Future Services/Applications

Deokjai Choi

2010. Oct

What is Service?

- Provider vs Consumer
- IT Service: executing software component (a piece of application logic) which can be accessed, interactive, discriptive, …
- Telecom service: what the user pay for
- Future Internet Service: a service will be provided through Future Internet
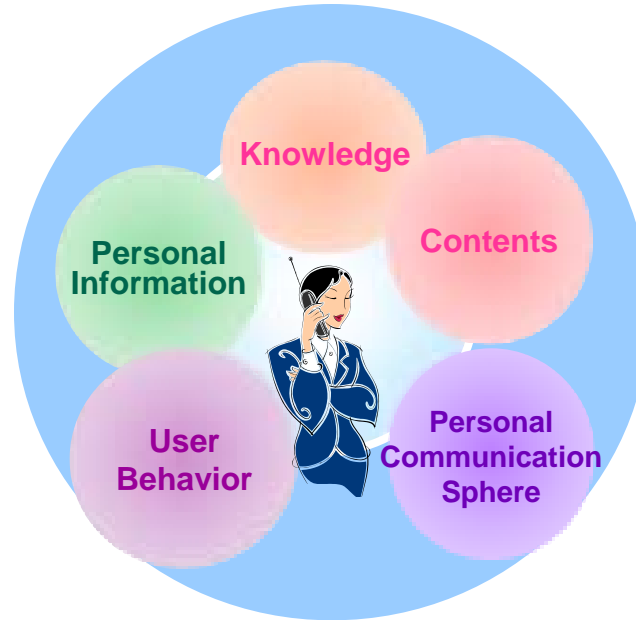
Look Back for IT Service

- Mainframe period: computing service
  - For military purpose (bomb path calculation)
- PCs: word processing, spread sheet
  - For business improvement
- Networking period: information search and transfer
- How can we name the coming future computing world?
  - Ubiquitous Computing Period?
  - SNS

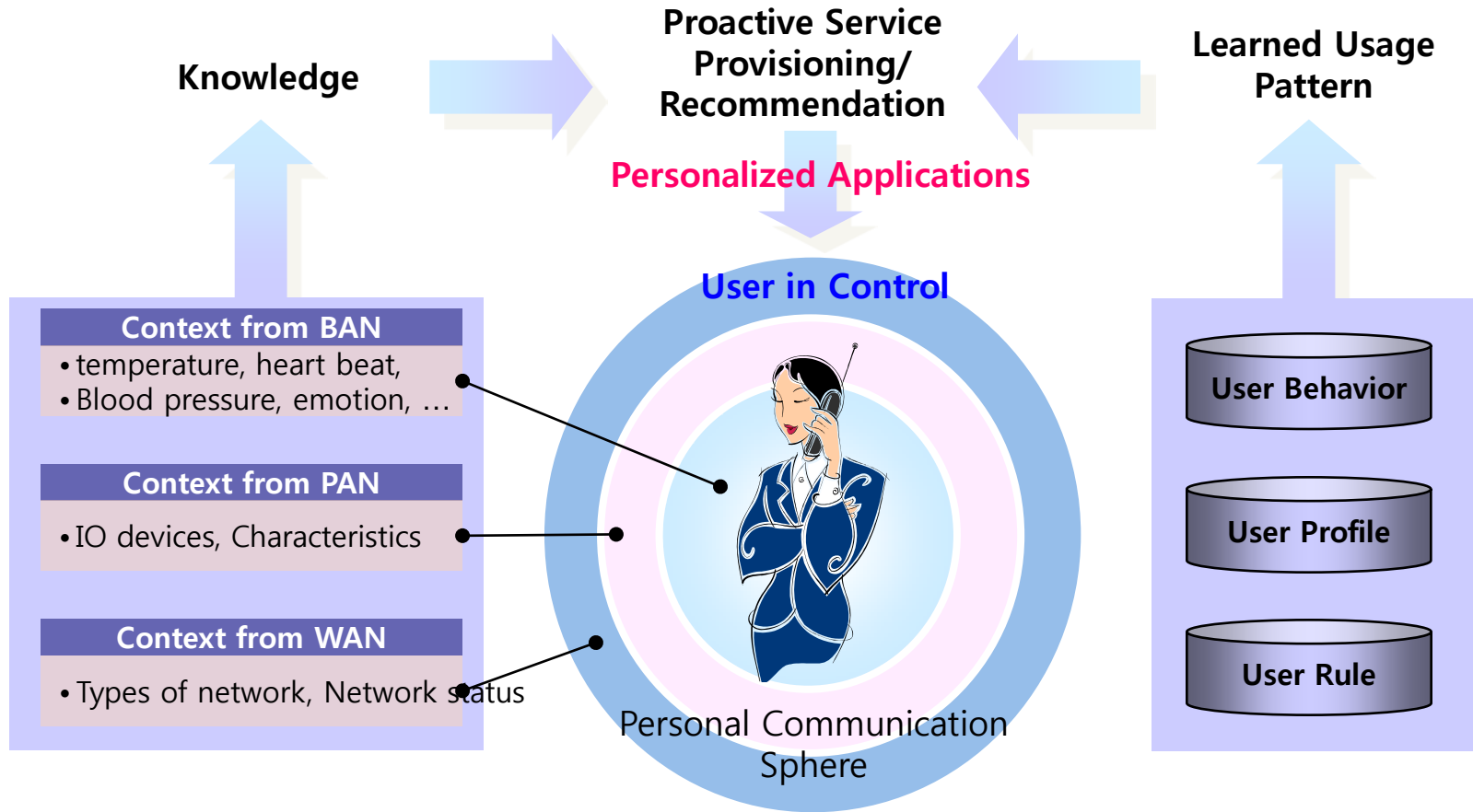# What are the characteristics for ubiquitous computing?

