



The CHOReOS FP7 project and the Future Internet OW2 initiative

Pierre CHÂTEL – Thales Communications



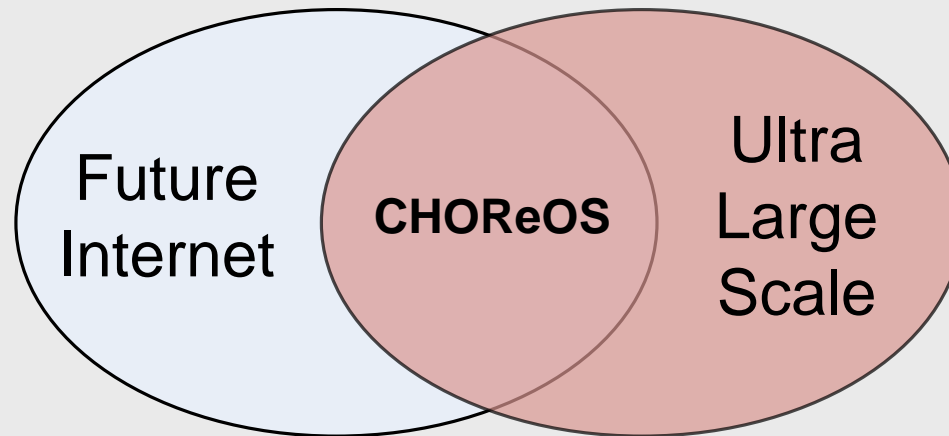
Large Scale Choreographies for the Future Internet

OW2 Annual Conference
November 25th, 2010

What is CHOReOS ?

“Large Scale Choreographies for the Future Internet”

- ▶ **Main goal:** sustaining **decentralized** service **choreographies**
- ▶ **Specific context:** Future Internet (FI), Ultra Large Scale (ULS)
- ▶ **Abstract:** “It revisits choreography-centric SOAs by introducing a **dynamic development process** and **middleware** for the implementation and coordination of services through choreographies”



In this presentation...

- ▶ main tenets behind **Future Internet** and **Choreography of Services**

CHOReOS at a glance

Duration:

- ▶ October 2010 – September 2013

Consortium of 15 partners:

- ▶ 7 industrials
- ▶ 8 academics

Total budget:

- ▶ 8.665.785 €

European programme:

- ▶ Call FP7-ICT-2009-5
 - ▶ Grant n°257178



Further information:

