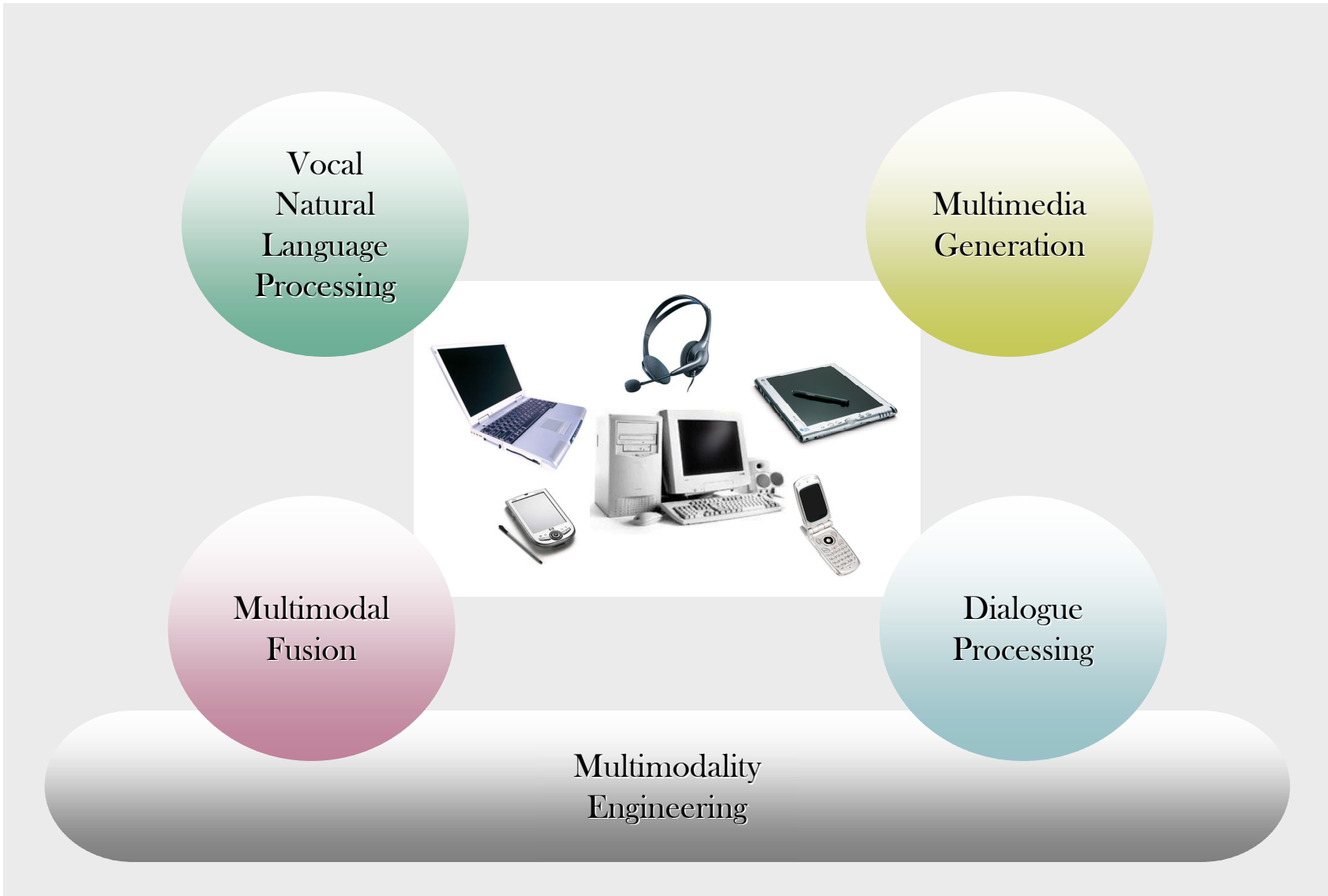
- To control interaction
- To instantiate interaction upon business
- To implement communication between applications

■ How

- Depending closely upon adaptation and task management
- Coordinating input interpretation and output generation
- Relying upon real-time resource management