- Anytime, anywhere,...based on ubiquitous neworking (one of the characteristics of future Internet)
- Trends
  - Embedded processors
  - Various emerging networking technologies
    - BAN, PAN, VANet, AdHoc, P2P, Sensor Network, WiFi, Wibro, Fixed wireless, ...
  - Powerful user devices
  - Software Tech: components, compositions, discovery, agent, reasoning, recognition, knowledge processing,..

Requirements for Future User

- I-Centric
- Context Aware
- user preference
- Proactive
- Seamless Service

I-Centric

Knowledge

Proactive Service Provisioning/ Recommendation

Learned Usage Pattern

Personalized Applications

User in Control

Context from BAN
- temperature, heart beat,
- Blood pressure, emotion, …

Context from PAN
- IO devices, Characteristics

Context from WAN
- Types of network, Network status

Personal Communication Sphere
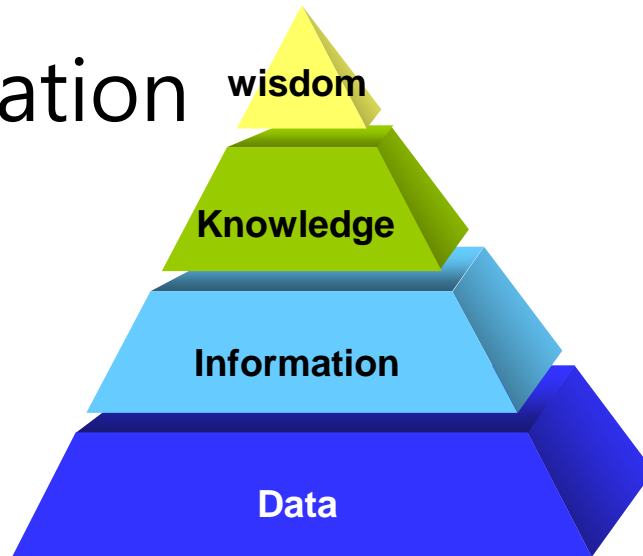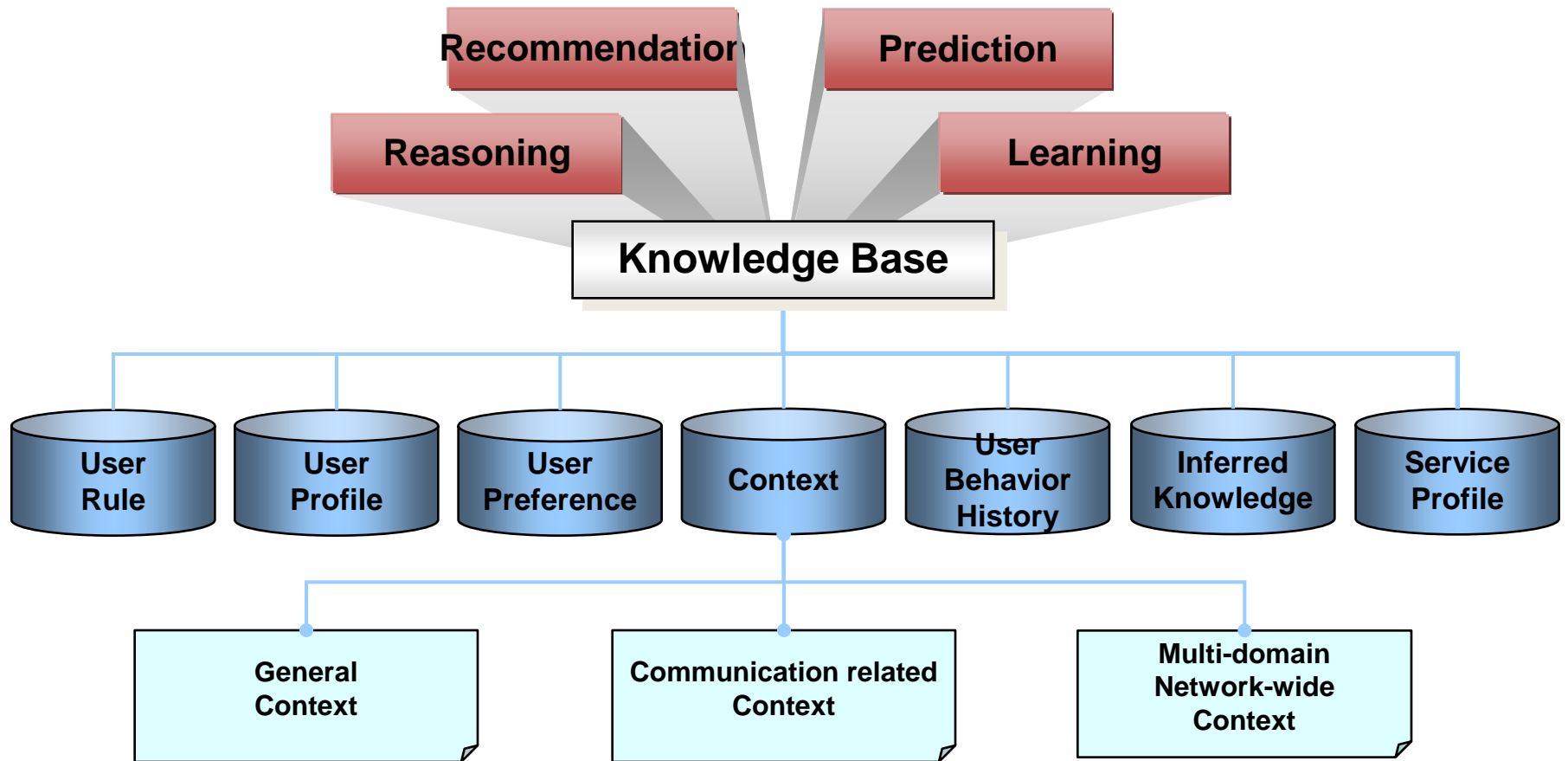
User Behavior