- ▶ <http://www.choreos.eu>

Consortium

7 industrials

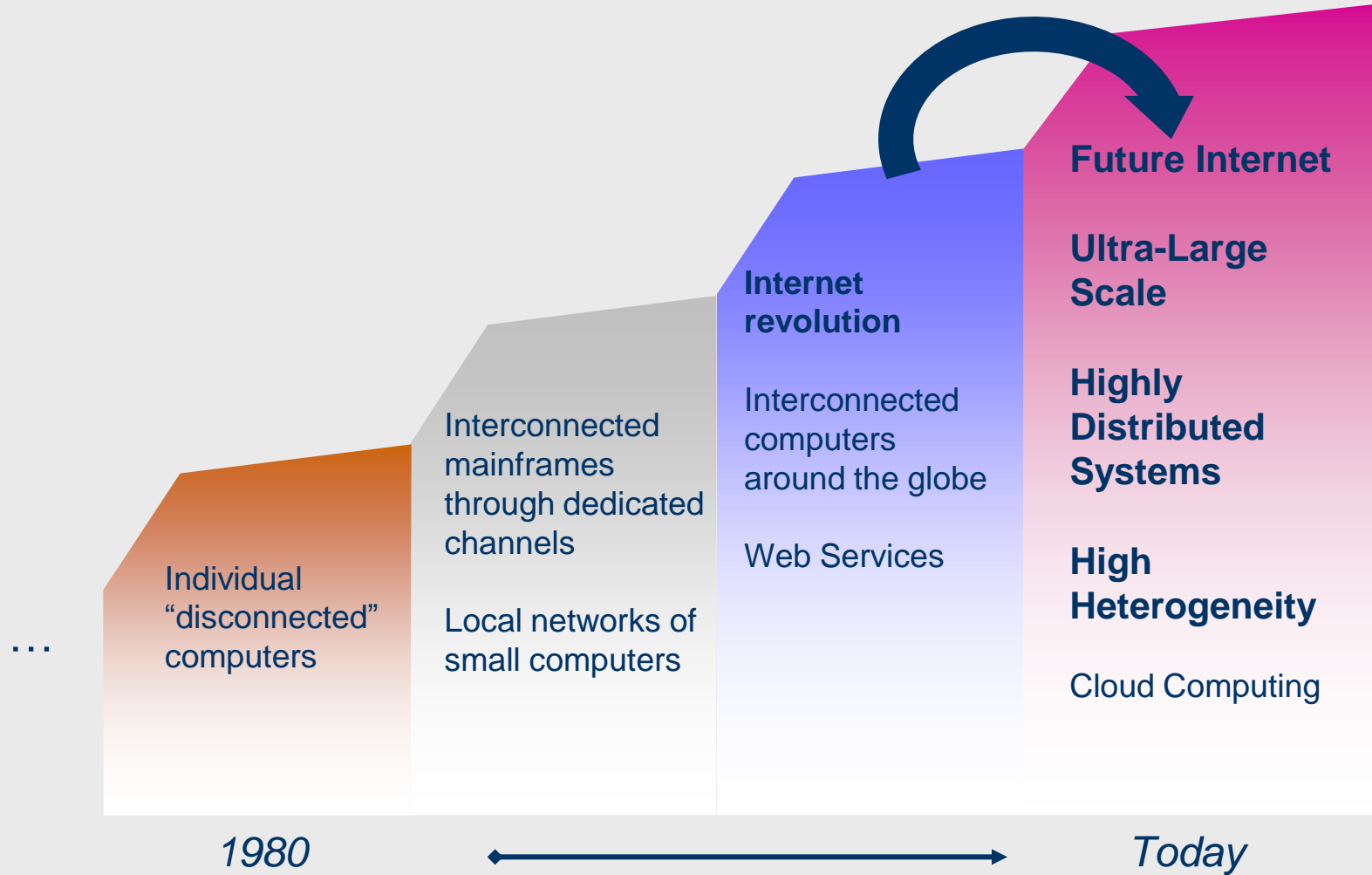


8 academics



From Context...

Help with the next big step in system architectures



...to Framework

The CHOReOS Integrated Dev. & Runtime Environment (IDRE)

Formally grounded
abstractions and models

Handle Ultra-
Large Scale

Choreography-centric
development process
and runtime

Handle high
service
distributivity

Service-oriented
middleware for the
Future Internet

Handle high
heterogeneity

Governance and V&V
support

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Main concepts

- ▶ Future Internet
- ▶ Service Choreography
- ▶ Cloud

Use Cases

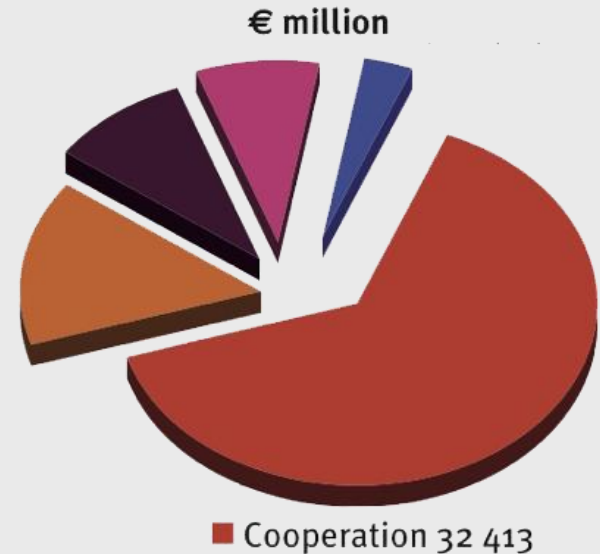
- ▶ Air Travel Logistics
- ▶ Others

Positioning inside FP7



“7th Framework Programme for Research and Technological Development”

- ▶ Bundles all research-related EU initiatives together under a common roof
- ▶ from 2007 to 2013, € 50 billion budget
- ▶ Objectives grouped into **Specific Programmes:**
Cooperation, Ideas, People, Capacities.
- ▶ **CHOReOS: Cooperation / ICT Programme**
 - ▶ **Theme:** Information and Communication Technologies
 - ▶ **Challenge 1:** Pervasive & Trusted Network & Service Infrastructures
 - ▶ **Objective 1.2:** Internet of Services, Software and Virtualization
 - ▶ **Outcome:** Service Architectures and Platforms for the Future Internet



Community building

- ▶ Collaborative services to project teams
- ▶ **Forge** to centralize all developments: including models, UML profiles and code

Dissemination

- ▶ Through OW2 activities (marketing services, organizing conferences, ...)
- ▶ CHOReOS artifacts published as **Open Source Software (LGPL)**

OW2 “Future Internet” initiative

- ▶ “(...) **joint efforts by OW2 Members** to develop **technical integration between projects and business synergies** in order to address specific market needs”
- ▶ grouping of scope-bound projects, CHOReOS is the first in this initiative
- ▶ will help **broaden the spectrum of CHOReOS** and facilitate dissemination to a wider community of users and developers

