The Language Grid for Intercultural Collaboration

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NICT Language Grid Project

Overview of This Talk

- This talk is on a new language service infrastructure on the Internet
  - to combine existing language resources (machine translations, morphological analyzers, dictionaries etc.) to create customized language services, and
  - to provide those language services for non-profit activities.
- We stared the Language Grid project at NICT in April 2006.
- We are not working on language technologies. Our technologies are
  - semantic Web services,
  - multi-agent systems, and
  - computer supported collaborative work (CSCW)

A Story of NPO Pangaea

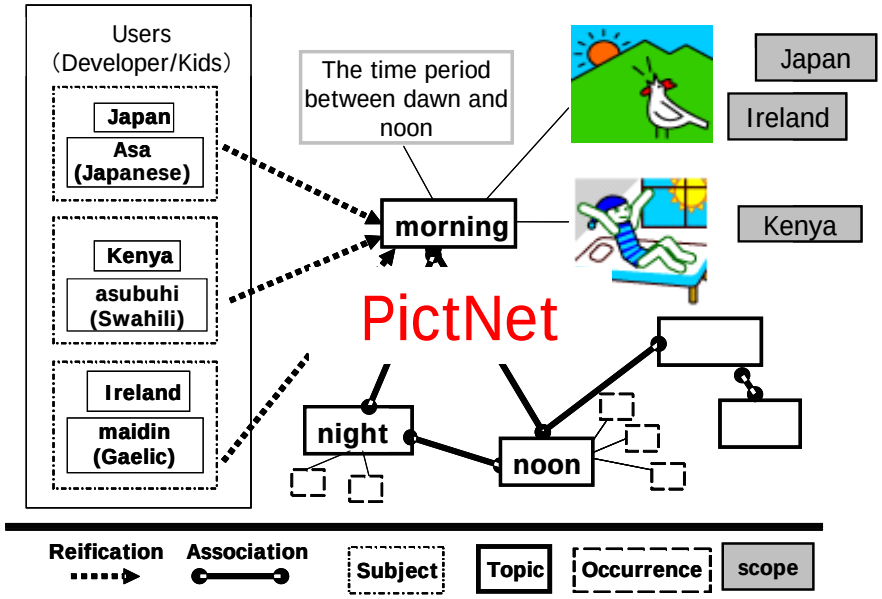
Rieko Inaba, Yohei Murakami Akiyo Nadamoto and Toru Ishida. Multilingual Communication Support Using the Language Grid. *International Workshop on Intercultural Collaboration (IWIC-07), Lecture Notes in Computer Science, 4568,* pp. 118-132, 2007.

Rieko Inaba. Usability of Multilingual Communication Tools. HCI, 2007.

Yumiko Mori. Atoms of Bonding: Communication Components Bridging Children Worldwide. *International Workshop on Intercultural Collaboration (IWIC-07), Lecture Notes in Computer Science, 4568*, pp. 335-343, 2007.

Playground for Kids

NPO Pangaea



Universal Playground enables kids around the world to develop bonds despite differences in distance, languages and cultural backgrounds.

Picton: Pictograms to talk with kids in different countries.

VIDEO

Pangaea Facilitator Meeting

How to support Pangaea facilitators using Korean, Japanese, English, and German translations with their own dictionary?

A Story of a Tunisian Researcher in Japan

Rieko Inaba, Yohei Murakami Akiyo Nadamoto and Toru Ishida. Multilingual Communication Support Using the Language Grid. *International Workshop on Intercultural Collaboration (IWIC-07), Lecture Notes in Computer Science, 4568*, Springer-Verlag, pp. 118-132, 2007.

Rescue Ahlem!

Help foreign researchers in Japanese meetings.

Ahlem is one of our project members, who is from Tunisia in North Africa. Although she can speak Arabic as her native language, and French and English , she cannot yet speak Japanese.

Three Japanese researchers input a summary of an ongoing discussion on the blackboard in Japanese. The input text is translated into English, and also in French, and displayed on Ahlem's laptop.

اَلسَّلَامُ عَلَيْكُمْ.


Rescue Ahlem!

All for One Collaboration Project

- All for One Collaboration Project at Kyoto University
- Help foreign students in Japanese seminars.

How to support Korean, Japanese, English, Chinese, French, and Indonesian people in this seminar in technological domains?

Language Grid
as a solution

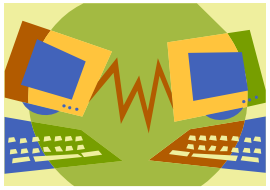
Toru Ishida. Language Grid: An Infrastructure for Intercultural Collaboration. *IEEE/IPSJ Symposium on Applications and the Internet (SAINT-06),* pp. 96-100, keynote address, 2006.

Toru Ishida, Akiyo Nadamoto, Yohei Murakami. Supporting Intercultural Collaboration by the Language Grid. *International Conference on Computer Supported Cooperative Work (CSCW-06),* pp. 181-182, 2006.