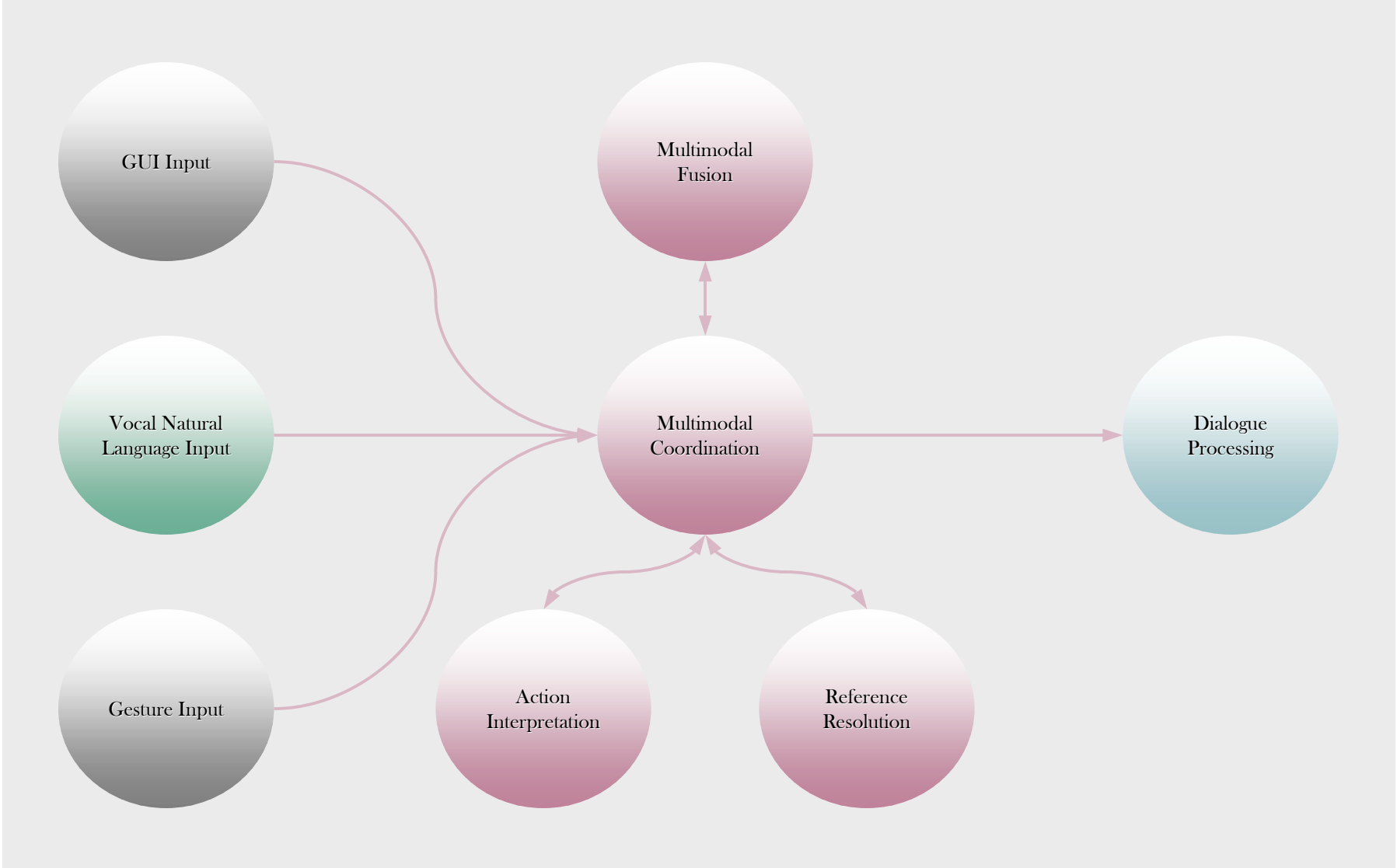
■ With

- A multi-application asynchronous interaction model
- An interaction context (interaction history & interaction state)
- A business context (business interaction patterns & application state)



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Architecture for Multimodal Fusion



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Multimodal Coordination

- **Function:** management of modality calls & supervision of the fusion process
- **Inputs:** all events from all modalities
- **Approach:** rules identifying coordinated events according to time, information content, etc.

