Possibilities and Technical Challenges in Information and Knowledge Infrastructure

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Theme in this talk

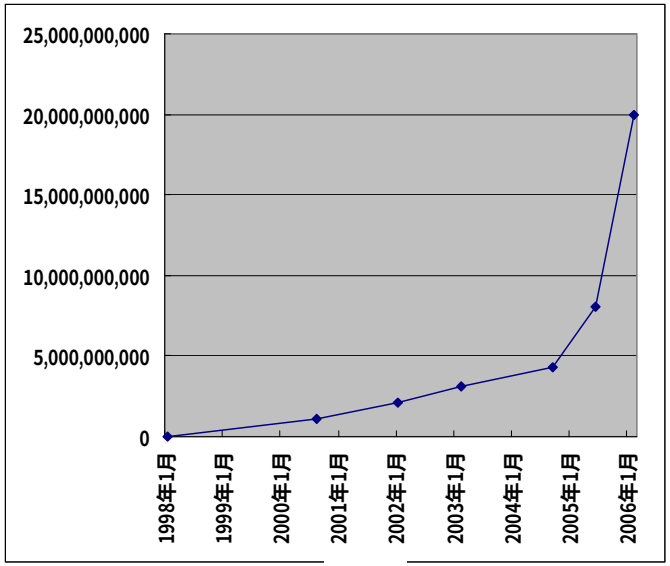
- Rapid growth of WWW is changing the traditional information distribution system in our society quickly
- What change happened?
- Which direction we are going?

Information distribution system in society

- Ancient days (w/o written languages): oral culture
  - Very limited distribution and preservation of information
- Ancient days (w written languages): handwritten materials
  - Limited distribution and some amount of preservation of information
  - Small amount of information providers and information consumers
- With printing technology after Gutenberg
  - Good enough distribution and preservation of information
  - Small amount of information providers and large amount of information consumers
- Internet Era (WWW Era)
  - So much distribution and preservation of information
  - Large amount of information providers and consumers

Web Now

- Page Amount: Over 20 billion pages
  - February 2006 (Yahoo!)
- Server Amount: Over 80 million servers (80,655,992)
  - April 2006 (Web Server Survey)



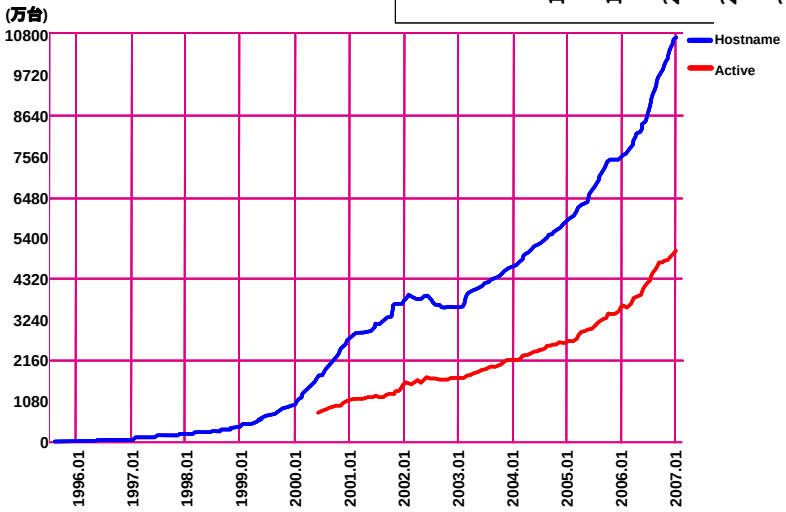


図1：Webサーバの台数の変化
(NetCraft, http://www.netcraft.com)

- Internet users: ca. 0.7 billion (14% of over 15 people)
  - March 2006
  - comScore http://www.comscore.com/press/release.asp?press=849

Top 15 Online Populations by Country, Among Visitors Age 15+*
March 2006
Unique Visitors (000)
Source: comScore World Metrix

	Unique Visitors (000)
Worldwide Total	***694,260***
United States	152,046
China	74,727
Japan	52,100
Germany	31,813
United Kingdom	30,190
South Korea	24,645
France	23,884
Canada	18,996
Italy	16,834
India	16,713
Brazil	13,186
Spain	12,452
Netherlands	10,969
Russia	10,833
Australia	9,735

What is information distribution now?