Identifying synergies with existing projects



▶ Orchestra

- ▶ “...solution to handle long-running, Service Oriented Processes”



▶ JORAM

- ▶ “...distributed MOM... designed with an OSGi™based services architecture to provide a dynamically adaptable messaging server”



▶ Fractal

- ▶ “...a modular, extensible and programming language agnostic component model that can be used to design, implement, deploy and reconfigure systems and applications”



▶ SOFA

- ▶ “...used for dynamic reconfiguration of component architecture and for accessing components under the SOA concepts”

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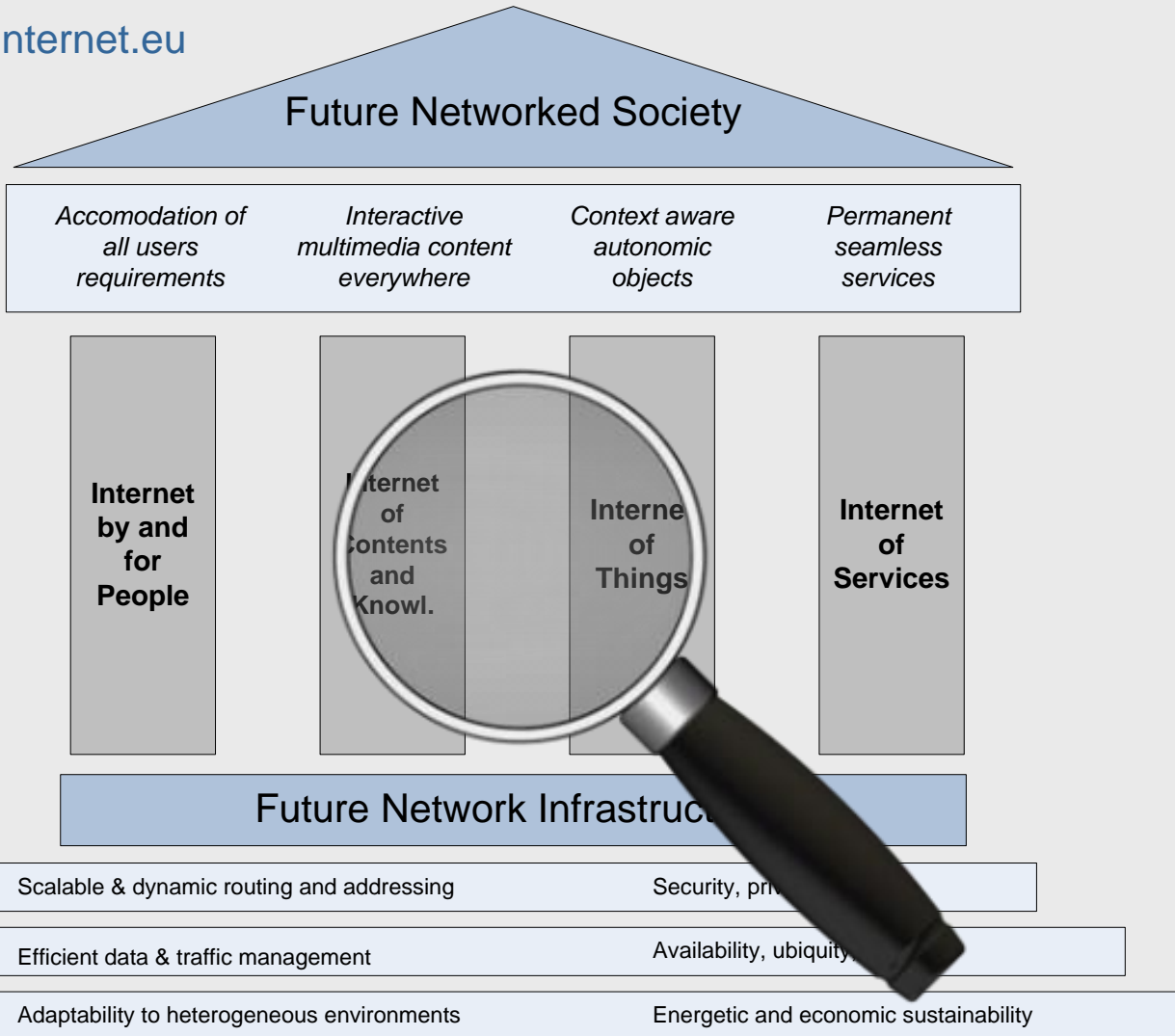
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FP7 / Cross-ETP (European Technology Platforms) vision

<http://www.future-internet.eu>





Internet by and for People

- ▶ **Goal:** to break the digital divide, by interconnecting growing populations of new users over time; to meet their needs and expectations

Internet of Contents and Knowledge

- ▶ **Goal:** to support mechanisms for knowledge dissemination both at local and global level. Knowledge & culture should be distributed worldwide

