Semantic Web Services

Mobile Services

Outline

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- Motivation
- Technical Solution
  - Preliminaries
  - Design Mobile Applications and Services
  - Mobile Platforms Overview
- Illustration by a larger example
- Extension
- Summary

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Where are we?

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#	Title
1	Introduction
2	Web Science
3	Service Science
4	Web services
5	Web2.0 services
6	Semantic Web
7	Web Service Modeling Ontology (WSMO)
8	Web Service Modeling Language (WSML)
9	Web Service Execution Environment (WSMX)
10	OWL-S and others
11	Light-weight Annotations
12	Applications
13	**Mobile Services**

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What are mobile services and why do we need them?

MOTIVATION

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Motivation: People Buy More Smart Phones Rather than PCs

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Personal Computers, Sold

236M

↓ **31%**
(2009 compared to 2008)

Soon the number of smart phones will take over PC

Smart Phones, Sold

225M

↑**28%** (2009 compared to 2008)

[Ref: Gartner , Competitive Landscape: Mobile Devices, Worldwide, 2Q09]

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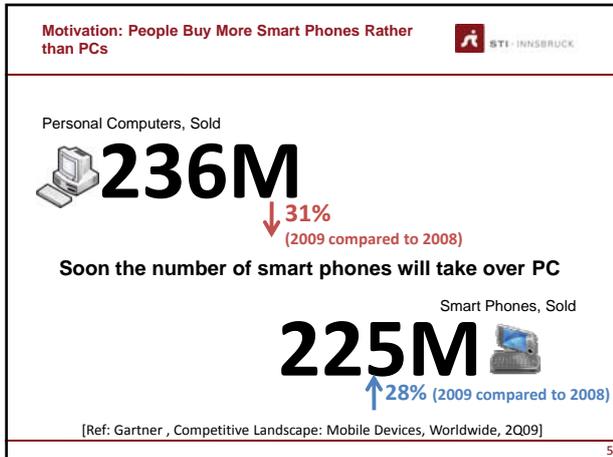
What Made the Mobile Web to Take Off?

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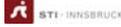
- Devices become very well designed and offering new touch screen based ways to navigate the Internet, e.g. iPhone
  - But still this is not really the motivation why Mobile Web become real, the real reason is mostly the new marketing strategy adopted

- Created a Web2.0 market place for applications
  - User can easily search for applications matching their needs, install them and updated them

- Mobile operators lowering prices for the Internet data connection with device for the end-user, for regulatory as well as reasons connected with the sales of the smartphones
  - Flat rate, 3GB cost around 15 euro per month. Before you could pay more than 100 euro for the same amount of data

- There are many products similar to iPhone, not only in term of device capability, but also in term of marketing strategy

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Motivation

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- The Mobile Web refers to using a mobile phone handset device incorporating a web browser to access the World Wide Web.
  - http://en.wikipedia.org/wiki/Mobile_Web

- Research and discussion on Mobile Web started in early 2000
  - Initially too expensive due to connection costs, few users, mostly top management in enterprises accessing emails with BlackBerry

- We can really speak of Mobile Web for everyone only since 2008 thanks to market revolution introduced by Apple's iPhone

- As by today the total number of mobile web users grew past the total number of desktop computer-based web users

- Number of services and applications accessible over mobile phones are constantly growing (in January 2010 more than 150,000 on Apps Store with more than 3,000,000,000 downloads)
  - Ref: http://www.apple.com/pr/library/2010/01/05appstore.html

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Why Mobile Web is so popular?

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Internet access "on the go" provides advantages to many, such as the ability to communicate by email with others and obtain information anywhere, the web, accessed from mobile devices

- Anytime and anywhere access

- Enables people to take advantage of Internet services even though usually they do not access Internet through a PC

- Make Internet access easy and cheap

- Brought new services on mobile phones

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Example: Google's Mobile Services STI · INNSBRUCK

[http://www.google.com/mobile/]

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Example Scenario II STI · INNSBRUCK

[http://www.youtube.com/watch?v=Q-Oq-9enE-k]

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Example Scenario I STI · INNSBRUCK

- SmartPhones are getting more and more powerful and offers wide functionalities

We have a meeting in 5 minutes! Where is Alex?