Multimodal Fusion

- **Function:** fusion of coordinated events from different modalities
- **Inputs:** coordinated events, to be merged
- **Approach:** rules for event fusion

Action Interpretation

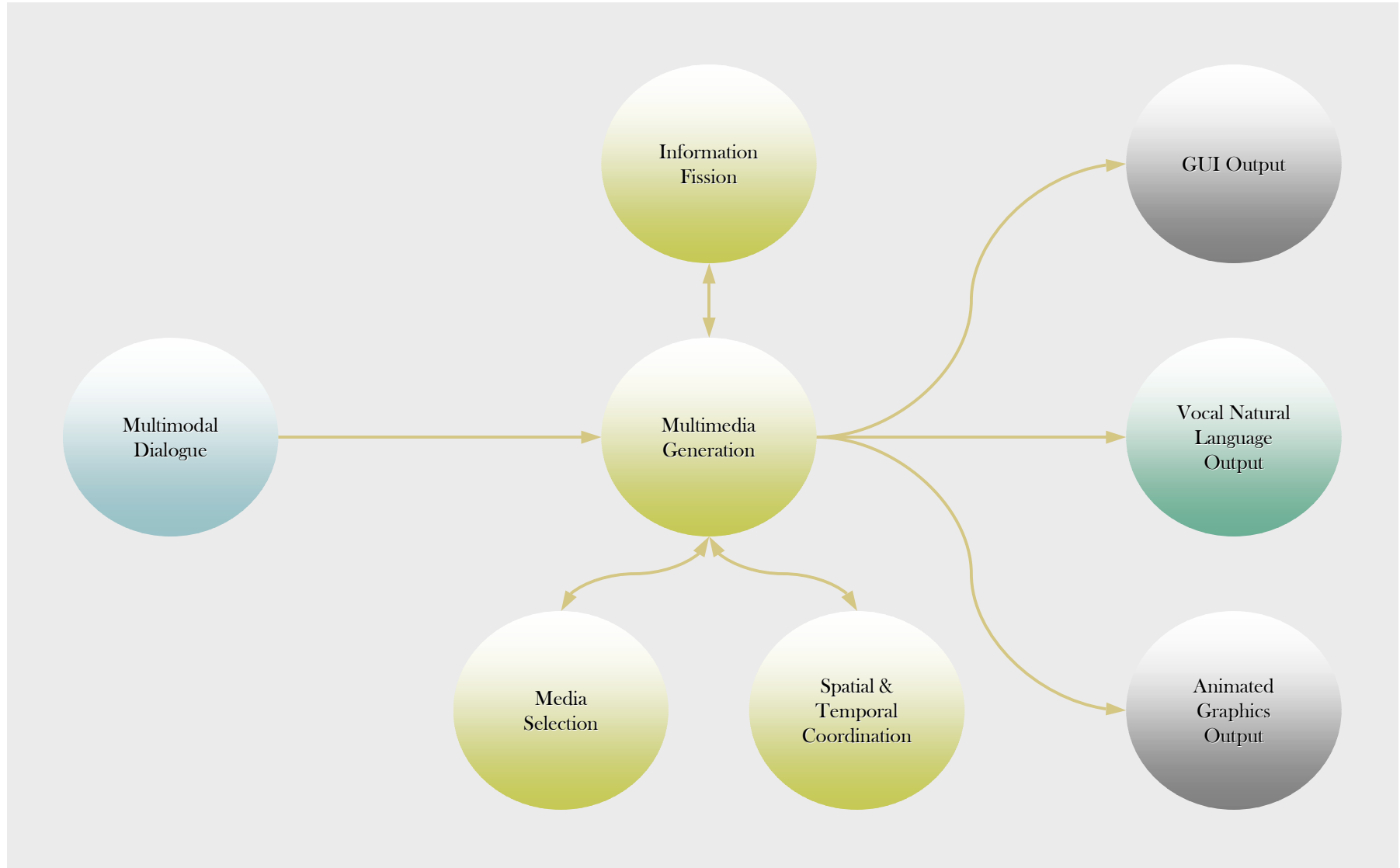
- **Function:** computation of logical forms
- **Inputs:** user events pre-processed with recognisers (in normal form)
- **Approach:** rules to convert normal forms into logical forms