Internet of Things (IoT)

- ▶ **Goal:** to create an universally addressable continuum, with objects as “living beings”. They will have defined behaviors, actions and unique way of individual identification

Internet of Services (IoS)

- ▶ **Goal:** to enable internet-scale service oriented computing as the next evolutionary step after components. “Loose coupling” between service consumers and producers (instantiated by the “Cloud” paradigm)

A full-fledged choreography framework should help deal with specific FI characteristics

CHOReOS manages:

▶ **Major characteristics of “Internet of Things”**

- ▶ **High heterogeneity:** totally different objects in terms of functionality, technology and application fields
- ▶ **Ultra Large Scale:** a unique identifier for every object (Pervasive technologies) that need to communicate with each-other in a meaningful way

▶ **Major characteristic of “Internet of Services”**

- ▶ **Distributivity:** numerous service orchestrations, dispatched over the Internet, that need to communicate through message exchanges, but without a single point of control

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Orchestration:

- ▶ Local / centralized perspective
- ▶ "Each player in the orchestra strictly follows instructions from the conductor"




Choreography:

- ▶ Global / distributed perspective
- ▶ "Dancers dance following a global scenario, without a single point of control"

Service orchestration:

- ▶ Refers to an executable business process, with a specific (business) goal
- ▶ Represents control from one party's perspective (the orchestrator)
- ▶ Interactions occur at the message level
 - ▶ Between orchestrator and services
 - ▶ Message sequence controlled by orchestrator
- ▶ Allows recursive combination
 - ▶ Orchestrated processes accessible through WS interfaces
 - ▶ Orchestration of composite WS

Service choreography:

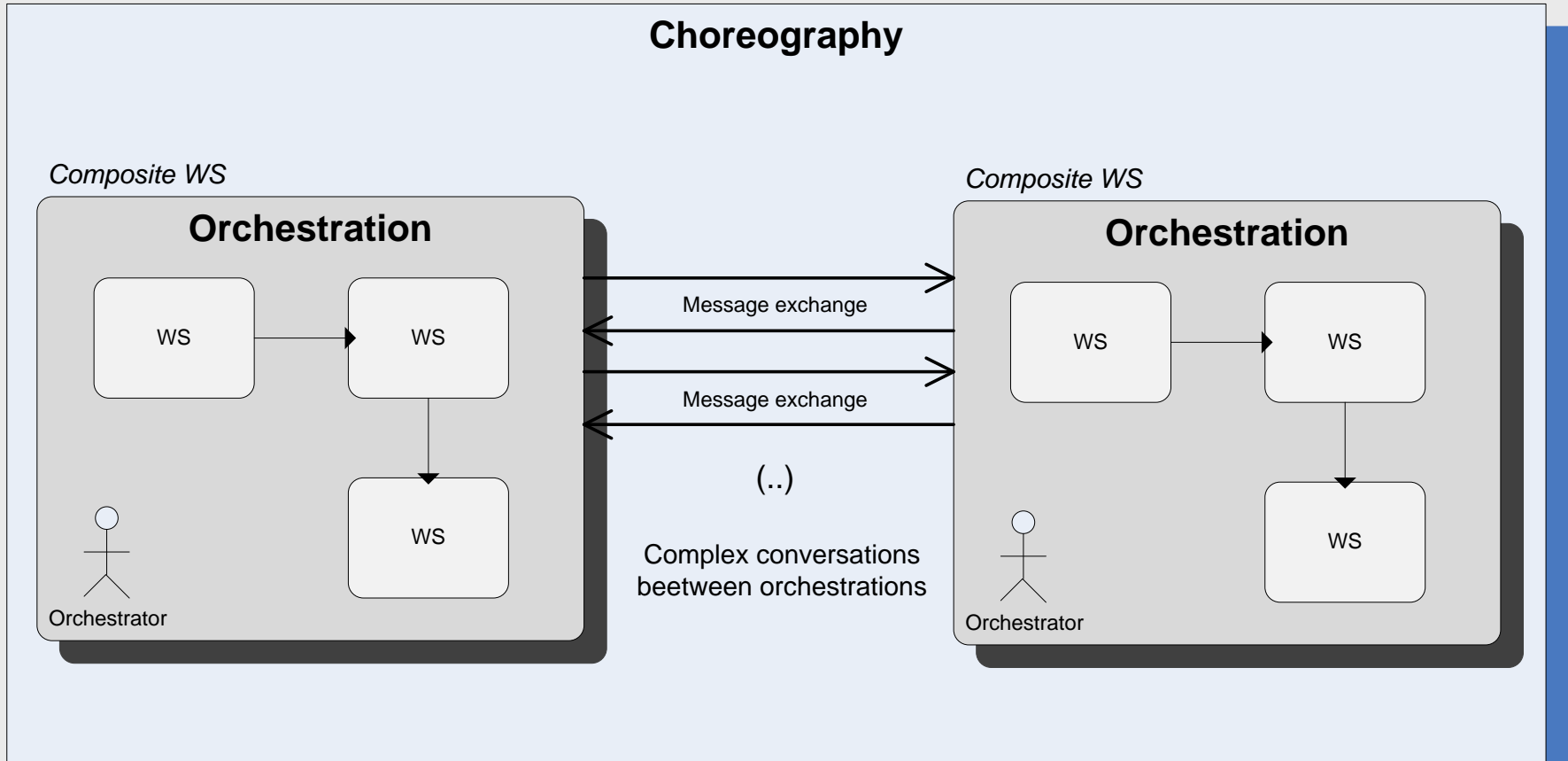
- ▶ Describes a non-executable protocol for peer-to-peer interactions 
 - ▶ Legal sequences of exchanged messages between peers
- ▶ Tracks the message exchange among multiple parties
 - ▶ More collaborative: allows each party involved in the interaction to describe its part
 - ▶ Guarantees interoperability by reflecting obligations and constraints between parties
- ▶ Interactions still occur at the message level
 - ▶ But directly between services