User Profile

User Rule

Context

- Human user
  - location, identity,…
- Device
  - IP address, location,…
- Network
  - identity, resources (bandwidth), QoS, security level, access type, coverage,…
- Flow
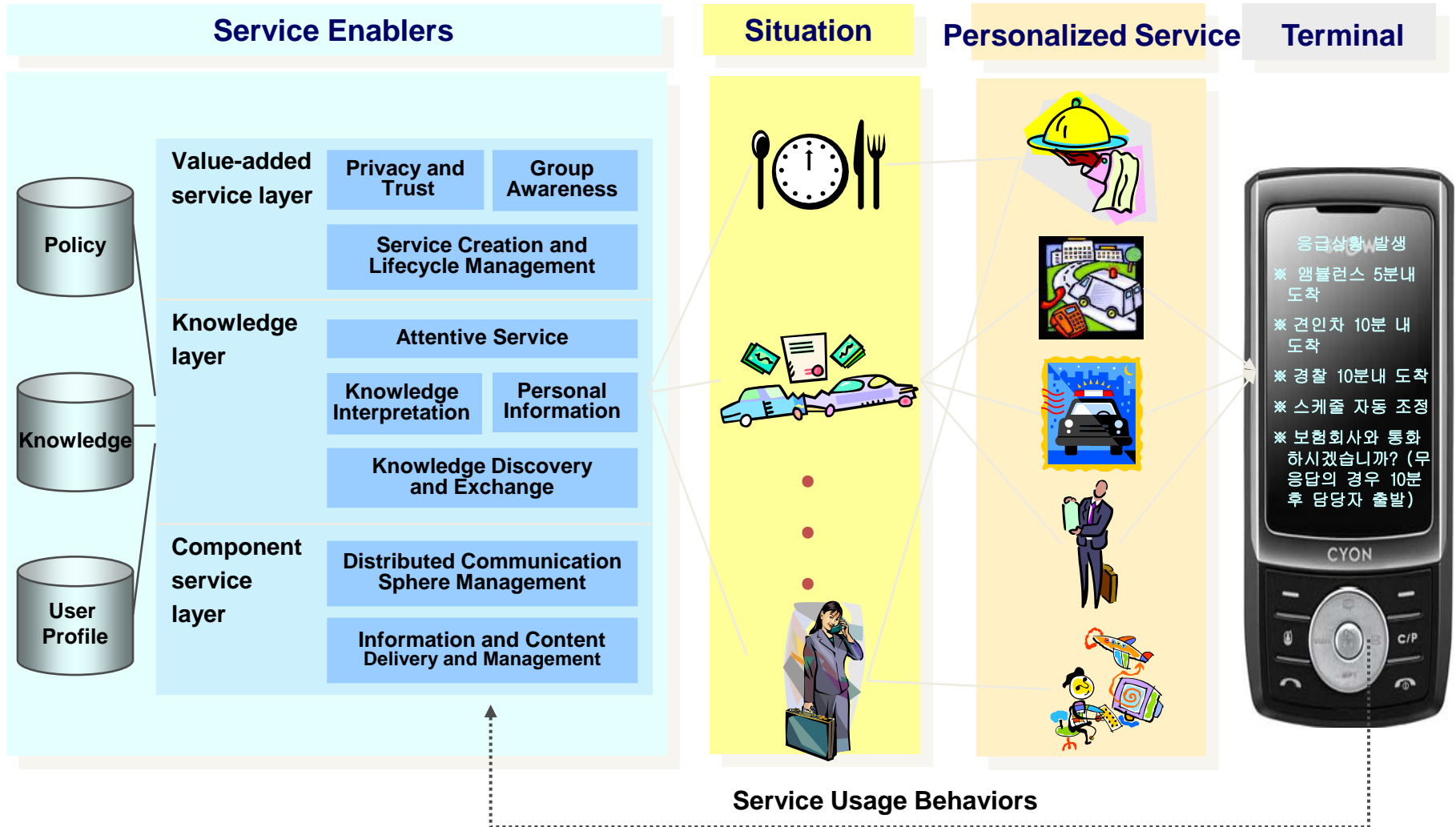 - congestion level, latency, jitter, loss, error rate, …