Reference Resolution

- **Function:** resolution of (multimodal) references i.e. conversion of logical forms into propositional forms (instantiated logical forms)
- **Inputs:** logical forms (including referring expressions)
- **Approach:** reference resolution algorithms based upon Mental Representation Theory

Multimodal
Fusion

Architecture for Multimedia Generation



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Multimedia Generation

- Supervises the generation process
- Produces multimedia presentations
- Coordinates the other modules
- Sends requests for rendering to the different devices

Information Fission

- Divides global information into simple information items
- Preserves the relations between information items
- Uses fission rules
- Uses the semantic representation produced by the dialogue

Media Selection

- Selects the best media to use given the context
- Uses ergonomics rules, business rules, user preferences
- Uses external context (noise, light), user profile and device models
- Allocates the chosen media to information items

Spatial & Temporal Coordination

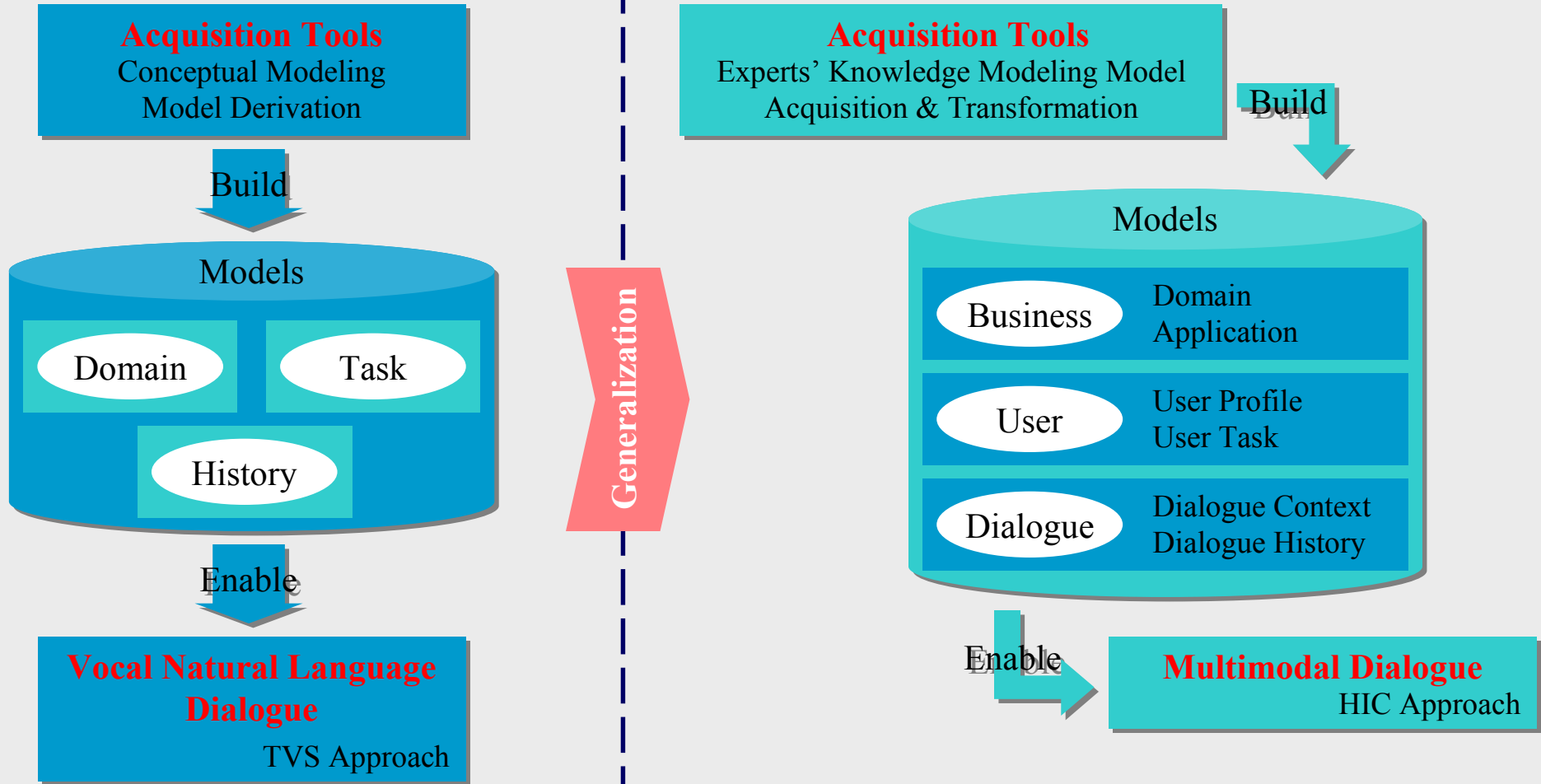
- Coordinates the whole presentation
- Creates referring multimedia expressions
- Arranges the presentation timing and coordinates medias and devices
- Uses a presentation planner