- Focus on Information and Communication Activities (ICA) not on Information and Communication Technologies (ICT)

From “old computing” to “new computing”

“The old computing was about what computers could do; the new computing is about what users can do. Successful technologies are those that are in harmony with users’ needs. They must support relationships and activities that enrich the users’ experiences.”

Ben Shneiderman, Leonardo's Laptop: Human Needs and the New Computing Technologies, MIT Press, 2002

- Paradigm shift is needed
  - *Technology-centered approach*
  - ***Human-centered approach***

ART(Activity and Relationship Table)

	COLLECT (Information)	**RELATE** (Communication)	**CREATE** (Innovation)	**DONATE** (Dissemination)
Self				
Family and friends (2-50 intimates)				
Colleagues and neighbors (50-5,000 regular encounters)				
Citizens and markets (5,000+)				

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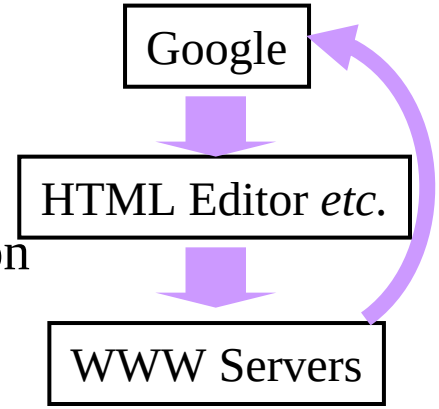
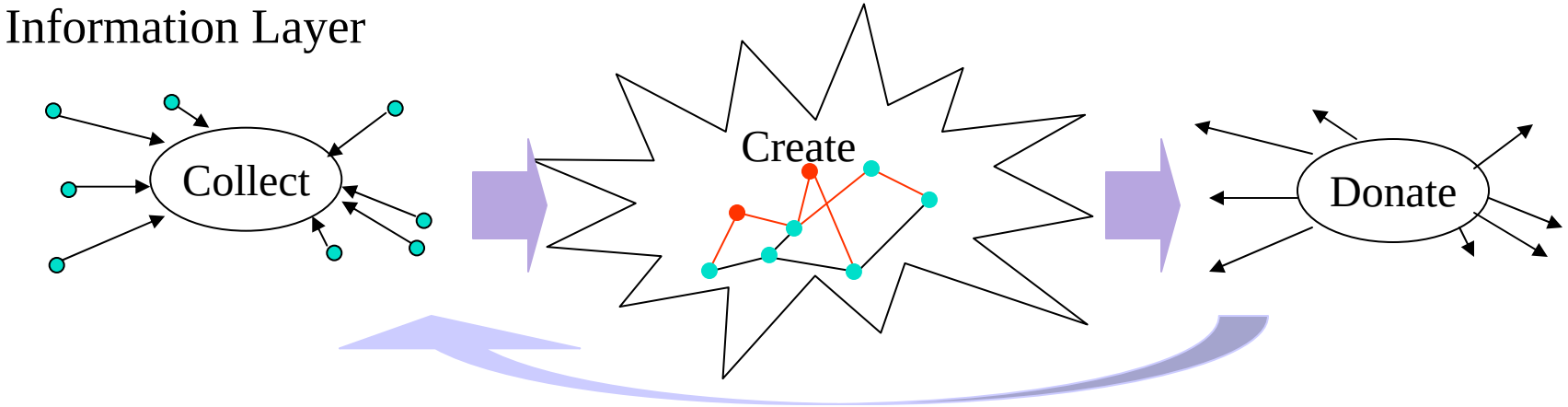
Information Activities

- A cycle of information exploitation
  - ***Collect***
    - Find and retrieve information
  - ***Create***
    - Process (classify, extract, combine, mix, …) information
    - Generate new information
  - ***Donate***
    - Publish and distribute information