Toru Ishida, Akiyo Nadamoto, Yohei Murakami, Rieko Inaba, Tomohiro Shigenobu, Shigeo Matsubara, Hiromitsu Hattori, Yoko Kubota, Takao Nakaguchi, and Eri Tsunokawa. A Non-Profit Operation Model for the Language Grid. *The First International Conference on Global Interoperability for Language Resources (ICGL-08),* 2008.

Role of the Language Grid

Use of language services is difficult



Network Service
(Machine Translation)

Price

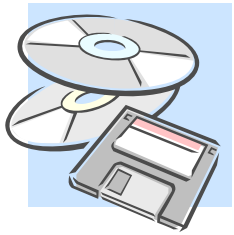
Quality

Contract

Copyright

Technology

Language Resource
(Dictionary)



Language Processing
(Morphological Analysis)

Language Services
Developed by Experts

Language Services
Developed by
Communities

Rights
Protection

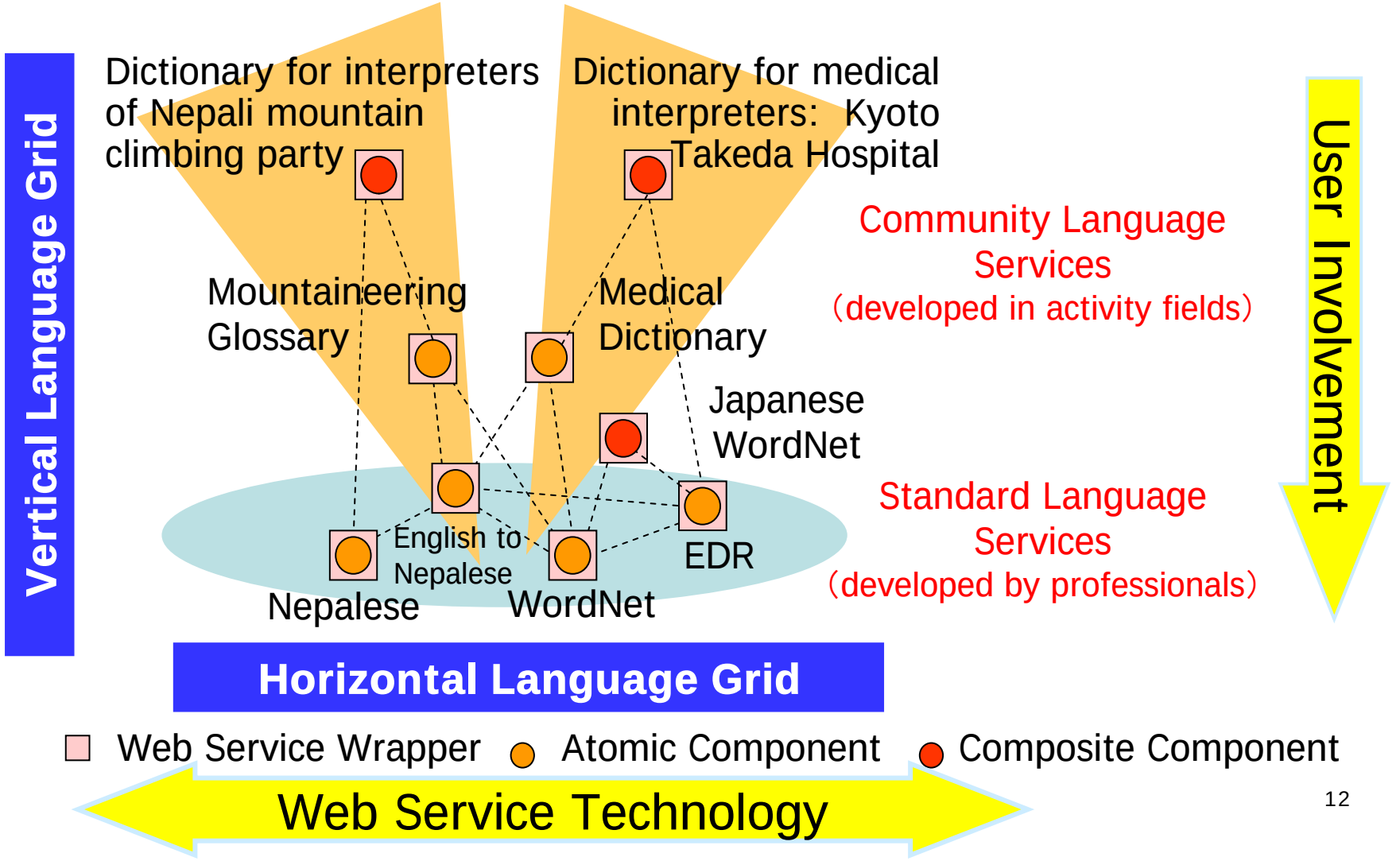
Development
Support

Language

Grid

Language Grid increases usability
and accessibility

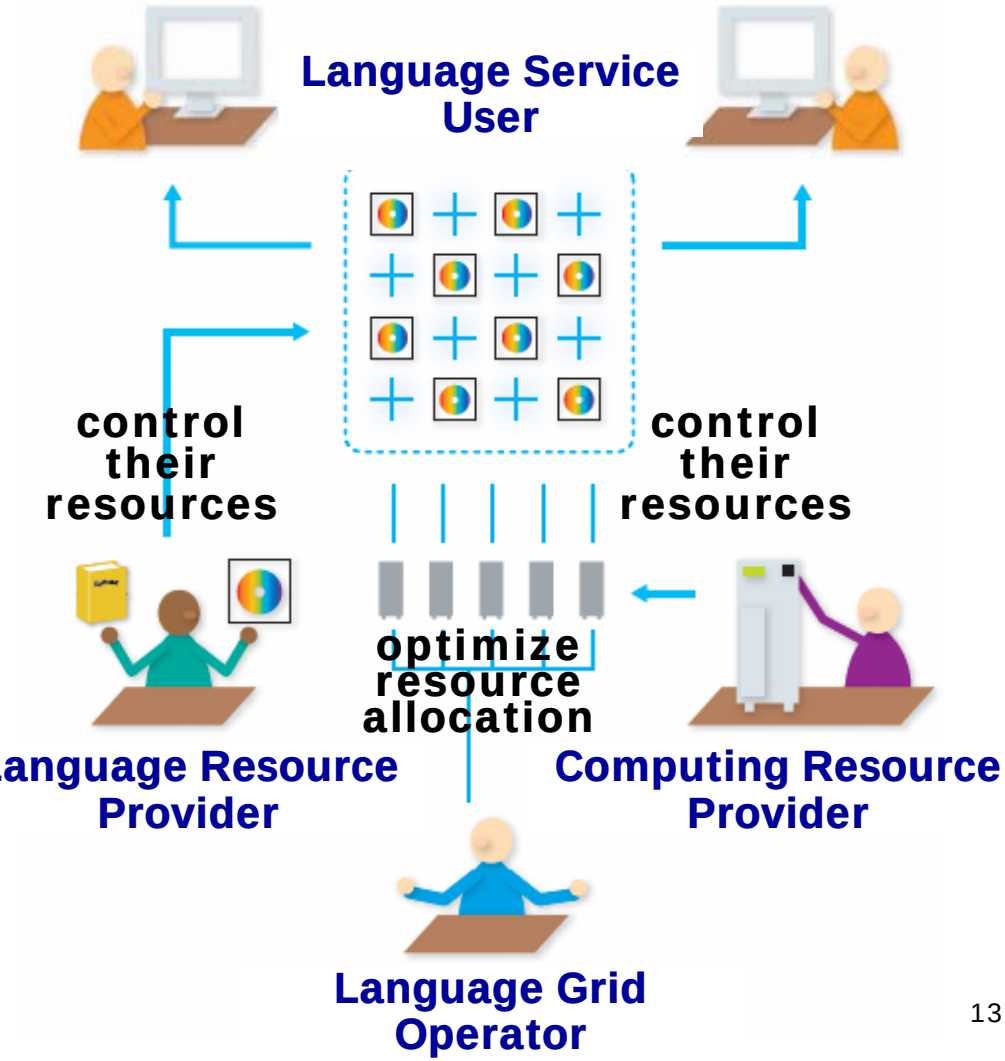
Architecture of the Language Grid



Stakeholders of the Language Grid

- Language Resource Provider
- Computing Resource Provider
- Language Service User
- Language Grid Operator

- Kyoto university will be a Language Grid Operator from November 2007.
- The *Letter of Agreement* for joining the Language Grid is available upon a request.