Approach for Multimodal Dialogue



Generalizing THALES Vocal System's (TVS) approach for vocal natural language to multimodality



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Formalism

- **Eventualities: states & events (including activities/processes)**
- **Application & user states (business entities & users as objects)**
- **Application & user events (business entities & users as participants)**
- **Temporal relations between states and events: eventuality graph**

Model

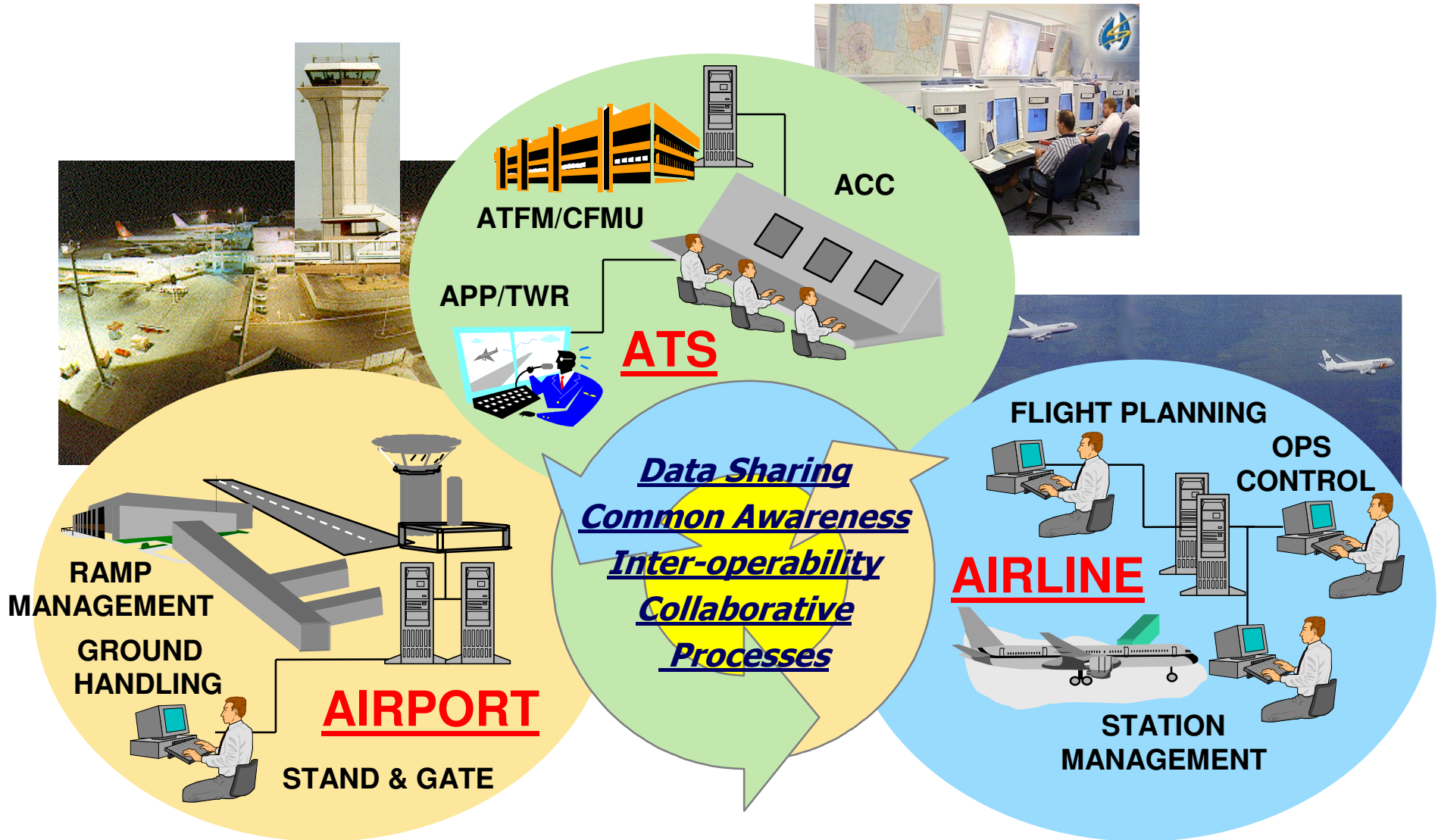
- **Dialogue & application state: state graph**
- **Dialogue history: eventuality graph**
- **Dialogue acts: communication events with propositional forms as participants**
- **Dialogue structure: tree of dialogue events & event groups**