Future Internet context:

- ▶ More and more distributed architectures and systems
- ▶ Large number of to-be-coordinated services,
- ▶ Heterogeneity in services, providers

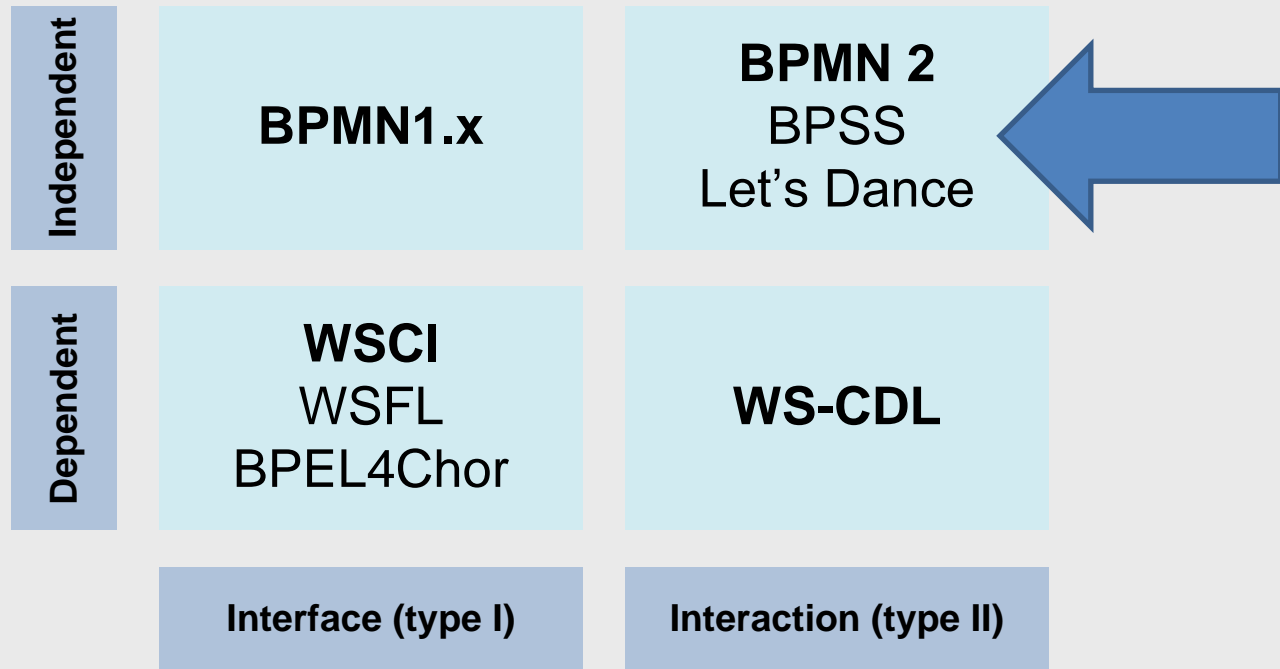
Choreographies to organize services, plan processes when centralized approaches are inapplicable, deprecated

Avoid single points of failure



▶ **Two paradigms [Decker, 2008]:**

- I. **Interconnected Interfaces Modeling:** choreography logic split across its participants through the roles they play, as specified by their interfaces.
- II. **Interaction Modeling:** choreography logic as a workflow, elementary interactions represent message exchanges between participants



▶ BPMN (Business Process Modeling Notation)