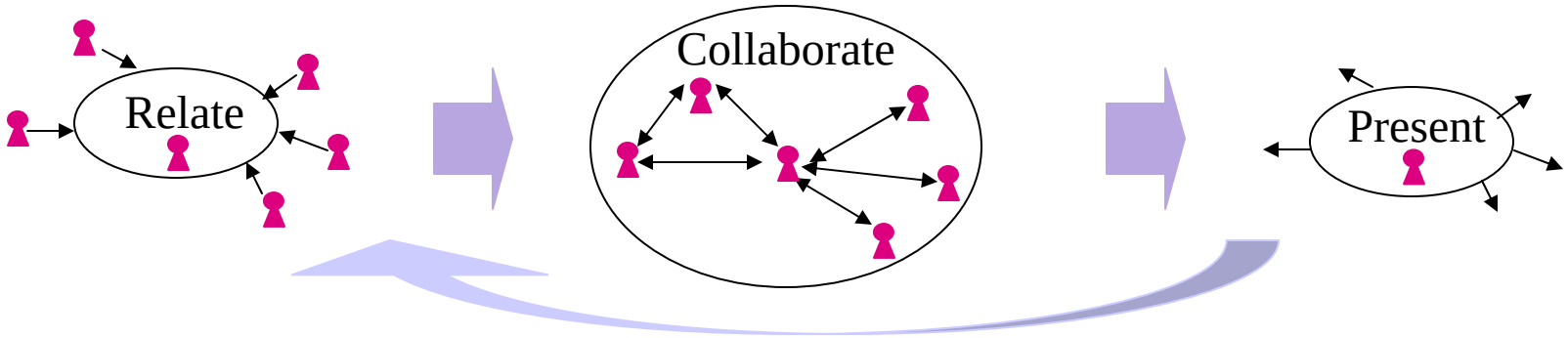




Communication Activities

- A cycle of human relationship exploitation
  - ***Relate***
    - Find and contact people
  - ***Collaborate***
    - Work with other people (organized work, teamwork, cooperation, …)
  - ***Present***
    - Identify and contribute ourselves to communities

Communication Layer



Web as Communication Media

- WWW is mainly considered as media for information activities.
- But …

Web as Communication Media

- When WWW was created, many researchers created their "homepages"
  - "Homepage"
    - Data and information on research
    - Self-introduction
      - Profile
      - "What's New"
      - Friends
  - Group Page
    - Data and information
    - Group members
    - "What's New"
    - …

Hideaki Takeda, Dr. Eng.

Hideaki Takeda is Associate Professor in Artificial Intelligence Laboratory in Graduate School of Information Science at Nara Institute of Science and Technology (NAIST). He received his Ph.D. in Precision Machinary Engineering from the University of Tokyo in 1991. He has conducted research on a theory of intelligent CAD, in particular experimental study and logical formalization of engineering design. He is also interested in multi-agent architectures and ontologies for knowledge base systems.

Information

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My Interests in Research

I am currently working the following three topics which are closed related togather.

