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Relational-Metric Based Control: A New Paradigm of Network Service and Resource Control

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Background

- **Personal space** *1
  - Physical closeness from a person to objects should reflect her or his social closeness to them

- `Information’ space to people
  - Physical closeness is measured
    - Availability of information
    - Latency of information delivery

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*1 Edward T. Hall The Hidden Dimension, 1966
Problem

- Mobile & Ubiquitous
  - You reach any information at any time, anywhere
- Broadband
  - Any information is delivered fast
Information space may not reflect social closeness

- Social Networking Service (SNS) is good direction but
  - Information more related to you is delivered faster? with higher quality?
Key idea: relational metrics

• Social closeness between any real objects: humans, locations, contents, machines, etc
• Quantified by integrated measurement of online and physical sensing

Real world

Online sensing (Web crawling, SNS analysis)

Physical sensing (Sensors on smartphones)

Relational metrics
Relational Metric Based Network Service and Resource Control

Real-world to relational metrics

Relational metrics to network services and resources

Real world

Relational

Network service

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Benefit

Comfortable information space

- You feel any information physically close to you are socially close to you
- Content you really need is delivered fast
- Good communication quality is guaranteed when you are connected to an important person
Other profits

1. Services for hidden or potential demands
   • Relational metrics are measured by integrated online-physical sensing
   • Relational metrics may reflect your hidden or potential demands you have not realize

2. Contextual services
   • If we look into short-term relational metrics around a person: they reflect her or his context: when/where/who/why/how

3. Self-organized and predictive services
   • Relational metrics enable self-organizing and providing a service before we realize we need it.
System model

- Actuators
  - Network services
  - In-network resources

- Clients in real world
  - Online sensor
    - Sensing data aggregator
  - Physical sensor
    - Context detection engine

- RMH

- Metric presentation engine
  - Metric evaluation engine
    - Short-term metric formation engine
    - Long-term metric formation engine

- Short-term metric database
  - Long-term metric database

Information / message flow
Data access

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Prototyped application 1

- Conventional content delivery requires to
  - describe demand using explicit keywords
  - choose pointer

- Relational content delivery

Relation graph between contents, people, locations, contexts

Automatic delivery with priorities based on relational metrics
Research issues and milestones

- 2011 Architectural design for static scenarios
  - Metric formation/evaluation/structure
  - Control platform
- 2012 Architectural design for dynamic scenarios
  - Metric update
  - Context detection
  - Control platform for dynamic scenarios
- 2013~ Further challenges
  - Interface specifications
  - Scalability improvement by distributed approaches

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Ultimate applications

- Life navigations
- Human/non-human resource matching
- Protection from epidemics, crimes, accidents, and disasters
- Self-reorganization after accidents and disasters