Function

- **Pragmatic interpretation of user requests as propositional forms**
- **Dialogue with the applications (including other users)**
- **Expression of application events as propositional forms**
- **Generation of system answers as propositional forms**

Multimodal
Dialogue

Application to Collaborative Decision Making in ATM

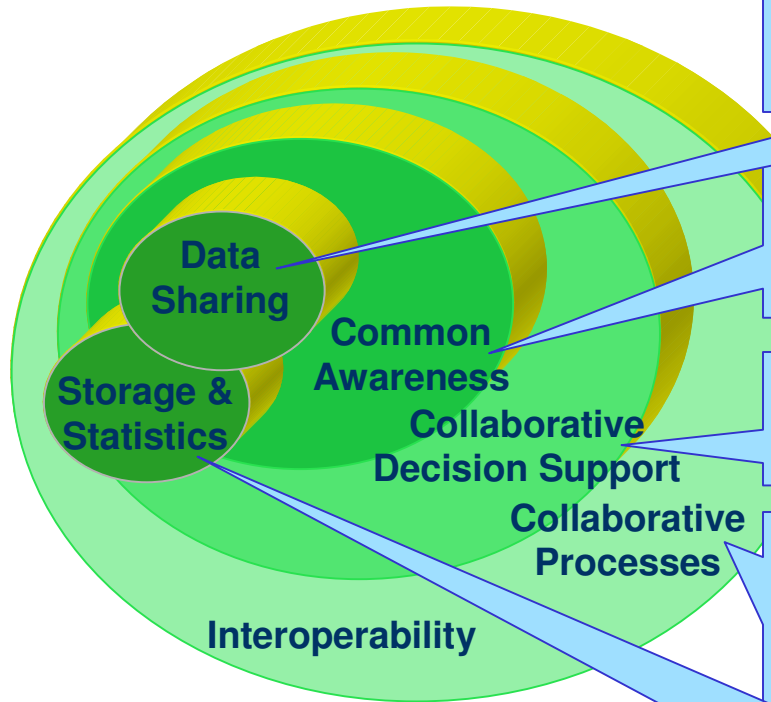


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HIC Impact on CDM for Air Traffic Management



COFOS



→ Data Collection from Multiple Sources
→ Data Formatting & Hosting

→ Provision of a Global Operations Plan
→ Data Filtering
→ Data Quality Indicator

→ Irregular Operations Alerting Service
→ Collaborative Messenger

→ Priority & Constraint Management
→ Integration with Airline Operations Control
Airport Resources Management and ATC Systems

→ Post Flight Analysis

HIC

Enhanced User Profile Management
✓ Only the information the user needs (filtering & push)
✓ “Adaptive” user model

Auto-Adaptation to User Terminal
✓ Automatic HMI configuration
✓ Automatic Data Filtering

“Workgroup” Messenger
✓ Team Work modeling rule
✓ Automatic Acronyms Translator, voice recognition/synthesis

XML Based Communication model
✓ Platform-independent architecture
✓ IP network compatibility