- Knowkedge Sharing
- Design Research
- Robotics

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Just for Communication

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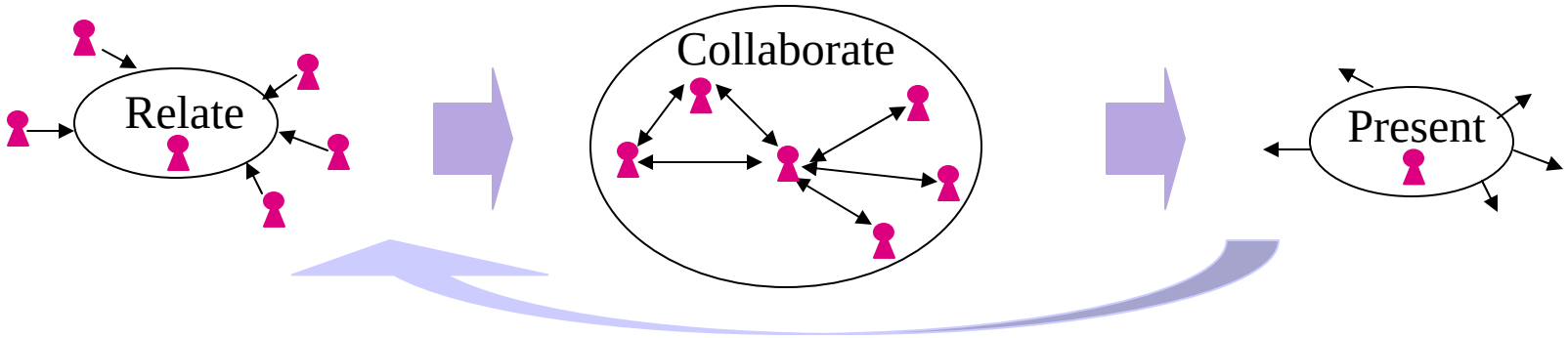
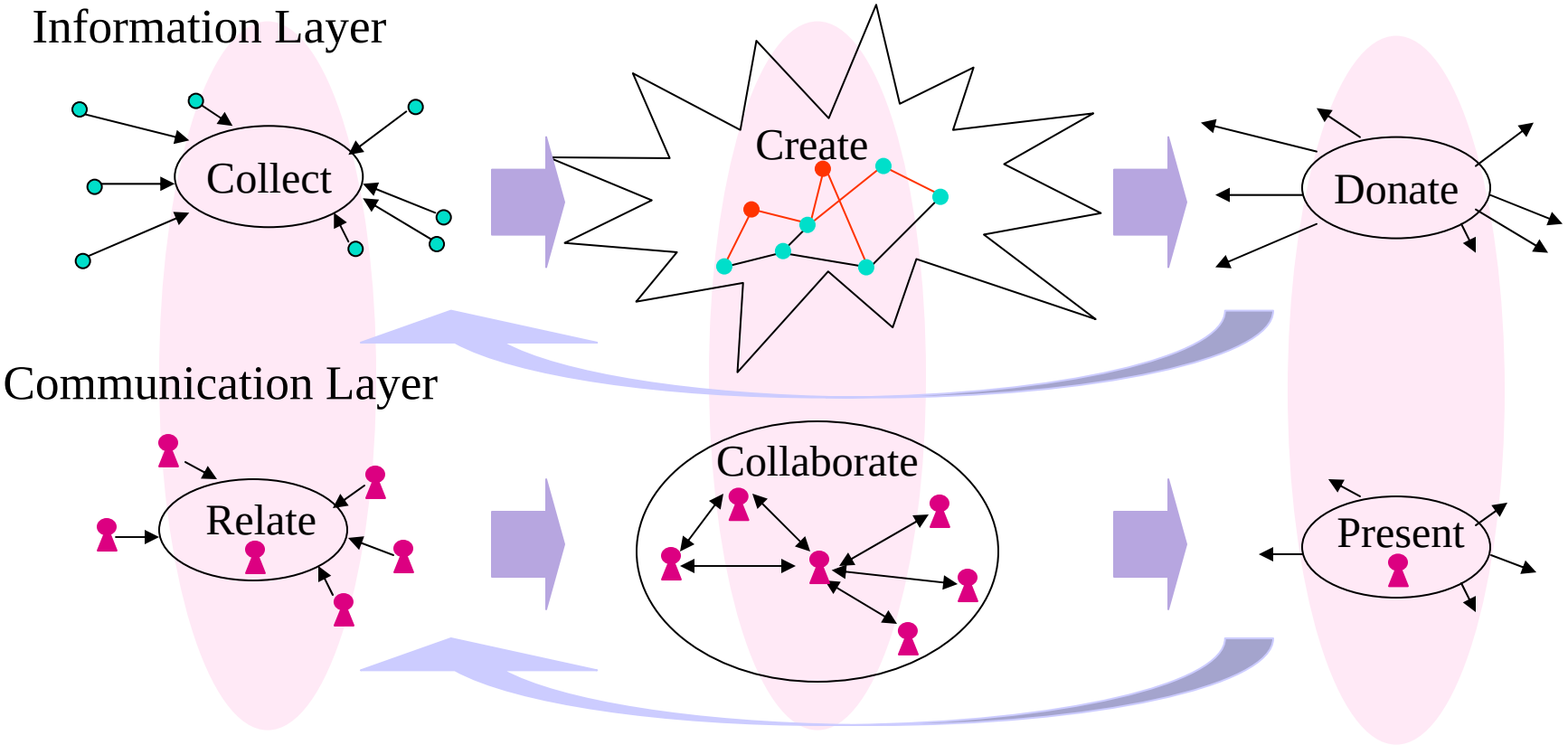