Marko

Michael

You can access the localization service on my gPhone!

- Years ago this sounds like a futuristic scenario, now it's reality

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Mobile Service for Mobile Platforms

TECHNICAL SOLUTION

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Overview of basic concepts

TECHNICAL SOLUTION: PRELIMINARIES

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Mobile Services vs. Web Services I   **STI · INNSBRUCK**

- Many Web Services and APIs were originally developed with server to server or server to browser in mind, not mobile applications

Protocol Usage by APIs

- REST (65%)
- SOAP (22%)
- JavaScript (6%)
- XML-RPC (3%)
- Atom (2%)

ProgrammableWeb.com 03/30/09

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Mobile Service - Definition   **STI · INNSBRUCK**

- "A radiocommunication service between mobile and land stations, or between mobile stations." – traditional, short
  [International Telecommunication Convention, Malaga-Torremolinos, 1973]

- "Radiocommunications services between ships, aircraft, road vehicles, or hand-held terminal stations for use while in motion or between such stations and fixed points on land." – official, by WTO
  [http://www.wto.org/english/tratop_e/serv_e/telecom_e/tel12_e.htm]

- "Any service that can be operated on a mobile device, such as both voice and data services, for example, roaming, SMS and MMS, video streaming, location-based services, etc." – technically oriented
 - We consider this one in the context of this lecture

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Mobile Services vs. Web Services II   **STI · INNSBRUCK**

- Mobile platforms have their own set of challenges given:
  - Bandwidth
  - Memory and CPU Availability
  - Storage Capacity
  - Connectivity Options and Issues
  - Security
  - User Interaction and Display

Web Service

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Mobile Applications vs Desktop Applications STI · INNSBRUCK
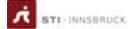
- Less Computing Power
- Need to keep down power consumption
- Connection not 100% available
- Smaller display
- Different means of interactions
- Mobile services (GPS, SMS, …)
- A multitude of Operating Systems
- Event driven paradigm

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Mobile Devices Constraints II STI · INNSBRUCK

- **Types of pages accessible**
  - Many sites that can be accessed on a desktop cannot on a mobile device. Many devices cannot access pages with a secured connection, Flash or other similar software, PDFs, or video sites, although recently this has been changing.

- **Broken pages**
  - On many devices, a single page as viewed on a desktop is broken into segments, which are each treated as a separate page. Paired with the slow speed, navigation between these pages is slow.

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Mobile Devices Constraints I STI · INNSBRUCK

- **Small screen size**
  - This makes it difficult or impossible to see text and graphics dependent on the standard size of a desktop computer screen.

- **Lack of windows**
  - On a desktop computer, the ability to open more than one window at a time allows for multi-tasking and for easy revert to a previous page. There are apps for the iPhone (e.g. Oceanus), as well as browsers such as Opera Minibut, allowing multiple windows, but sometimes a limited number, and not multiple windows in the same screen.

- **Navigation**
  - Most mobile devices do not use a mouselike pointer, but rather simply an up and down function for scrolling, thereby limiting the flexibility in navigation.

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Creating applications dealing with mobile devices constraints

TECHNICAL SOLUTION: DESIGN MOBILE APPLICATIONS AND SERVICES

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Reference Architecture for Mobile Applications

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- Specialization of a three tier architecture

- Some parts of data (data sources) and some parts of logic (services) are accessed via remote connection

http://apparchguide.codeplex.com/
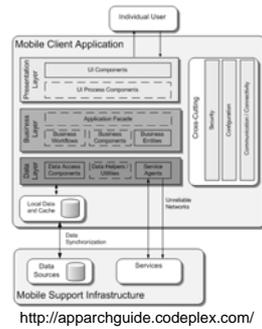
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Business-Logic Layer

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- The business-logic layer is responsible for implementing the basic rules of the system according to the operating rules of the business

- This layer is in charge of accessing the data tier and for processing the data retrieved and sent to the presentation layer

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Presentation Layer

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- The presentation layer is responsible for all interactions with the user

- The most common ways to present data to mobile users:
  - HTML
  - Native UI

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Data Layer

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- The main function of the data layer is to provide fast, reliable access to data needed to run a system