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COFOS/HIC: Focusing on User Adaptation



COFOS CLIENTS



**AIRLINE
DISPATCH**

**PUNCTUALITY
MANAGER**

STAND & GATE

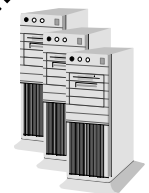
**AIRPORT
RESOURCE
MANAGER**

**STATION
CONTROL**

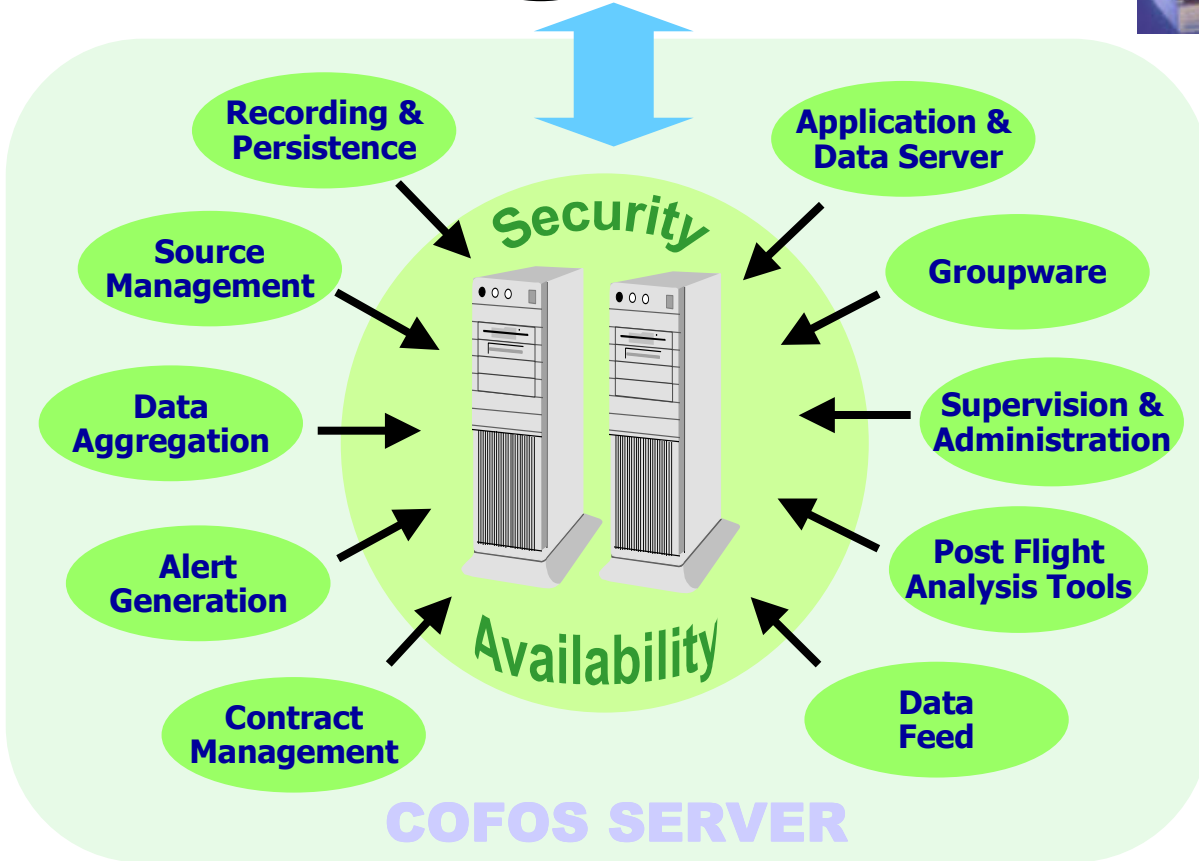
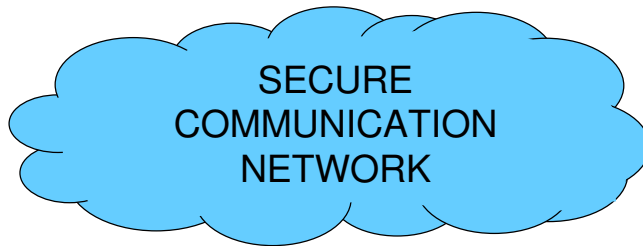
**GROUND
HANDLER**