Information and Communication Activities

- Two layers for our activities
  - ***Information layer*** only concerns explicitly represented and processed information.
  - ***Communication layer*** concerns potential information. Potential information can be revealed through communication among people.



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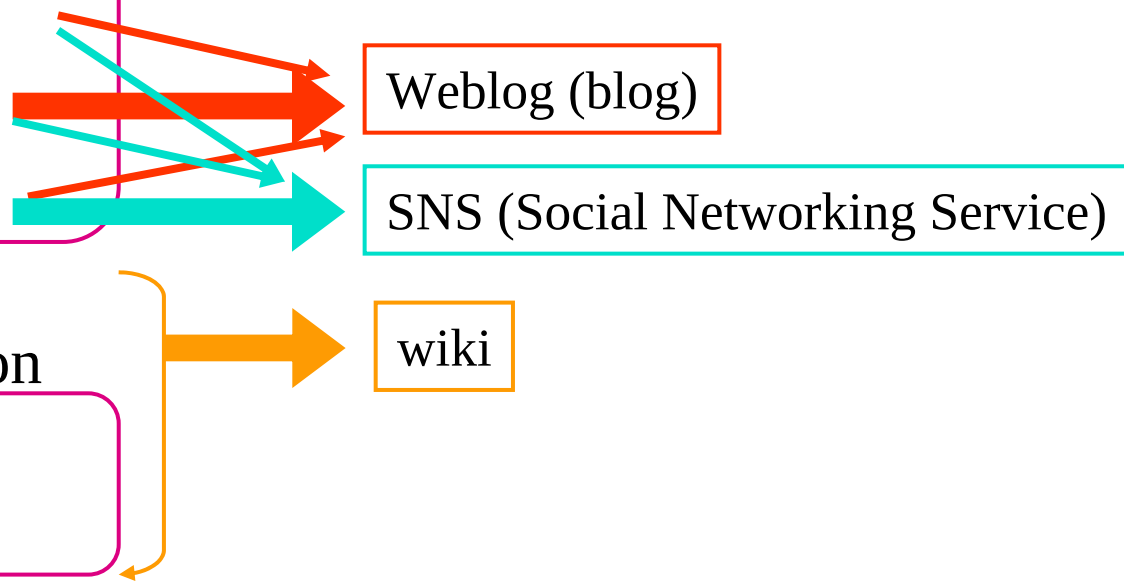


Direction for ICA

- More focus on the communication layer
  - Social network
    - Social Network Analysis
    - Network Science
    - Social Network Mining
    - Social Network-based Services
  - Communities