- Additionally, the data layer is responsible for maintaining information about the relationships between data

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Design Challenges STI · INNSBRUCK

- Authentication vs. Authorization
  - How to simplify Mobile User access to Web APIs and Services

- Speed Traps
  - How to avoid excessive number of requests that may saturate the available bandwidth to the device (and cause higher connection prices)

- Large Data Set Handling
  - How to handle large data set so as to reduce response time and bandwidth consumption

- User Interaction
  - How to deal with constraints posed by mobile devices displays, connections to provide and effective interaction to users

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Speed Traps STI · INNSBRUCK

- Connection in mobile environments is subject to different quality in different contexts
  - Connection could be on wifi, 3G or 1G based signal and bandwidth

- Connection is a scarce resource
  - Connection may not be always available

- Thus we need to adapt to connection quality and availability by
  - Segmenting functionality and/or calls to prevent bandwidth issues
  - Adopting polling techniques that adapts to the available bandwidth and connection
    - Create subset of calls and functionality when on slower bandwidth
    - Use notifications if possible
    - Modify polling interval based on need
  - Recovering from intermittent or lost connections

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Authentication vs. Authorization STI · INNSBRUCK

- Definitions
  - Authentication is any process by which a system verifies the identity of a user who wishes to access it [http://mtechit.com/concepts/authentication.html]
  - Authorization is the process of giving someone permission to do or have something [http://hitachi-id.com/concepts/authorization.html]

- Security is an important concern over mobile connections where devices are used in more open environments

- Usual desktop solutions for authentication and authorization that requires complex interaction with remote services may constitute a complex overhead to mobile users

- Thus we need to adopt principles to simply, but still retain security of access to remote services through mobile devices
  - Authentication from the API provider based on API Key stored on the devices can avoid user to provide their authorization details.

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Large Data Set Handling – Overview STI · INNSBRUCK

- Data transmission is a costly resource
  - In term of performances, bandwidth and a service cost

- Transmission of large chunk of data is more error prone than small chunk of data
  - Quality of connection is not constant in a mobile environment

- Thus we need to minimize large data sets, by employing techniques such as:
  - Ask for only those elements that you require (Filtering)
  - Ask for only those items that you require (Paging)
  - Cache what you can locally instead of requesting the same data (Caching)

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Large Data Set Handling – Filtering
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- Types of Request Filtering
  - Selection criteria for narrowing data set returned

- In general determine how efficient are the calls – reduce data waste
  - How much extra data, streaming, parsing is happening to access the data you use? How much data is being dropped on the floor?

```
<?xml version="1.0" encoding="utf-8"?>
<FindItemsAdvancedRequest xmlns="urn:ebay:apis:eBLBaseComponents">
<!-- Standard Input Fields -->
<MessageID> string </MessageID>
<!-- Call-specific Input Fields -->
<BidCountMax> int </BidCountMax>
<BidCountMin> int </BidCountMin>
<CategoryHistogramMaxChildren> int </CategoryHistogramMaxChildren>
<CategoryHistogramMaxParents> int </CategoryHistogramMaxParents>
<CategoryID> string </CategoryID>
<CharityID> int </CharityID>
<Condition> ItemConditionCodeType </Condition>
<Currency> CurrencyCodeType </Currency>
...
<ShippingLocation> CountryCodeType </ShippingLocation>
<ShippingPostalCode> string </ShippingPostalCode>
<SortOrder> SortOrderCodeType </SortOrder>
<StoreName> string </StoreName>
<StoreSearch> StoreSearchCodeType </StoreSearch>
</FindItemsAdvancedRequest>
```

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Large Data Set Handling – Caching Strategies
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- To minimize API round trips leverage caching and storage
  - Cache in memory (volatile memory of the mobile device)
  - Cache in onboard light weight database or file (persistent memory of the mobile device)
  - Off device persistence (persistent storage service over the Web)

Memory Cache	Onboard	Off Device
• Memory Intensive • Non-persistent • E.g. data key for last viewed item	• Space Limitations • Persistence across sessions • E.g. user Information	• Requires Connection • Reuse across users • E.g. statistics, look up tables

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Large Data Set Handling – Paging
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- Provide paging functionality to users
  - Cluster set of contents into pages (improves also UI usability)

- Not all calls have paging available
  - If the service you are calling does not allow to retrieve "pages" of data, using them on the device, will not anyway prevent transfer of large chunk of XML data (unless device support live XML stream parsing).