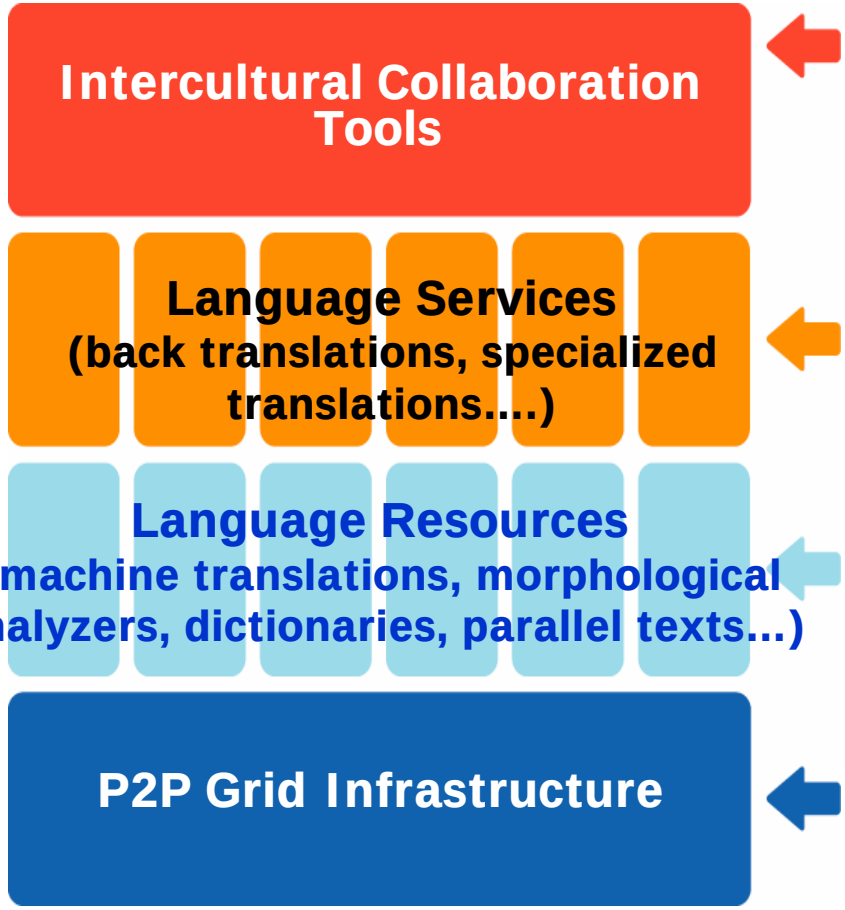
Current Status of the Language Grid

Yohei Murakami, Toru Ishida and Takao Nakaguchi. Language Infrastructure for Language Service Composition. *International Conference on Semantics, Knowledge and Grid (SKG-06),* 2006.

Tomohiro Shigenobu. Evaluation and Usability of Back Translation for Intercultural Communication, HCI, 2007.
Conference on Semantics, Knowledge and Grid (SKG-06), 2006.

Tomohiro Shigenobu. Kunikazu Fujii, Takashi Yoshino. The Role of Annotation in Intercultural Communication, *HCI*, 2007.

Service Layers of the Language Grid



1. Intercultural Collaboration Tools

Multilingual communication is supported using various language services.

2. Language Services

Multiple language resources are composed using Web service workflows.

3. Language Resources

Language resources are made usable as Web services with standardized interfaces.

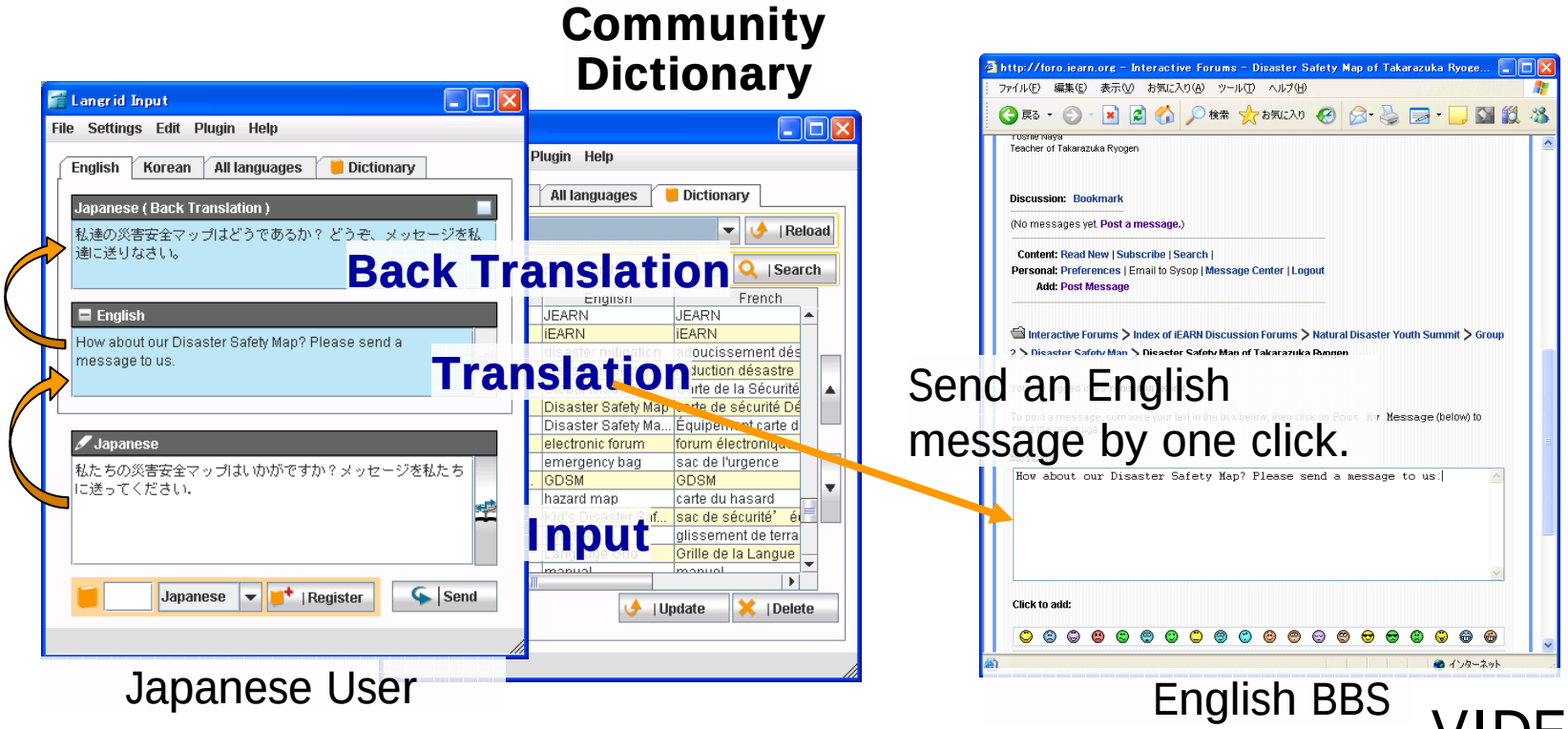
4. P2P Grid Infrastructure

Allow users to connect to Language Grid servers on the Internet.