Knowledge

- Reasoning
- Learning
- Prediction
- Recommendation

wisdom

Knowledge

Information

Data

Network Intelligence

Service Scenario

Service Enablers

Policy	
Knowledge	
User Profile	

Value-added service layer

Privacy and Trust	Group Awareness

Service Creation and Lifecycle Management

Knowledge layer

Attentive Service

Knowledge Interpretation	Personal Information

Knowledge Discovery and Exchange

Component service layer

Distributed Communication Sphere Management

Information and Content Delivery and Management

Situation

Personalized Service

Terminal

응급상황 발생

※ 앰블런스 5분내 도착

※ 견인차 10분 내 도착

※ 경찰 10분내 도착

※ 스케줄 자동 조정

※ 보험회사와 통화 하시겠습니까? (무 응답의 경우 10분 후 담당자 출발)

CYON

Service Usage Behaviors

Major Components

- Service Interaction
- Service Discovery
- Service Composition

A service interaction protocol for context-aware applications
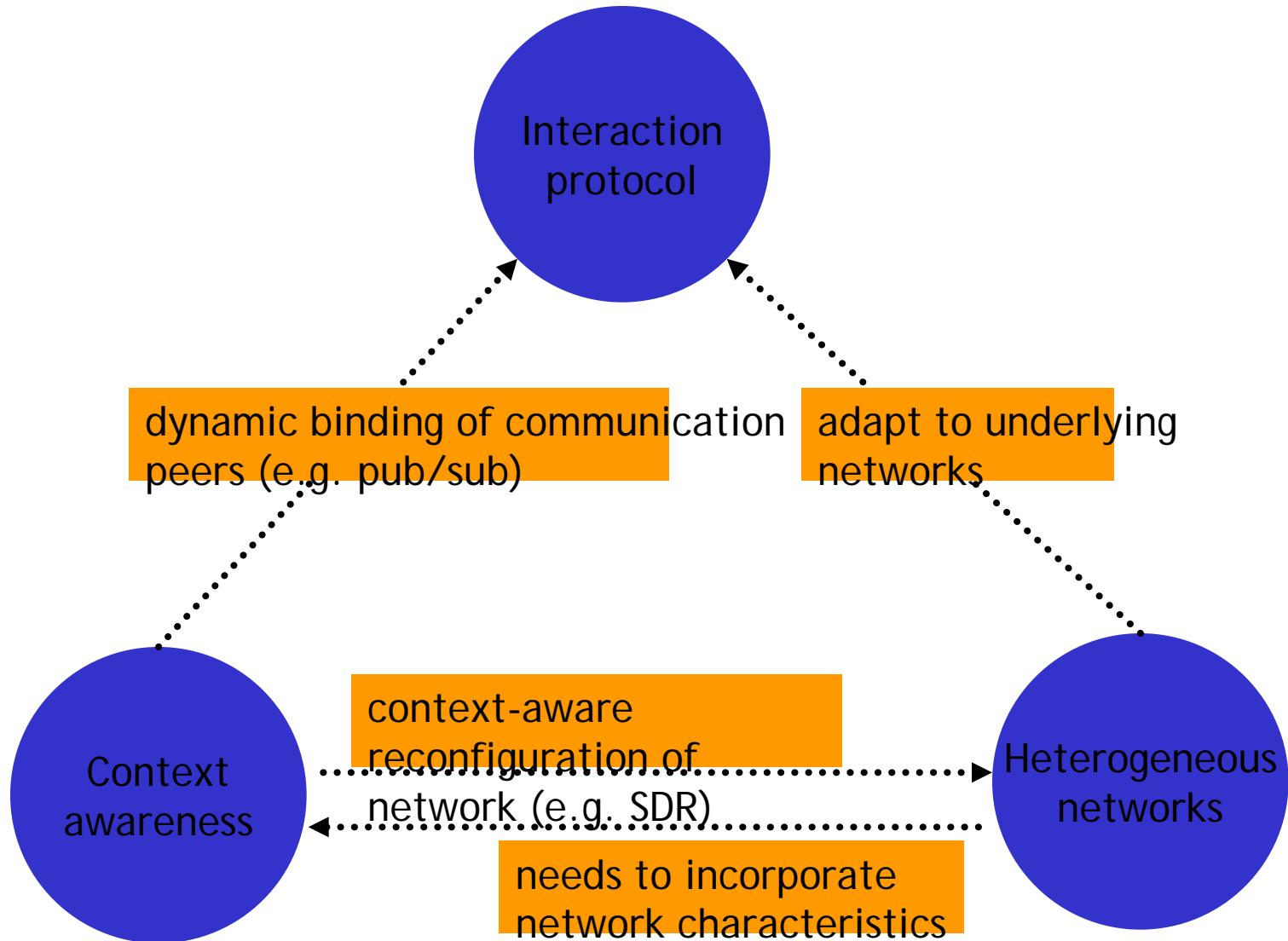
Dongman Lee