- ▶ “*De-facto standard for process modeling on the implementation independent level*” [Decker, 2008], maintained by the OMG
- ▶ **v1.x (2004) follows type I paradigm (Interconnected Interfaces) :**
 - participants = swim lanes (pools), interconnected by message flow, in a collaboration model
- ▶ **v2.0 (2010) introduces type II paradigm (Interaction):**
 - each step (Choreography Task) involves at least two participants

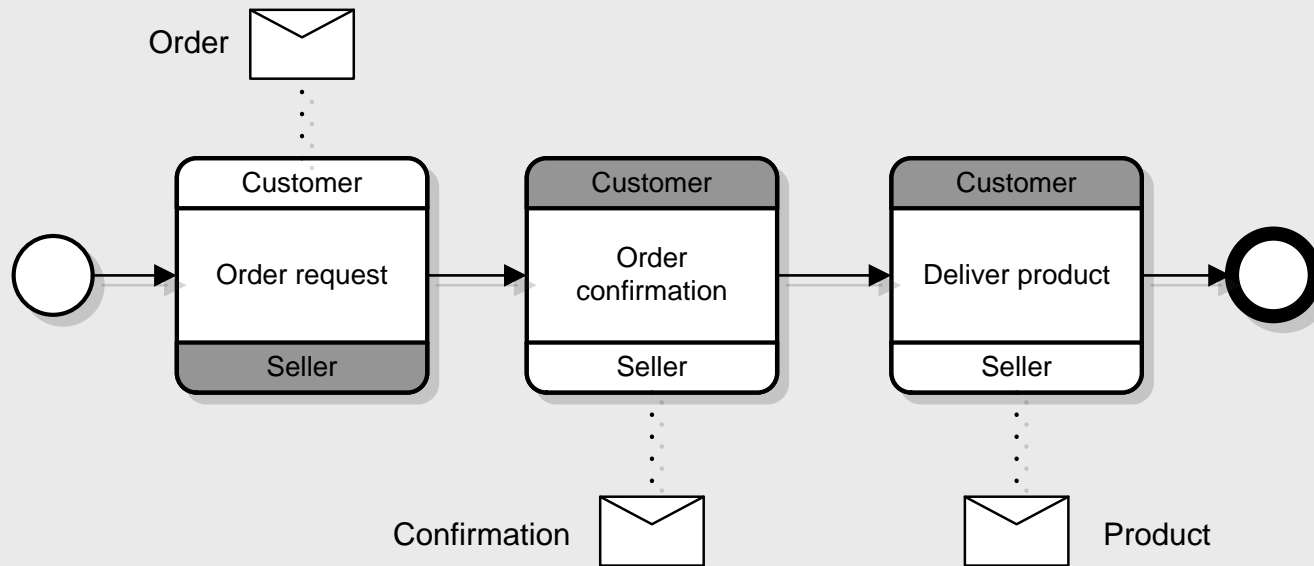


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CHOReOS in the Cloud...

Goal : enable scalable service provisioning based on Cloud computing



- ▶ Well recognized technology for sustaining very large load
 - ▶ ULS → we need to support computationally-intensive processes that serve **millions of users** issuing **thousands of simultaneous service requests** to **thousands of services**
- ▶ General idea: Cloud as “another” deployment target
 - ▶ A Choreography is not directly executable
 - ▶ Translation/compilation process → multiple corresponding orchestrations
 - ▶ Part of these orchestrations deployed on the Cloud
- ▶ Implementation: Apache Hadoop
 - ▶ ... combined with InteGrade Grid Computing technology
 - ▶ To enable scalability in terms of users, requests, services, choreographies, and computing nodes