- Inform user of current location in set, easy access to next and previous sets (page)
  - Enable users to navigate through pages
  - Enable users to understand where they are in the collection of data

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User Interaction
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- Besides issues related to connection aspects, adoption of mobile devices poses challenges for the User Interaction
  - Asking for new information using synchronous call, due to bandwidth limitations may totally block user interactions with the application
  - Re-requesting already accessed information may end up in making slower the interaction

- Thus we need to employ techniques that hide the limitations of mobile devices and mobile connections by
  - Caching of information for future retrieval and navigation
  - Executing web service parsing and display in background when possible to prevent UI blocking
  - Using JIT and Information on Demand to maximize small layouts and minimize web service calls

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MOBILE PLATFORMS OVERVIEW

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**Worldwide Smartphone Landscape
Source: AdMob traffic**

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[http://metrics.admob.com/]

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Smartphone OS Competitive Landscape

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	iPhone OS (Apple)	BlackBerry OS (RIM)	Window Mobile (Microsoft)	Android (Google)	Symbian (Nokia)
Platform	• Closed	• Closed	• Open	• Open	• Open
Source Code	• Closed	• Closed	• Closed	• Open	• Open (in future)
2009 WW Market Share [Gartner]	• 14.4%	• 19.9%	• 8.7%	• 3.9	• 46.9%
Smartphone traffic share [AdMob]	• WW: 46% • US: 39%	• WW: 5% • US: 7%	• WW: 1% • US: 1%	• WW: 25% • US: 46%	• WW: 21% • US: 1%
Pros	• Early momentum • Data hungry early adopters • Powerful distribution channel	• Strong reach (particularly in US)	• Manufacturer / carrier agnostic	• Manufacturer / carrier agnostic • Open source innovation	• Massive global reach • Open source innovation
Issues	• Apple dependant	• BlackBerry dependent • Distribution	• Distribution	• Late to market • Uncertain consumer demand	• Limited reach in US • Distribution
Application ecosystem [Distimo]	• iTunes Apps Store • >185K apps • More than 3B downloads	• BlackBerry App World • 5,5k apps	• Windows Marketplace • 1k apps	• Android Market • 50k apps	• OVI Market • 7k apps

[Gartner, http://www.gartner.com/it/page.jsp?id=1306513, 02/2010]
[AdMob, http://metrics.admob.com/2010/04/march-2010-mobile-metrics-report/]
[Distimo, http://www.distimo.com/uploads/reports/Distimo%20Report%20-%20January%202010.pdf]
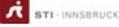
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iPhone OS (Apple)

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- Pros
  - Strong user growth and data-hungry user base
  - Application store creating a vibrant app ecosystem with great momentum
    - More than 85K applications (~20% free)
    - More than 1 million downloads
  - Powerful technology enablers (e.g., multi-touch, GPS, accelerometer)
- Issues
  - App approval process is largely a black-box to developers
  - Apps viewed as competitive to Apple are often shut down
  - Downloads highly dependent on "featured" or "top download" promotion in store
  - App store is the only authorized distribution channel
  - Apple / hardware dependent
- Recent news / developments
  - NDA requirement: Apple finally removed the onerous NDA requirement
  - Flash: signs pointing towards development of iPhone flash player
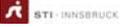- Development resources
  - http://developer.apple.com/iphone/index.action
  - http://iphoneincubator.com/blog/

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BlackBerry OS (RIM)

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- Pros
  - Large reach and data-hungry user base
  - Developers not limited to single distribution channel
- Issues
  - Developer momentum appears to be shifting to iPhone
  - Less reach outside of North America
  - Application distribution more difficult today vs. iPhone's app store
  - Users more email focused vs. web consuming iPhone users
  - RIM / hardware dependent
- Recent news / developments
  - BlackBerry Application Center scheduled to debut w/ BlackBerry Storm OS v4.7
  - Speculation that Storm (i.e., touchscreen iPhone competitor) will be available in November
- Developer resources
  - http://na.blackberry.com/eng/developers/
  - http://www.blackberrydeveloperconference.com/
  - http://crackberry.com/