1. Intercultural Collaboration Tools

Langrid Input

- Langrid Input is a tool to support multilingual text input.
- It can input multilingual text into existing collaboration tools such as BBS.

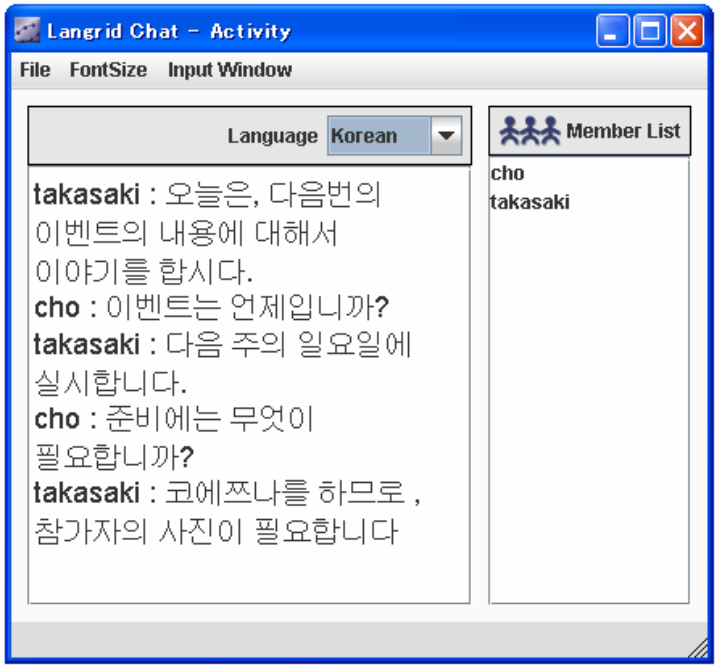


VIDEO

Langrid Chat

- Langrid Chat is a tool for multilingual chatting.
- Users can add pictograms to their messages to express emotions, which are often lost through machine translation.

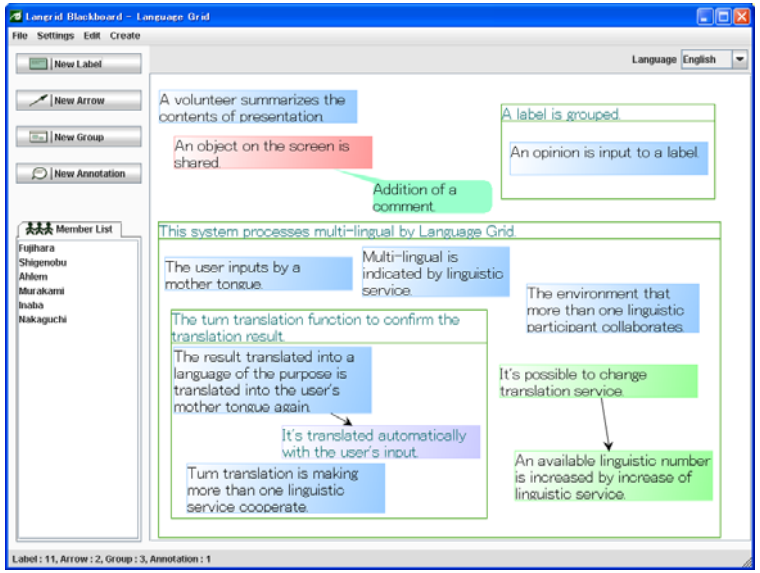
Japanese User



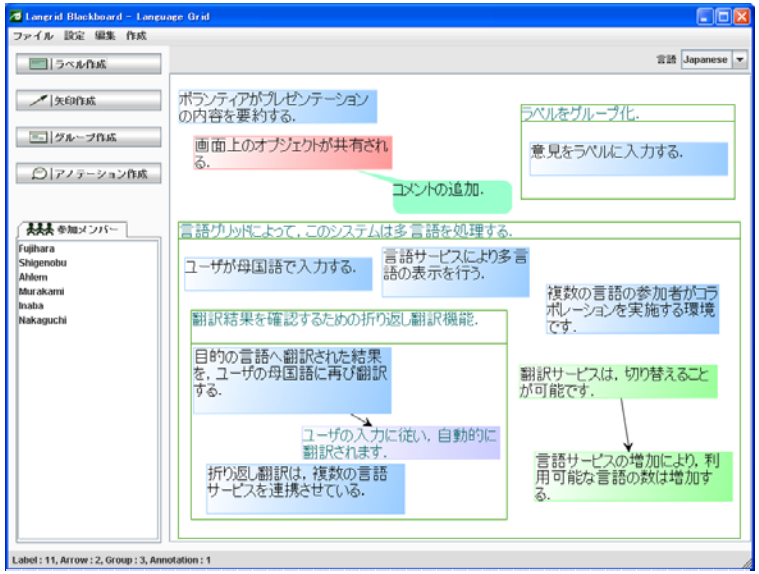
Korean User

Langrid Blackboard

- Langrid Blackboard is an electronic blackboard for multilingual information sharing.
- This tool helps users to summarize meetings. Users can input texts and read them in their first languages.