ICU

Introduction

- Interaction protocols
  - Request/Reply vs. Publish/Subscribe
- Why Publish/Subscribe in Context-aware computing?
  - Event producers and consumers should be decoupled to adapt to contextual changes.
- Issues of publish/subscribe
  - Subscription schemes
    - Topic-based, content-based, and type-based
  - Architecture
    - Centralized server, distributed servers, and no server
  - Event dissemination
    - Communication mechanism: Unicast or multicast
    - Event filtering

Standards & Specifications

- OMG Data Distribution Service (DDS)
- Java Message Service (J2EE JMS)
- OASIS WS Notification
- XMPP Publish-Subscribe (XEP-0060)
- CORBA Event/Notification Service
- OGSI (Open Grid Services Infrastructure) Notification
- OGC SWE SAS
  - Open Geospatial Consortium Sensor Web Enablement Sensor Alert Service

Issues

Interaction protocol

Context awareness

Heterogeneous networks

dynamic binding of communication peers (e.g. pub/sub)

adapt to underlying networks

context-aware reconfiguration of network (e.g. SDR)

needs to incorporate network characteristics

Challenges

- Context awareness vs. Heterogeneous networks
  - Aspects of currently associated network constitute current context. (e.g. attached location, network performance metrics, PAN-id)
  - Requires network characteristics to be exposed to context management
  - Or, requires network to be context-aware
- Heterogeneous networks vs. Interaction protocol
  - Communication performance is often a limiting characteristic of interaction model.
  - Requires an interaction protocol to adapt to underlying networks

Large Scale Semantic Service Discovery in the Future Internet

April 2007
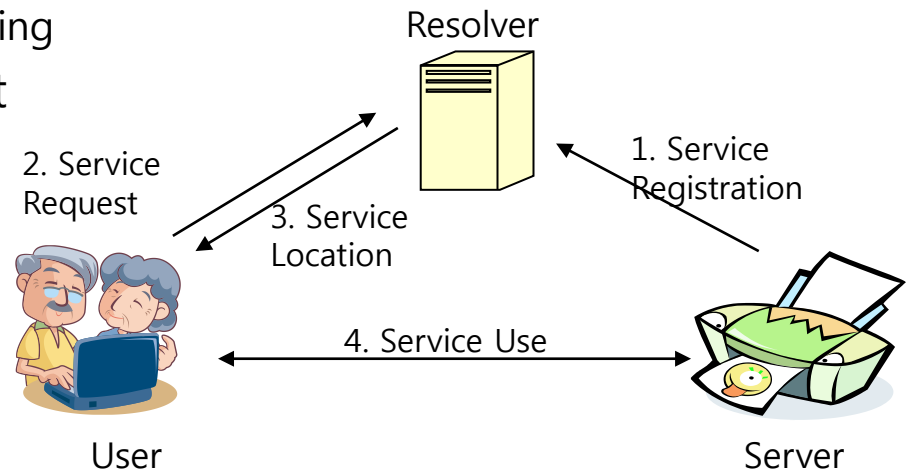
ICU, Younghee, Lee

Contents

- Introduction
- Well known protocols
- Service discovery in ad-hoc networks
- Semantic service discovery
- Large scale semantic service discovery
- Context aware service discovery

Why service discovery?

- Human will be surrounded by a various computing devices.
  – Tiny sensors, PDA, PC, CP, notebook, server...
- Extreme complexity to manage those devices
  – *Zero-administration, Zero-configuration*
  - Need to facilitate interaction between the computer
- => Goal of Service discovery

- Originally, to lower the burden of system configuration
  – "Plug and play" or "zero configuration"
- In more dynamic or ad-hoc environments, service discovery is a necessity.

Service Discovery

- What is service discovery?
  - A protocol which enables users to discover the most appropriate services to the given context by automatically detecting the services available in the network.

- Components and issues
  - Directory repository
    - Directory structurization
  - Service description and matching
    - Semantic representation and matching
  - Query and service announcement
    - Semantic routing

Resolver

2. Service Request

3. Service Location

1. Service Registration

4. Service Use

User

Server

Why service discovery?

