CLOUD COMPUTING APPLICATIONS FOR LOGISTICS

Jakob Rehof
Professor, Chair of Software Engineering, Technical University of Dortmund
Director, Fraunhofer-ISST Dortmund and Berlin

First Mysore Park Workshop on Cloud Computing 2010
Infosys Mysore Campus
January 13-16, 2010, Mysore, India
The Fraunhofer-Gesellschaft: Short Profile

- Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e. V. (»Fraunhofer Society for the Promotion of Applied Research«)
- Named after the researcher, inventor and entrepreneur Joseph von Fraunhofer (1787-1826)
- Founded in 1949
- Headquarter in Munich
- 80 research units including 57 Fraunhofer Institutes at over 40 different locations in Germany
- Around 12,700 employees
- Branches in Europe, the USA and Asia
Logistics industry Germany and NRW

- Logistics is one of the largest industries (3rd) in DE:
  2.7 M employed
  (about 7% of total workforce)

- 7% growth in logistics - 17% in intralogistics

- 220 B€ in 2008 in DE, 950 B€ in EU

- NRW – largest logistics Land in DE:
  - 5,700 logistics companies (many sme)
  - 160,000 employed
  - Location of 33 of top 100 logistics companies in DE
  - Central node in global flow of goods
  - Largest inland port in DE
Fraunhofer Innovation Cluster »Cloud Computing for Logistics«

**Budget**
- 3 * 3 Mio. € (Fraunhofer, NRW, Industry)

**Time frame**
- 3 Years (starting Q4 2009)

**Partners (currently on LOI basis)**
- Fraunhofer ISST, Fraunhofer IML, TU Dortmund
- Industry (Providers/SW 2 Mio, User Group 1 Mio)
  - Accenture
  - WM-Group
  - ...

© Fraunhofer ISST
Efficiency Cluster Logistics Ruhr (t.b.d.)

Time frame: 2010-2015
Partners: 124 (19 research)
Volume: > 100 M€
Why use cloud for logistics?

- SME dominated industry
  - Limited or no IT-competence and/or investment
- Specialization (→ 3PL → 4PL)
  - Need to focus on business competence (rather than IT)
- Need for individualized solutions (processes) on-the-fly
  - Time to build (12-18 months) is too long
  - Refresh time (3-5 years) too short for strategic investments
- Serve more customers
  - without the up-front investments in IT
Some characteristics of logistics

- The product is a process (get X from A to B)
- Processes very difficult to standardize
  - Dynamics, nondeterminism
  - High variance across instances (e.g., locality)
- Opportunity for service level standardization
- Internet of things
  - RFID
  - Universal addressability of dumb things
- Processes consist of things, people and programs (services) that need to be networked and orchestrated into solution processes
Logistics: Internet of things, services and people

To understand how the Internet encourages this interweaving of complex systems, you need to appreciate how it has changed the nature of computer programming. Back in the twentieth century, a programmer had the opportunity to exercise absolute control within a bounded world with precisely defined rules. They were able to tell their computers exactly what to do. Today, programming usually involves linking together complex systems developed by others, without understanding exactly how they work. In fact, depending upon the methods of other systems is considered poor programming practice, because it is expected that they will change.

Now consider a program that is directing delivery trucks to restock stores. It needs to know not just the time of day, but also the locations of the trucks in the fleet, the maps of the streets, the coordinates of its warehouses, the current traffic patterns, and the inventories of its stores. Fortunately it can keep track of all of this changing information by connecting to other computers through the Internet. It can also offer services to other systems that need to track the location of packages, pay drivers, and schedule maintenance of the trucks. All of these systems will depend upon one another to provide information, without depending on exactly how the information is computed. All of these communicating systems are being constantly improved and extended, evolving in time.