English User

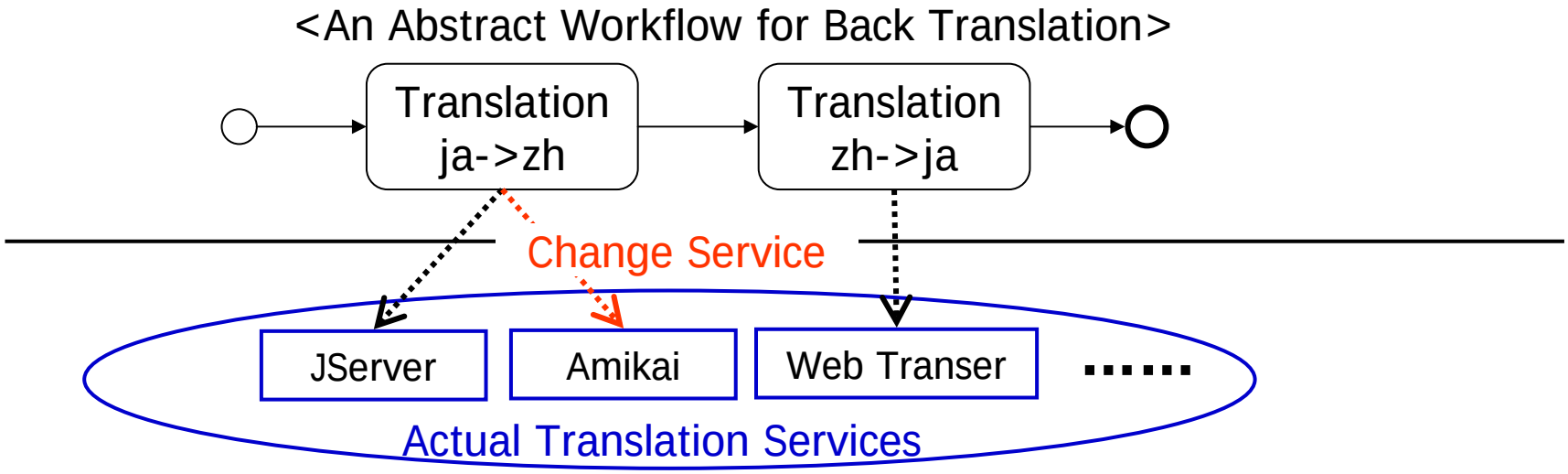


Japanese User

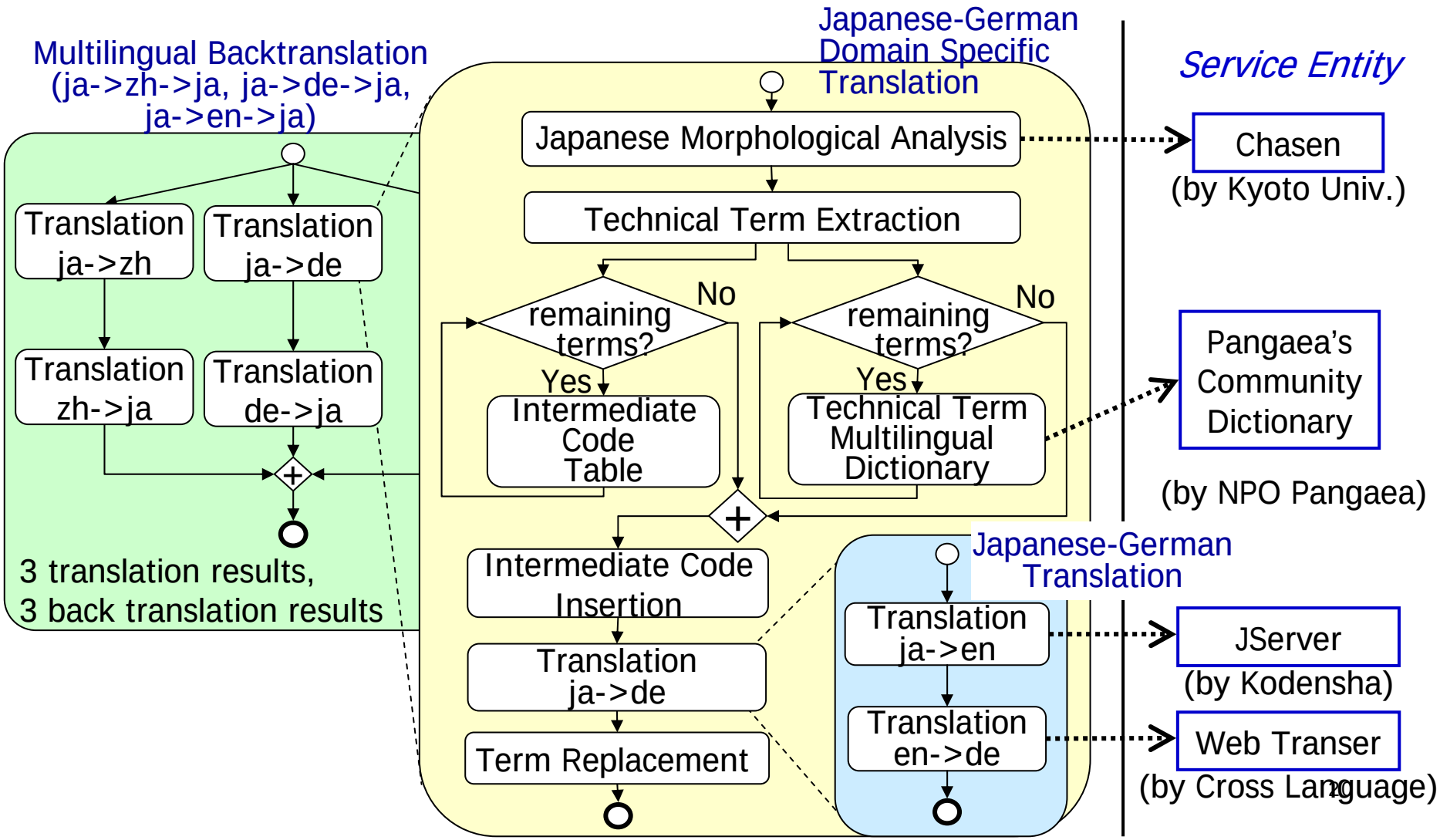
VIDEO

2. Language Services

- Any collaboration tool can use language services.