Shifting from information to knowledge

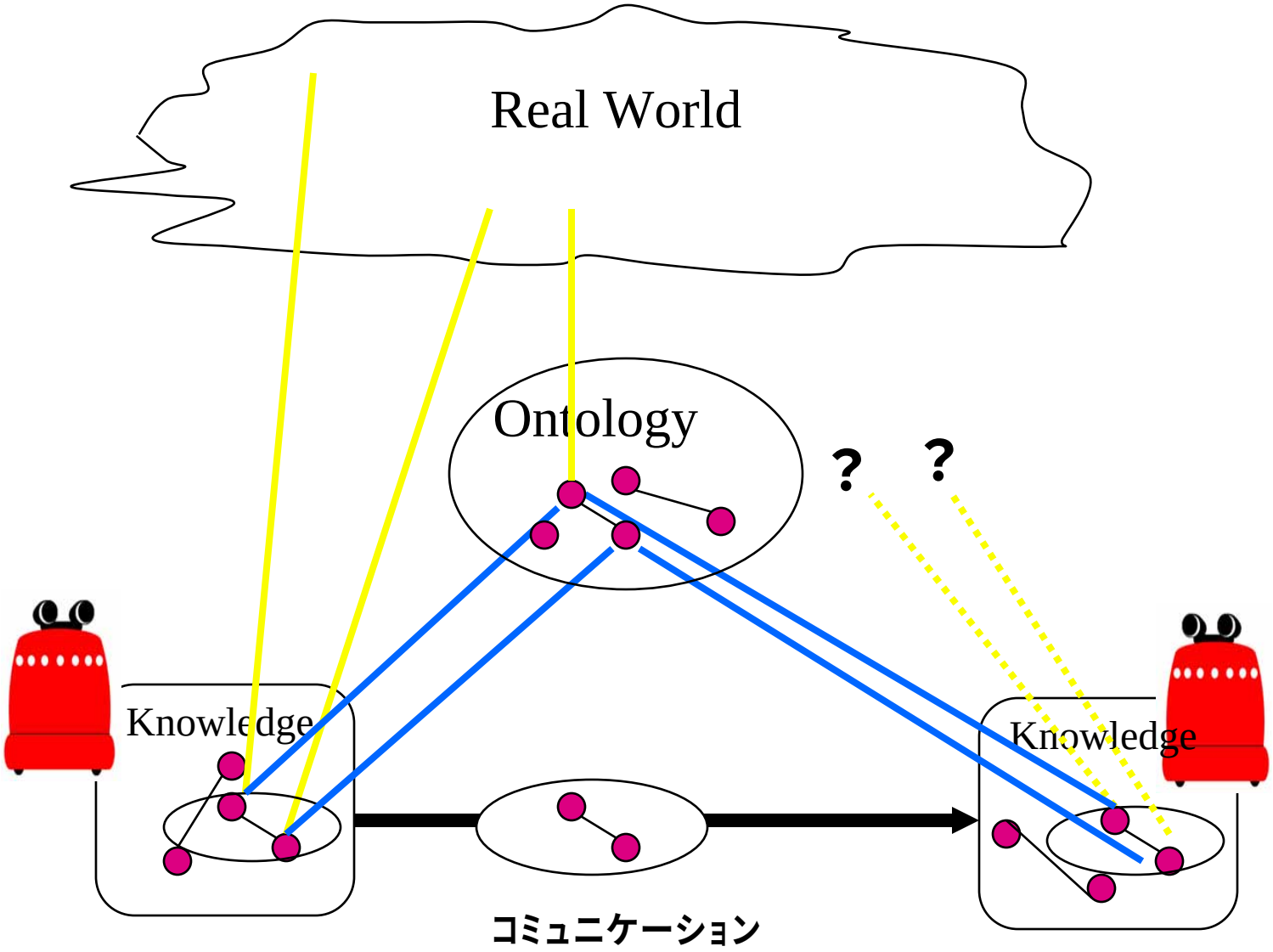
- Ontology for knowledge sharing

Why knowledge sharing is needed?