- Scenario [1]
  - **Mr. Sue visits ICU**
  - **He searches the Web and finds an on-line Map using his PDA.**
    - **But it's too small to view on his PDA**
  - **PDA locates the printers**
  - **Mr. Sue (or system) picks up a closest printer among the public printers that are allowed to be used by the guests**
  - **PDA requests printing service (without having a driver for the printer) without Mr. Sue's intervention**
- We need to find appropriate services:
  - Printing service, Wireless connection service and Location information service.
  - Service discovery system will do that with your minimum intervention

Pervasive Service Discovery vs Web service discovery

- **Web Service Discovery**
  - No physical location limitation
  - Focuses only on interoperation among applications
  - Interoperability through standards such as WSDL and XML
  - Universal Description, Discovery, and Integration(UDDI)
    - The discovery and configuration process: analysts, programmers, administrators
  - Registry and data structure: mainly for EC.: too specific for Pervasive computing service

- **Pervasive Service Discovery**
  - Ambient Services Discovery: Local
  - Focuses also on both among applications and people
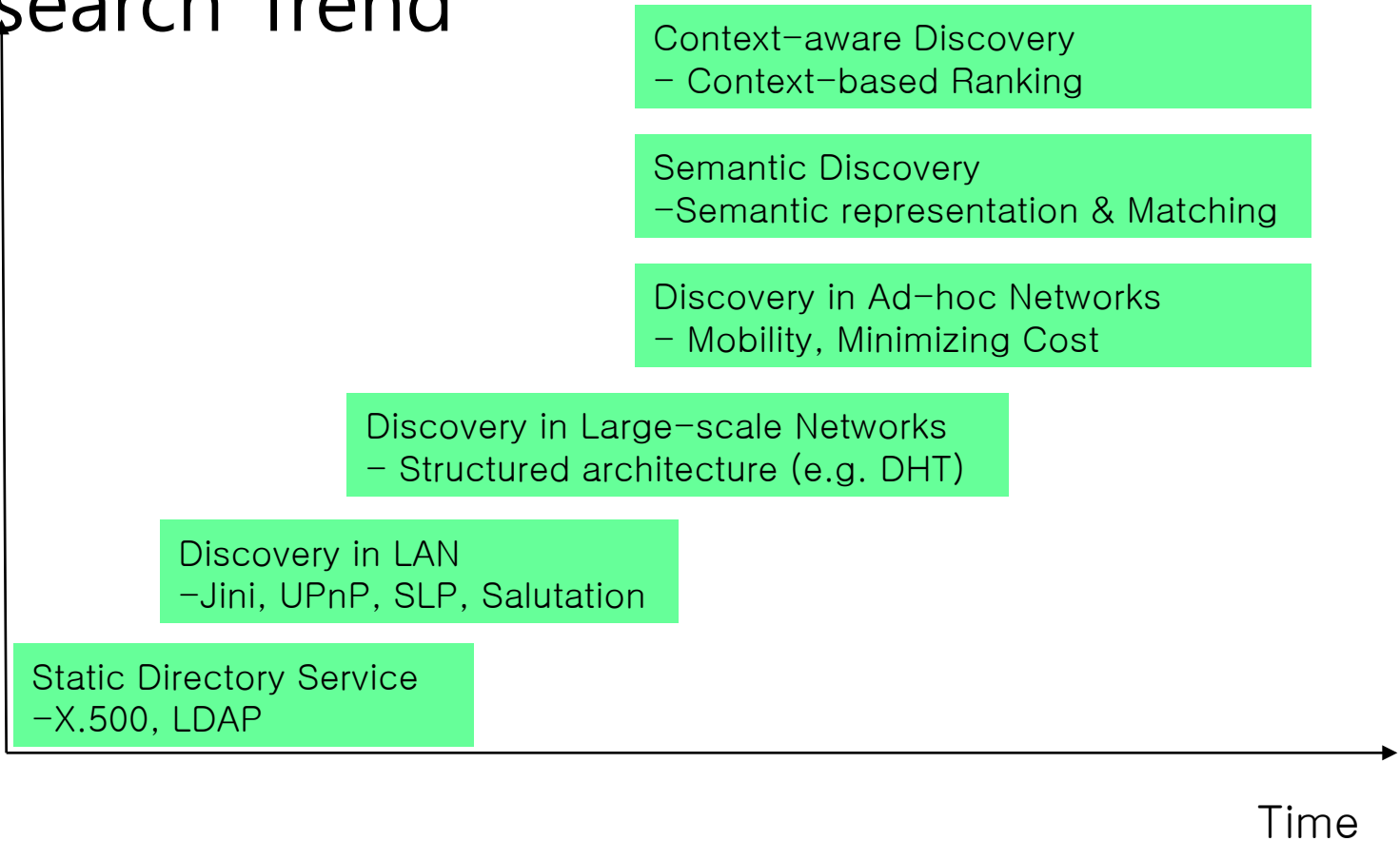 - Integration with people and their ambient environments.