W. Daniel Hillis, The Dawn of the Entanglement, Edge Question 2010 „How is the Internet changing the way you think?“
Fraunhofer Innovation Cluster
»Cloud Computing for Logistics«

- Logistics by design
  - Semantic models for logistics
- Logistics as a service
  - Service engineering for cloud logistics
- Logistics as a product
  - Cloud market place for logistics services (Logistics Mall)
Vision of the Logistics Mall

Frachtbrief
Transporthandel (Muster)
Transportdienst

IT-Dienste-Entwickler
Werkzeuge
kauft

Logistik-Kunde
startet
informiert

Logistik-Dienstleister

Logistikprozess-Designer

Auftragsverfassung
Fahrauftrag u. Frachtbrief
Transport
Liefer-nachweis

€
Mall marketplace functions (customer view)

- **Login/registration**
  - Management of authenticated users (customers, providers, hosts)

- **Buy**
  - Information on contracting and terms of use of Mall offerings
  - Contracting for use of applications/services/processes from Mall offerings (contracts, terms of use, SLA's, terms of payment)
  - Integration of shops with third party offerings

- **Use**
  - Information on terms of use
  - Configuration of user specific portals (GUI, functionality, etc.)

- **Develop**
  - Information on development environment of Mall and on deployment of offerings into Mall
  - Contracting and terms of use for development tools
Components of Mall Marketplace

Web-Frontend

- User management
- Product management
- MMP Framework Manager
- MMP Administration
- Customers DB
- Service Repository
- Security
- Monitoring MMP
- Providers DB
- Process Repository
- CMS
- Contracting
- Hosts DB
- Business Ontology
- CRM
- Shop-Management
- MMP Config DB

Data Center

MMP-Server

Virtualization layer
Customer portals

- Login/registration
- Applications
  - Individualized user access to applications and services provided in the Mall
- Logistics processes
  - Individualized user access to instances of logistics processes and process orchestration
  - Cockpit with stats on running processes
- User management and access control
- Cost and billing information
- Reporting (usage, resources, cost, SLAs, problems,...)
- Buy and develop
  - Access to other functions of Mall
- Help: Online user manual and trouble ticketing
Components of Customized Access Framework (CAF)
Logistics process designer

- Login/registration
- Process elements
  - BPMN 2.0, SPOT ML elements for modeling logistics processes
- Logistics services
  - Semantic repository of services available for binding into processes
- Business objects
  - Browser for business ontology
- Make new logistics process (from scratch or by pattern)
- Process repository (storage of process models)
- Search: semantic search for logistics services and business objects
- Check: semantic checking of process model
Components of Logistics process designer (LPD)

Web-Frontend

- User management
- Process modeling
- Logistics process management
- LPD Framework Manager
- LPD Administration
- Proc. elements
- Checking
- Security
- LPD Monitor
- Services
- Sem. Search

Virtualization layer

Data Center

User DB
Service Repository
Process Repository
Business Ontology
LPD Config DB

LPD-Server
Frontends of Logistics Mall

Mall Marketplace (MMP)

Customized Access Framework

Service design environment

Mall application dev. environment

Data Center

MMP-Server

CAF-Customer-Server

Process-Engine-Server

Process Design Server

App Dev. Server
Logistics Mall Infrastructure

Browser / Virtual Desktop

Mall Marketplace (MMP)
Customer portals (CAF)
Logistics process designer (LPD)
Service Eng. Framework (SEF)

Logistics Mall Infrastructure (LMI)
- User management
- Product management
- Ontology management
- Document management

- User DB
- Service Repository
- Process Repository
- Business Ontology
- Document Repository

Virtualisierungsschicht

Data Center
Challenges

Security
- Data
- Composition of services from several providers

Application Integration

Standardization, interoperability

Service composition
- Composing services from several providers inside and outside cloud
- Orchestrating services into processes

Which Cloud Computing?
- Many commercial end emergent offerings to choose from
- Lacking standards (interoperability, virtualization,...)

Billing
- Complex individual business models for services in the cloud
- Real-time transparency of cost, compliance etc. for customer