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Android (Google)

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- Pros
  - Open source => could help accelerate pace of innovation
  - Manufacturer-independent => could help accelerate consumer adoption
  - Technology support (e.g., touchscreen, GPS, accelerometer, video and still cameras)
- Issues
  - Late to market relative to iPhone
  - At least initially, demand is expected to trail iPhone demand
- Recent news / developments
  - 1st Android phone (T-Mobile G1) went on sale on Oct. 22 2008
  - Sept. '08: Officially released v1.0 of SDK in Sept
  - Aug '08: Awarded $3.75MM to 20 developers in the Android Developer Challenge
- Developer resources
  - http://android-developers.blogspot.com/
  - http://code.google.com/android/documentation.html

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Windows Mobile

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- Pros
  - Strong user reach
  - Manufacturer agnostic
  - >18K apps
- Issues
  - Current version in market (Windows Mobile 6) lacks support for some popular technology enablers (e.g., multi-touch, GPS, accelerometer)
  - Next-gen version will be late to market
  - Less developer enthusiasm vs. that for iPhone and Android
  - Application distribution more difficult today vs. iPhone's app store
- Recent news / developments
  - Microsoft to launch "Skymarket" applications marketplace for Windows Mobile 7 (planned for launch in 2H '09)
  - Speculation that Windows Mobile 7 will support revamped UI and multi-touch
- Developer resources
  - http://www.microsoft.com/windowsmobile/en-us/business/developers.mspx

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Symbian (Nokia)

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symbian OS

- Pros
  - Massive global reach
  - Like Android, being open source could help accelerate pace of innovation
- Issues
  - Limited reach in the US
  - Application distribution more difficult today vs. iPhone's app store
- Recent news / developments:
  - June '08: Nokia announced plans to acquire full ownership of Symbian and start the Symbian Foundation, which will be an independent force for the future development of Symbian OS. They stated that Symbian OS (including the platforms S60, UIQ and MOAP(S)) will become open source in the first half of 2009
- Developer resources
  - http://www.forum.nokia.com/main/resources/technologies/symbian/

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ConfTool by Christoph Blank

ILLUSTRATION BY A LARGER EXAMPLE

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Scenario

- An administrator sets up the Web Application for a particular event
  - By adding simple templates, he adds custom data types to be exchanged
  - The administrator also extends the mobile application with custom handlers for the specified data types.

- A user now registers himself through the Web Application
  - In the next step he can download the client application to his mobile device by following a link
  - After entering the details he wants to share, he is ready to participate
  - If he encounters a person he wants to share his details with, they simply synchronize their profiles by exchanging their ID through RF-ID or QR-Code
  - In the next step the accounts of both users have been populated with the additional information
  - The new information can now be used on the mobile phone or be displayed within the Web Application through the custom extensions.
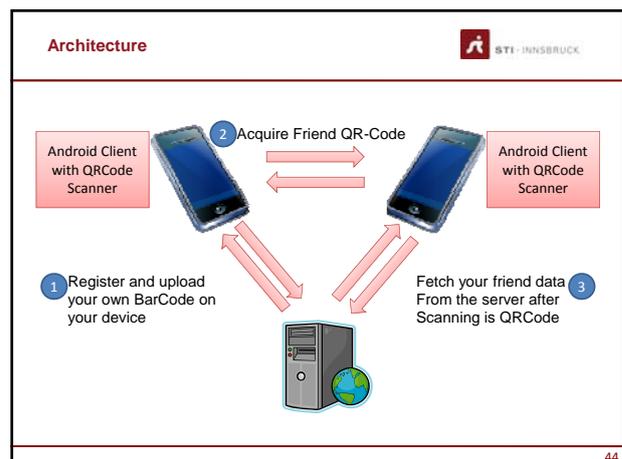
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Motivation

- At certain events, for example conferences, exhibitions, etc … participants often want to exchange information of interest with each other, such as: phone number, address or similar