- To create a new language service, describe an abstract workflow in BPEL4WS using the existing BPEL editors.
- Then, assign a concrete Web service to each task in the abstract workflow.

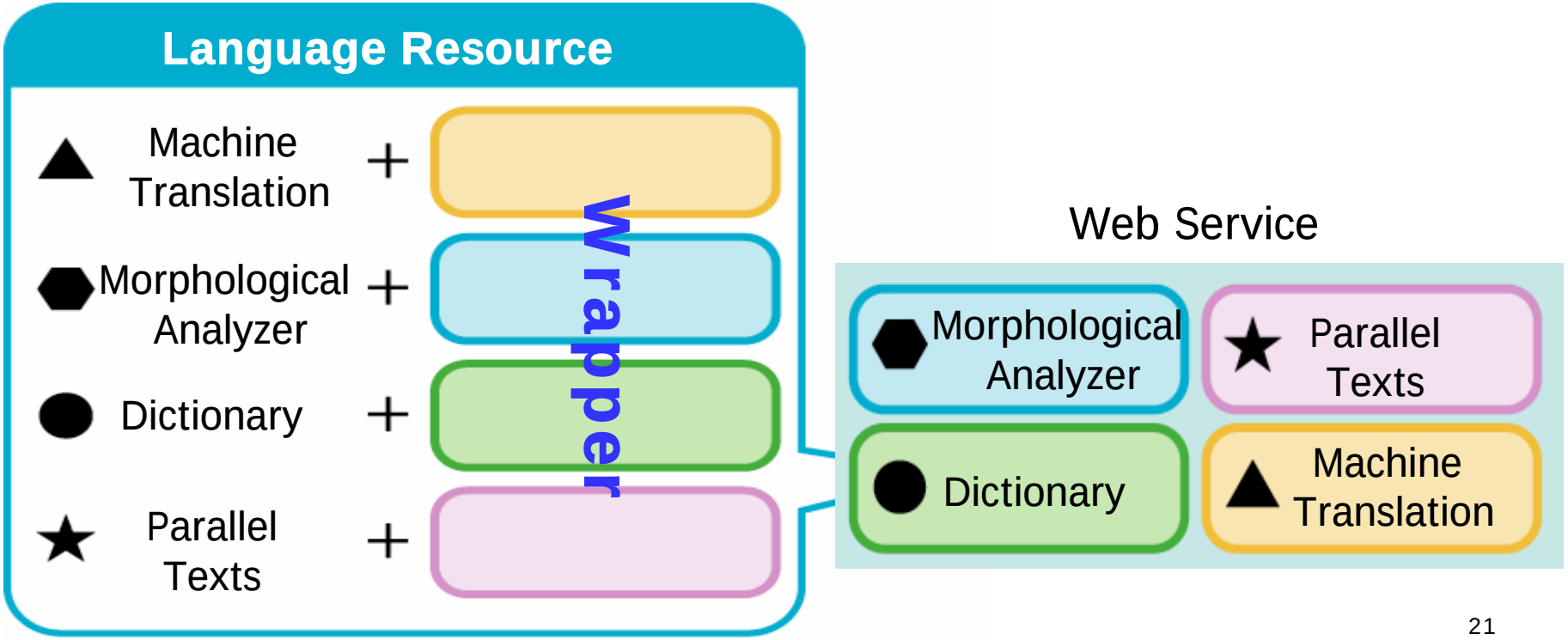


Workflow can be Complex!