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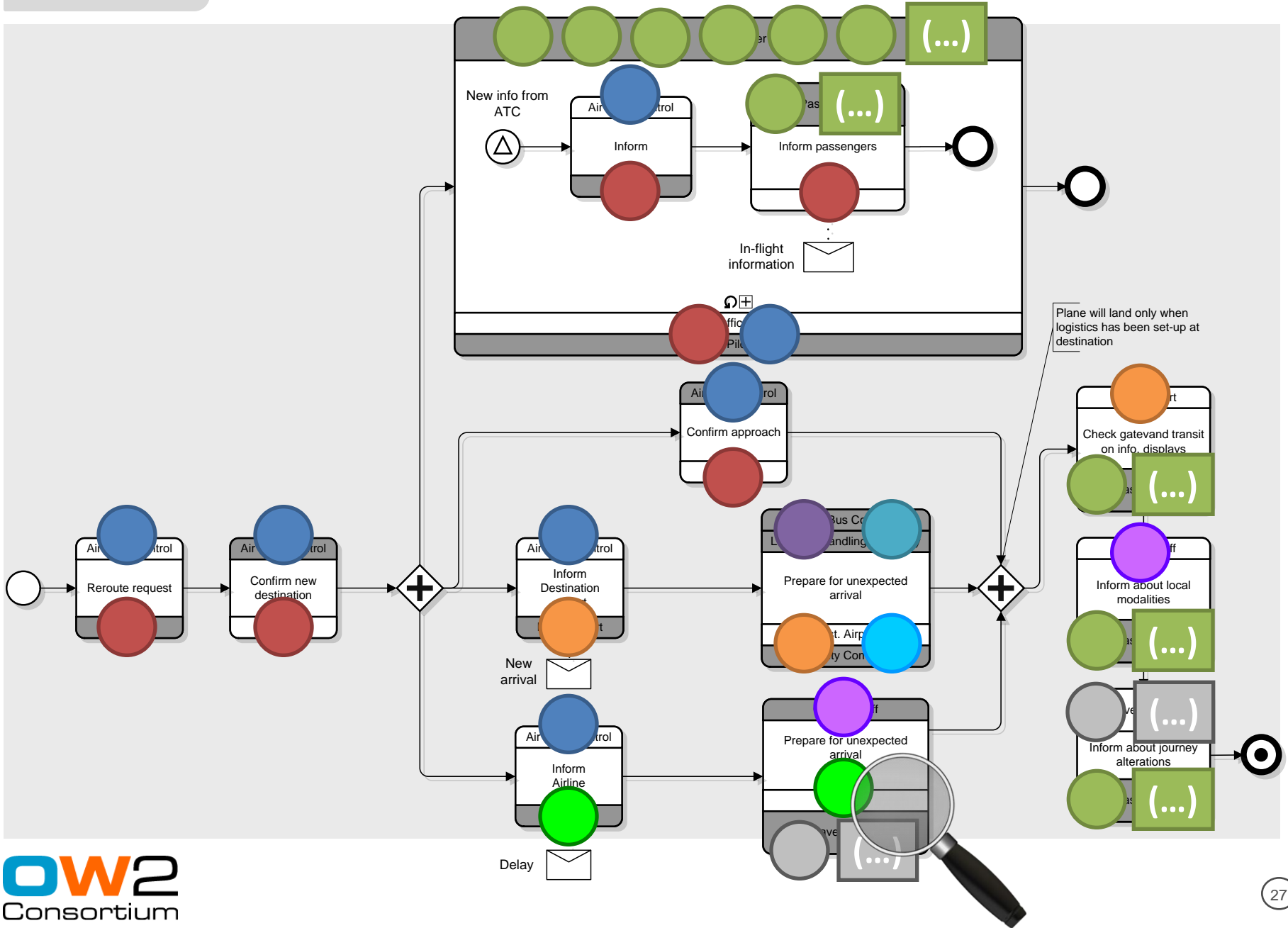
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Description