- More and more social platforms like Skype, XING, Youtube, Facebook start to attract a variety of users

- The result is that people want to exchange additional information, besides the basic contact data

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Architecture

Android Client with QRCode Scanner

2 Acquire Friend QR-Code

Android Client with QRCode Scanner

1 Register and upload your own BarCode on your device

Fetch your friend data From the server after Scanning is QRCode 3

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Screenshots STI · INNSBRUCK

More details on:
http://iot.sti2.at/wordpress/?page_id=108

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Why Semantics can play an important role? STI · INNSBRUCK

- To solve interoperability issues among different platforms

- To support more accurate and Web-scale service/application discovery

- To support transparent integration of different services

- To provide dynamic binding to services according to user profiling (e.g. Location)

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EXTENSIONS

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m:Ciudad – Vision
An example of an approach for user-generated mobile services STI · INNSBRUCK

m:Ciudad, a step forward in Mobile User-generated Content and Services. A service infrastructure for the mobile platform for:

- Instantaneous, on-the-go service creation and provision. The mobile user as a prosumer: producer, provider and consumer of services and their associated contents.

- Fixed versus mobile service convergence in a wide sense: one worldwide user-powered content network.

- Efficient context utilization. Automatic/manual context-aware content generation and publication.

- Discovery, access and mobile-to-mobile communication in a very distributed, volatile platform (such as the mobile one, with the service "not-always-on" paradigm).

m:Ciudad micro-services
http://www.mciudad-fp7.org/

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m:Ciudad – Research Challenges

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Service Description Language
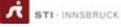
Ontology template-based service creation; (inter-user service composition from worldwide available services).

Service deployment; viral service advertising; service sharing; service taxonomy, service usage policies.

Event-based content capturing (context-aware); Local and remote content & context tools; automatic tagging; content taxonomies.

Semantic / fuzzy search; distributed recommendation; user-term driven service/content search. Translation from folksonomy to service ontology.

IMS role; SIM/USIM role; seamless roaming treatment; QoS; Security.

Service execution environments; service business models; service business protection, rich user interfacing.

Business models, privacy, identification, dynamic billing.

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Summary

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- Mobile Web is now a reality

- The are a pletora of different platforms but they all share common challanges imposed by the mobile environment
  - Less Computing Power
  - Need to keep down power consumption
  - Connection not 100% available
  - Smaller display
  - Different means of interactions
  - Mobile services (GPS, SMS, …)
  - …

- Such challenges can be overcame with proper design

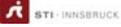- There is lot of space for innovative applications and for beneficial adoption of Semantics

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SUMMARY

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REFERENCES

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  - J.D. Meier, A. Homer, D. Hill, J. Taylor, P. Bansode, L. Wall, R. Boucher Jr, and A. Bogawat: Design Mobile Applications. In "Microsoft Application Architecture Guide (Patterns & Practices)", Microsoft Press, 2009, http://apparchguide.codeplex.com/wikipage?title=Chapter%2019%20-%20Mobile%20Applications

- Further reading and references:
  - Y. Natchetoi, V. Kaufman, and A. Shapiro: Service-oriented architecture for mobile applications. In "Proceedings of the 1st international Workshop on Software Architectures and Mobility" (Leipzig, Germany, May 10 - 10, 2008). SAM '08. ACM, New York, NY, 27-32. http://doi.acm.org/10.1145/1370888.1370896.
  - http://www.w3.org/2005/Talks/200509Berlin/all.htm

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Questions?

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Wikipedia

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- http://en.wikipedia.org/wiki/Mobile_Web
- http://en.wikipedia.org/wiki/App_Store
- http://en.wikipedia.org/wiki/Near_Field_Communication
- http://en.wikipedia.org/wiki/Mobile_operating_system
- http://en.wikipedia.org/wiki/IPhone_OS
- http://en.wikipedia.org/wiki/Symbian_OS
- http://en.wikipedia.org/wiki/IPhone_OS
- http://en.wikipedia.org/wiki/Windows_Mobile
- http://en.wikipedia.org/wiki/Google_Android
- http://en.wikipedia.org/wiki/BlackBerry_OS
- http://en.wikipedia.org/wiki/OMTP

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