Pervasive Service Discovery

- ## Integration with People
  - Integration of computing devices with people
  - How do we protect personal privacy?
    - Personal information : person's presence, even health status from wearable medical device, user's intention.....
  - How much prior knowledge a user or service provider must have for service discovery?
    - Ambiguity: "print" service, "printing" service, standard service name?
- ## Integration with Environments
  - How can we precisely define the ambient environment ?
    - Location, current user tasks,
    - Visitor's view differs from host's view
  - Heterogeneity
    - H/W, S/W platform, network protocols : common platform?
  - Dynamic conditions
    - Time based approaches: soft state and leased based approaches

Service Discovery

- Research Trend

Pervasiveness (vertical axis)

Time (horizontal axis)

Context-aware Discovery
- Context-based Ranking

Semantic Discovery
-Semantic representation & Matching

Discovery in Ad-hoc Networks
- Mobility, Minimizing Cost

Discovery in Large-scale Networks
- Structured architecture (e.g. DHT)

Discovery in LAN
-Jini, UPnP, SLP, Salutation

Static Directory Service
-X.500, LDAP

Service Discovery

- ## Standards / Specifications
  - Discovery Protocols
    - Jini, UPnP, SLP, Salutation
    - UDDI
    - Web Service Dynamic Discovery (WS-Discovery)
      - complementary to UDDI which is focusing on dealing with devices and systems that are not always connected to the network (by MS, Intel, Canon …)
    - WSMX (Web Services Execution Environment)
      - an execution environment which enables discovery, selection, mediation, invocation and interoperation of the Semantic Web Services (WSMX working group)
      - Includes WSMO and WSML
  - Service Description
    - Web Service Description Language (WSDL)
    - SOAP Service Description Language (SSDL)
    - Web Service Modeling Language (WSML)
  - Ontology architecture for Semantic Description
    - DAML-S, OWL-S
    - Web Services Modeling Ontology (WSMO)

Components

- Directory repository
  - Centralized
  - Distributed
    - Hierarchical
    - Structured P2P
    - Ad hoc
- Service description
  - Attribute/value
  - Tree-like
  - XML
  - Ontology (DAML, OWL)

◆ Announcement
  - Register
  - Multicast/broadcast

◆ Query/Service Access
  - Syntax
  - Ontology
  - Programming language dependency

Service selection

- User vs. Protocol Selection
  - To find services for users efficiently and accurately
  - Protocol selection
    - Little user involvement
    - No reflect the actual user's will
  - User selection
    - Tedious for a user to examine many printers and compare them
  - Balance?
- Best match
  - Matches the best service based on application defined metrics: INS
- Context-awareness
  - Location, connection, person's situation
- Scope-awareness
  - To support a large amount of services, defining and grouping services in scope: location(INS with Cricket), optional attribute for location (Jini)
  - Administrative domain information: multiple hierarchy directory:
    - Yellow pages, White pages; service information in non-leaf directory: hashed (SSDS)
- QoS-awareness
  - Better service: less loaded services or better resource price ration services
    - Most protocols only support static attribute : not load of the printer
    - INS: application define their metrics and service lookups are based on the metrics

Well-known protocols

- Jini
- UPnP
- SLP
- Bluetooth SDP
- Salutation

Jini - introduction

- Java-based and distributed network-connecting technology by Sun Microsystems
- Network Plug-And-Work
- Enable spontaneous networking:
- Promote service-based architecture
- A federation of clients and services
  - Entities in federation provide and/or obtain services to/from other entities
  - All developments in Java
  - Code mobility
- Relies heavily on:
  - Object serialization
  - RMI: Remote Method Invocation

UPnP

- Service advertisement and discovery architecture supported by UPnP Forum
- Peer-to-Peer Model
- Based on current Internet protocols and technologies
  - XML/HTTP, RPC
- No mobile code—instead, standardized protocols and service descriptions
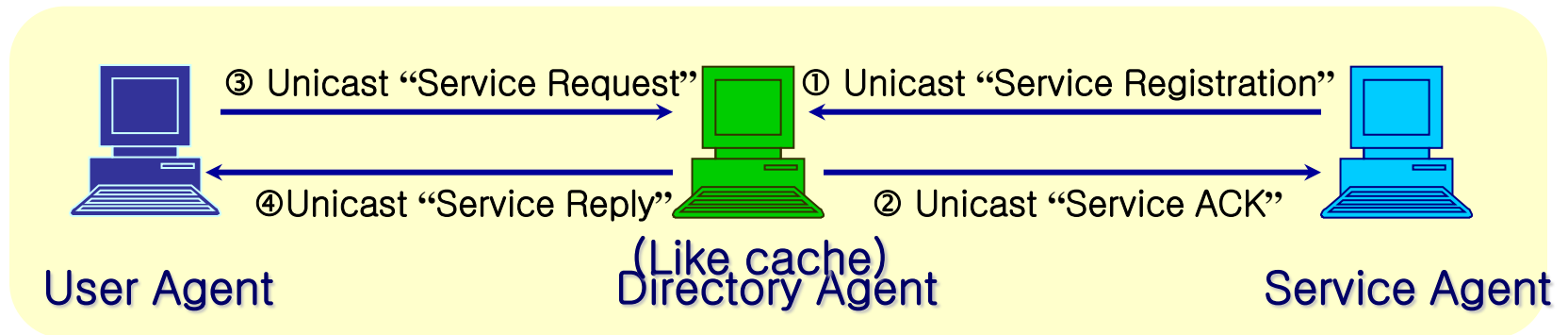- XML-based service descriptions
- UPnP V1.0 Spec in 2000