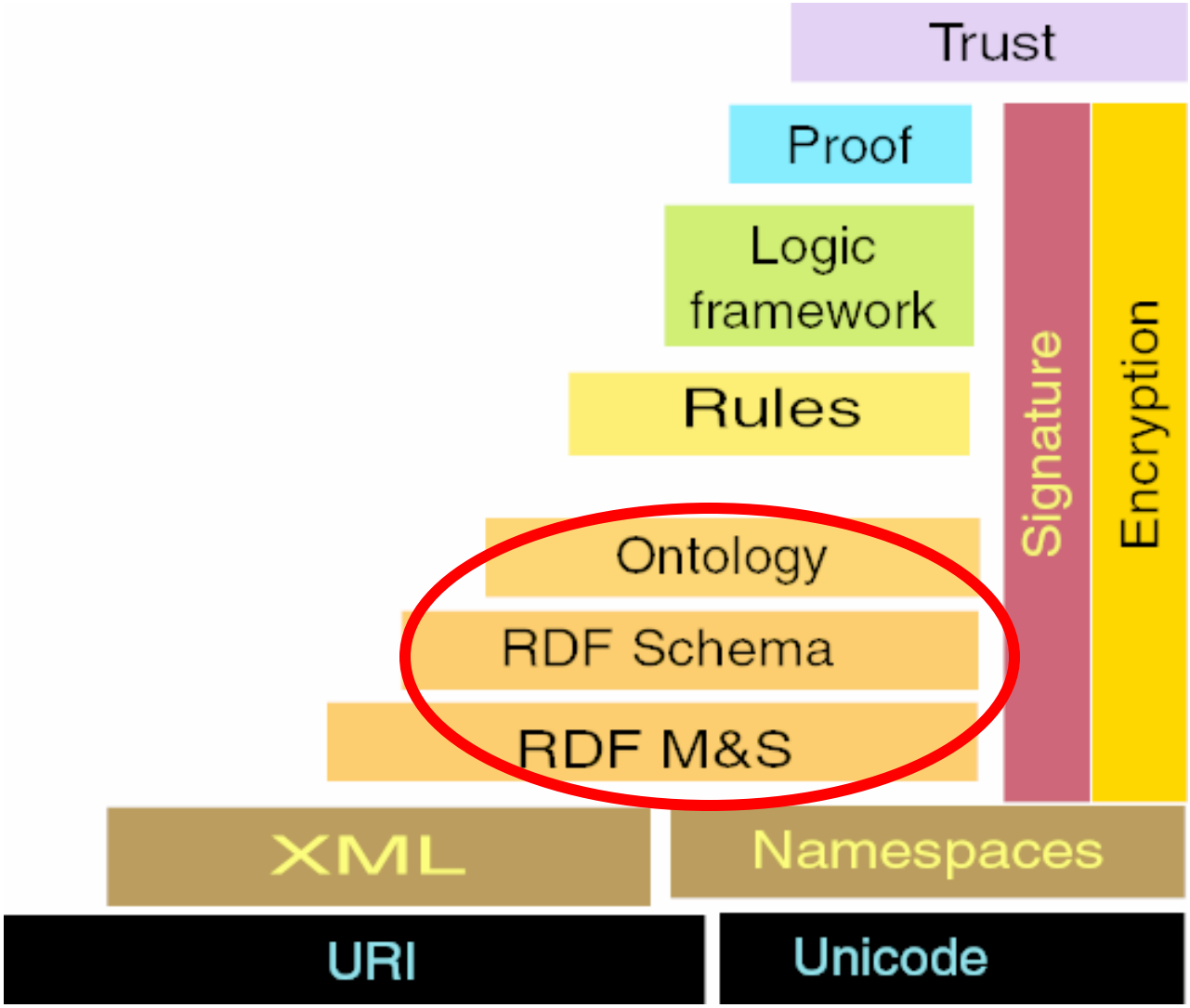
- WWW explicates needs for common background knowledge among people
  - In fixed information distribution, all people are expected to share background knowledge
  - In flexible information distribution such as WWW, it is not guaranteed.

- Ontology:
  An ontology is an explicit specification of a conceptualization
  [Gruber]

Ontology and Agent Communication



Architecture for the Semantic Web



Tim Berners-Lee http://www.w3.org/2002/Talks/09-lcs-sweb-tbl/

The Aim of The Semantic Web

- "The Semantic Web is an extension of the current web in which information is given well-defined meaning, better enabling computers and people to work in cooperation."

  *The **Semantic Web**, **Scientific American**, May 2001, Tim Berners-Lee, James Hendler and Ora Lassila*

- The Semantic Web is a vision: the idea of having data on the web defined and linked in a way that it can be used by machines not just for display purposes, but for automation, integration and reuse of data across various applications.