**Data Feed / Customization
/ Integration**



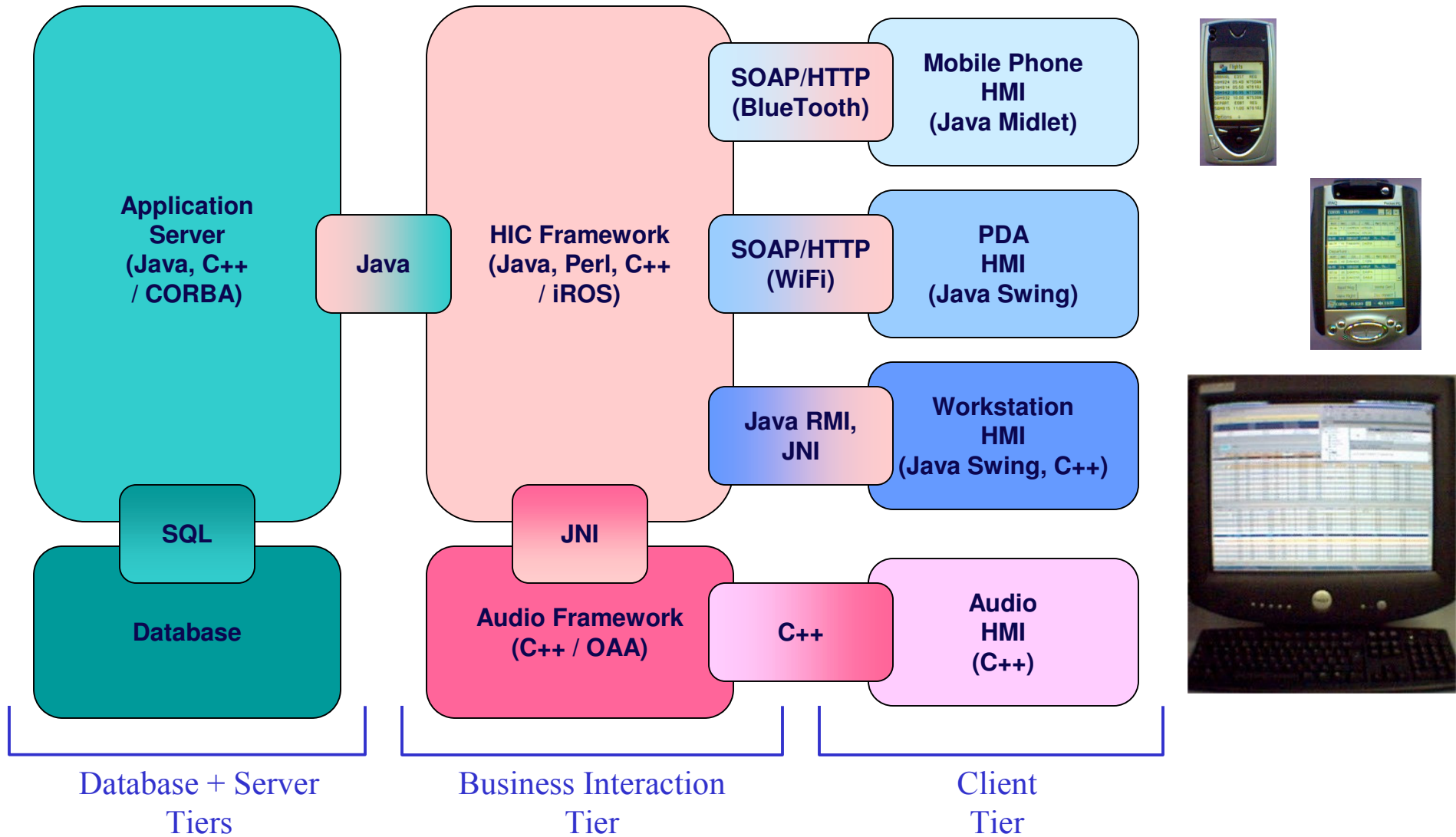
THALES



COFOS SERVER

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Architecture of the HIC Platform Implementation



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