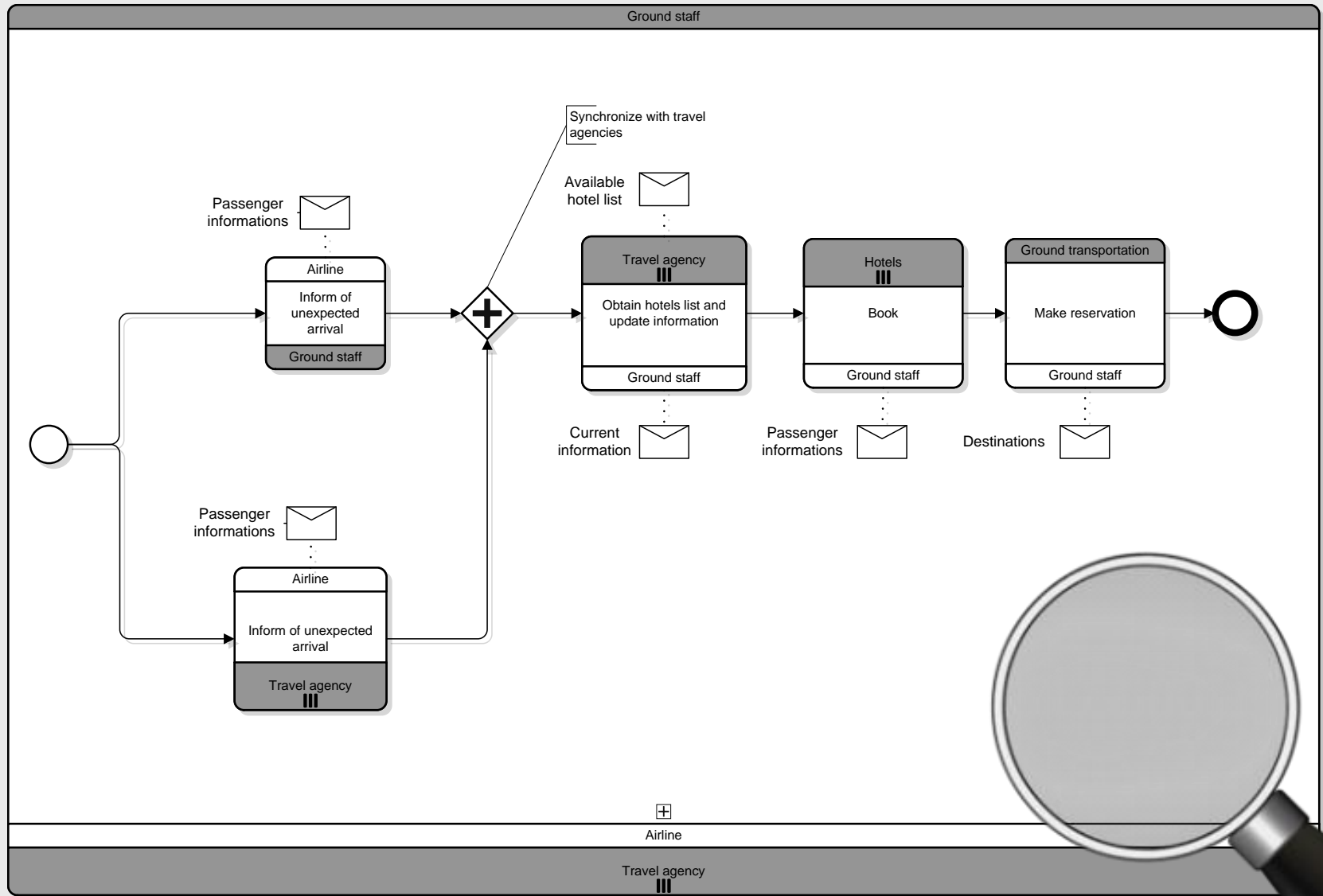


- ▶ **Air transportation / service to passengers**
 - ▶ actual coordination proven inefficient during **unexpected events**
- ▶ **Bad weather at destination → flight rerouted to another airport**
 - ▶ passengers p.o.v.: stress, lack of information, delays everywhere
 - ▶ service providers differ between airports, flights → flexibility need
- ▶ **Choreographies are introduced as part of a global solution**
 - ▶ already existing business processes (orchestrations) for specific/local parts of the scenario, with well-known orchestrators (e.g. air traffic control, airport authorities, airlines)
 - ▶ lack of broad-spectrum/global choreographies...
 - between these areas of responsibility
 - between first and second-level actors (e.g. luggage handling company, airport information desk, hotels, travel agencies, ground transportation, **passengers, ...**)

Global choreography



A sub-choreography



Expected impact

Before CHOReOS

- ▶ At alternate airport
 - ▶ Delays everywhere (plane logistics, handling passengers luggage, ...)
- ▶ At airline level
 - ▶ impervious dedicated logistics for each situation
- ▶ For passengers
 - ▶ Poor indications
 - ▶ Extra costs
 - ▶ Waste of time
 - ▶ ... extra stress !

After CHOReOS

- ▶ At alternate airport
 - ▶ Less delays in rerouting-consequences
- ▶ At airline level
 - ▶ **Efficient coordinated logistics**
 - ▶ **Costs reduction**
 - ▶ Improved flight rescheduling process
- ▶ For passengers
 - ▶ Better information
 - ▶ Less waste of time and money
 - ▶ Improved airline/brand image

Citizen journalism

- ▶ **Collection, report and dissemination of news and information by the public**
 - ▶ interaction among **millions** of (smart-phone) users who share information
 - ▶ lack of coordination and verification of provided contents and contributions
- ▶ **Dynamically composed large-scale choreographies introduced**
 - ▶ for run-time integration of services provided by different users
- ▶ **Mobile-enabled coordination of people requires ULS and QoS-aware systems in terms of concurrent users**

DynaRoute

- ▶ **Mobile-enabled coordination of people**

Conclusion

Future internet is multifaceted, as are the associated issues and challenges

CHOReOS provides solutions at the conceptual and technical level

- ▶ Is focused on certain aspects of the FI !
- ▶ **Highlights a coordination paradigm that is both distributed and of higher granularity than orchestrations → Choreographies**

Choreographies as a core of these solutions, in order to deal with...

- ▶ **Ultra-Large Scale** problems
- ▶ **High distributivity** of systems & architectures based on services
- ▶ **Heterogeneity** of these services

Contact

THALES

▶ **Address :**

Pierre CHATEL
Thales Communications France
DSC/R&T/CEA/SC2

Campus de Polytechnique
1, avenue Augustin Fresnel
91767 Palaiseau Cedex - France

▶ **Mail :**

pierre.chatel@thalesgroup.com

▶ **Phone:**

+33 (0)1 69 41 55 65