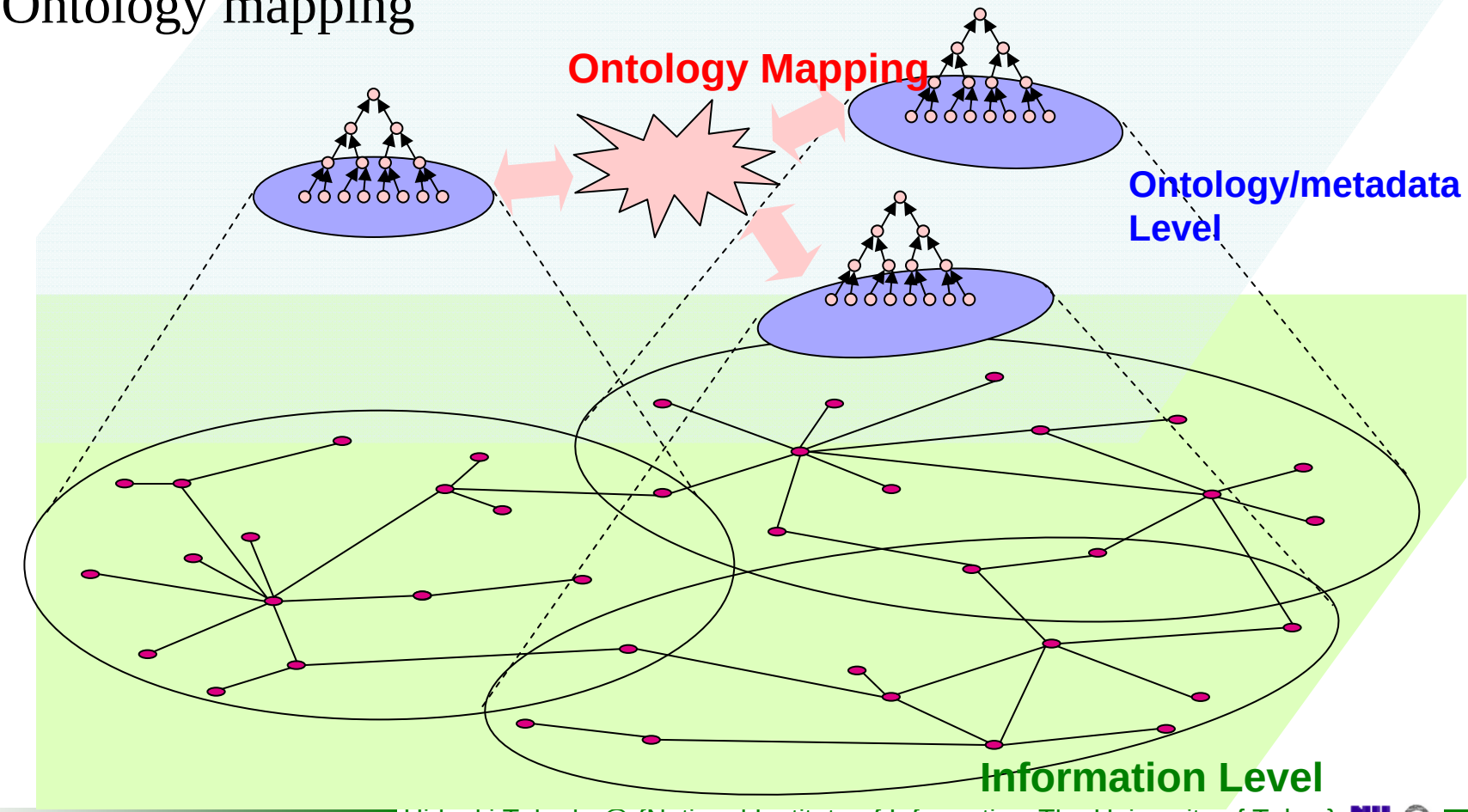
http://www.w3.org/2001/sw/

Challenges for Realizing Semantic Web

- Representation of Ontology-based Web
  - OWL (Web Ontology Language)
- Definition of Ontologies
  - Top-level ontology
  - Domain ontologies
- Manipulation of multiple ontologies
  - Even a single target can be represented in different ontologies
  - Communities often develop own ontologies
  - Mapping or mediating among different ontologies are needed

Community-based information distribution and sharing

- Information distribution within communities
- Information distribution cross communities
  - Ontology mapping



Next Information distribution system: Summary

- Information and communication activities
  - vs. Information and communication technologies
- Communication level: Social network and community
  - vs. information level
- Ontology level
  - vs. Information level
- Distributed ontologies
  - vs. a unified ontology