UPnP – Six Steps

- Addressing   ➔ AutoIP
  - For the IP address impaired…
- Discovery   ➔ SSDP
  - Discovery and advertisement
    - multicast discovery support
    - XML UDP unicast and multicast packets to advertise their services
- Description   ➔ (HTTP)
  - What are the characteristics of a service?
- Control   ➔ SOAP
  - Making a service do its thing(s)
- Eventing   ➔ GENA
  - Updates on interesting service state changes
- Presentation   ➔ (HTTP)
  - Device GUI

Service Location Protocol (SLP)

- IETF standard protocol for service discovery and advertisement
- Designed solely for IP-based networks
- Doesn't define the protocol used between the client and server

◆ Standard Case

③ Unicast "Service Request"   ① Unicast "Service Registration"

④ Unicast "Service Reply"   ② Unicast "Service ACK"

(Like cache)

User Agent   Directory Agent   Service Agent

Salutation Introduction

- The Salutation Architecture was invented to
  - Solve the problems of service discovery and utilization
  - Among broad set of appliances and equipments
  - In an environment of widespread connectivity and mobility
- Find and Bind on a network
  - Devices
  - Applications
  - Services
- Open Architecture
  - Independent of
    - Operating System
    - Network Protocol
    - Product Class

Service discoveries in ad-hoc networks

- No central directory service
- Limited use of network/device resources
- Distributed
- Main entities
  - Node acts as client + server
- Service announcement
  - Flooding: How to reduce flooding traffic?
    - Periodically, delta announcement (Konark)
    - Slotted (DEAPSpace uses slotted+periodic)
  - Cache advertisements
  - TTL

Service discovery in ad hoc networks

- Service description
  - What is described?
    - service name, type, attribute, keywords, properties and functions
    - Service hierarchy - tree like structure (Konark, GSD)
    - Interface format, e.g., function prototype.
  - How is it described and stored?
    - WSDL file (Konark)
    - Data structures similar to ASN.1 (DEAPSpace)
      - Encoder/decoder
    - Ontology: OWL, DAML+OIL (GSD)
- Access to the service
  - RPC
    - SOAP/HTTP (Konark)
    - Specific Interface, e.g., function prototype
      - Encoder/decoder (DEAPSpace)
  - Query formation
    - Path based or syntax based
  - Request routing
    - Policy based (Allia)
    - Group based (GSD)

Semantic service discovery

- **Difficulties of Service Discovery**
  - Different Resources
    - Computing Devices, Software Services, Information Sources
    - Representations, Capabilities, Usage
  - Distinct Environmental Characteristics
    - Preference, Permission, Context
- **Research Issues**
  - Abstract Representations
  - Semantic Matching
  - Context-awareness
- **Use of semantic ontology**
  - Inexact/exact querying
  - More powerful reasoning engines and AI tools
  - Enhancing current service location protocols

Find me the best Pizza service…

Context vs. Semantics

- Context
  - Any information that can be used to characterize the situation of entities (i.e. whether a person, place or object)
    - Identity, Location, Status (or Activity), Time

- Semantics
  - Abstract notions which can be implicitly derived to identify the differences and correlations between objects/concepts
    - What is the semantics of "Alarm"?
      - Definition in dictionary
        » Sudden fear produced by awareness of danger
        » A noise warning of danger
        » A bell and etc. which sounds to warn of danger or to wake a person from sleep

Semantic service discovery

- **DReggie** [8]
  - ◆ Enhanced Jini lookup service to enables semantic service discovery of Jini enabled services.
  - ◆ Target application : M-commerce
  - ◆ Two main concepts for service discovery
    - ■ DAML based service ontology
      - – service components and their some properties such as service name, capability, requirements.
    - ■ Prolog reasoner for semantic discovery

- **Enhanced SDP in Bluetooth** [10]
  - ◆ Semantic service discovery in ad hoc network
  - ◆ Two main concepts for semantic matching
    - ■ DAML based service ontology
    - ■ Prolog-based XSB Reasoning engine

- **Limitation**
  - ◆ Does not assume pervasive environment : need components for evaluation of dynamic attributes
  - ◆ Ontology restriction : describe only service

Location-aware service discovery

Where is the closest Italian restaurant to me?
- Location sensing
- Nomadic users
- Handy devices

Future?

- Human does not know future, even tomorrow what may take place, we do not know?
  - How can we imagine after 20 years later application or services?