3. Language Resources

Language resources are registered as Web services equipped with a standard interface based on the "language service ontology."



Now Available!

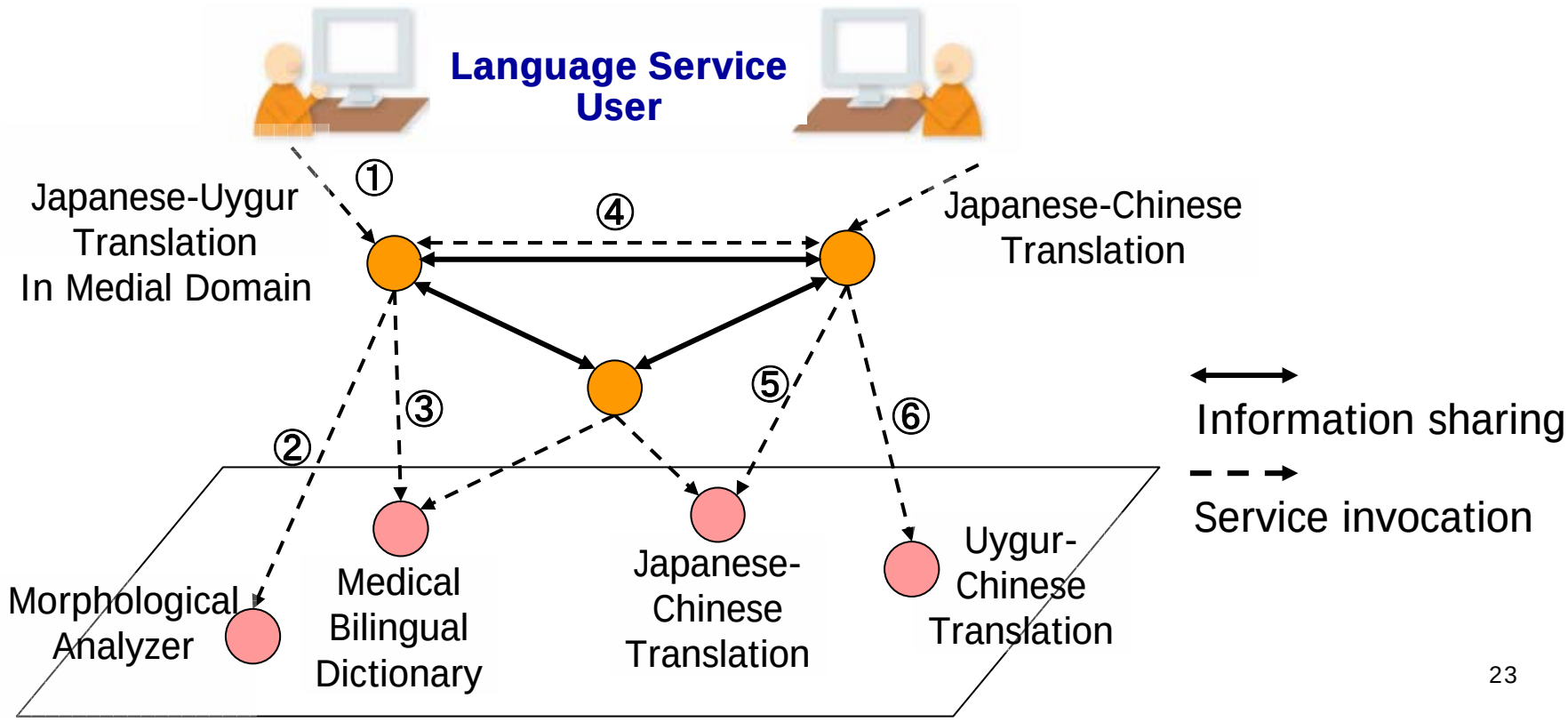
- Machine Translation
  - (Japanese, Chinese), (Japanese, Korean), (Japanese, English), (English, German), (English, Spanish), (English, French), (English, Italian), (English, Portuguese)

KODENSHA® CROSS LANGUAGE

- Morphological Analysis
  - Japanese, Chinese, Korean, English, German, Spanish, French, Italian, Bulgarian
- Bilingual Dictionary
  - Medical field: (Japanese, Chinese, Korean, English, Portuguese)
  - Disaster field: (Japanese, Chinese, English, French, Korean, Spanish, Thai)
  - IT field: (Japanese, English, Chinese)

4. P2P Grid Architecture

- Core Node: Search language resources. Control accesses to resources.
- Service Node: Provide language resources.



Research Issue 1

Language Service Ontology

Yoshihiko Hayashi and Toru Ishida. A Dictionary Model for Unifying Machine Readable Dictionaries and Computational Concept Lexicons. *International Conference on Language Resources and Evaluation (LREC-06),* pp.1-6, 2006.

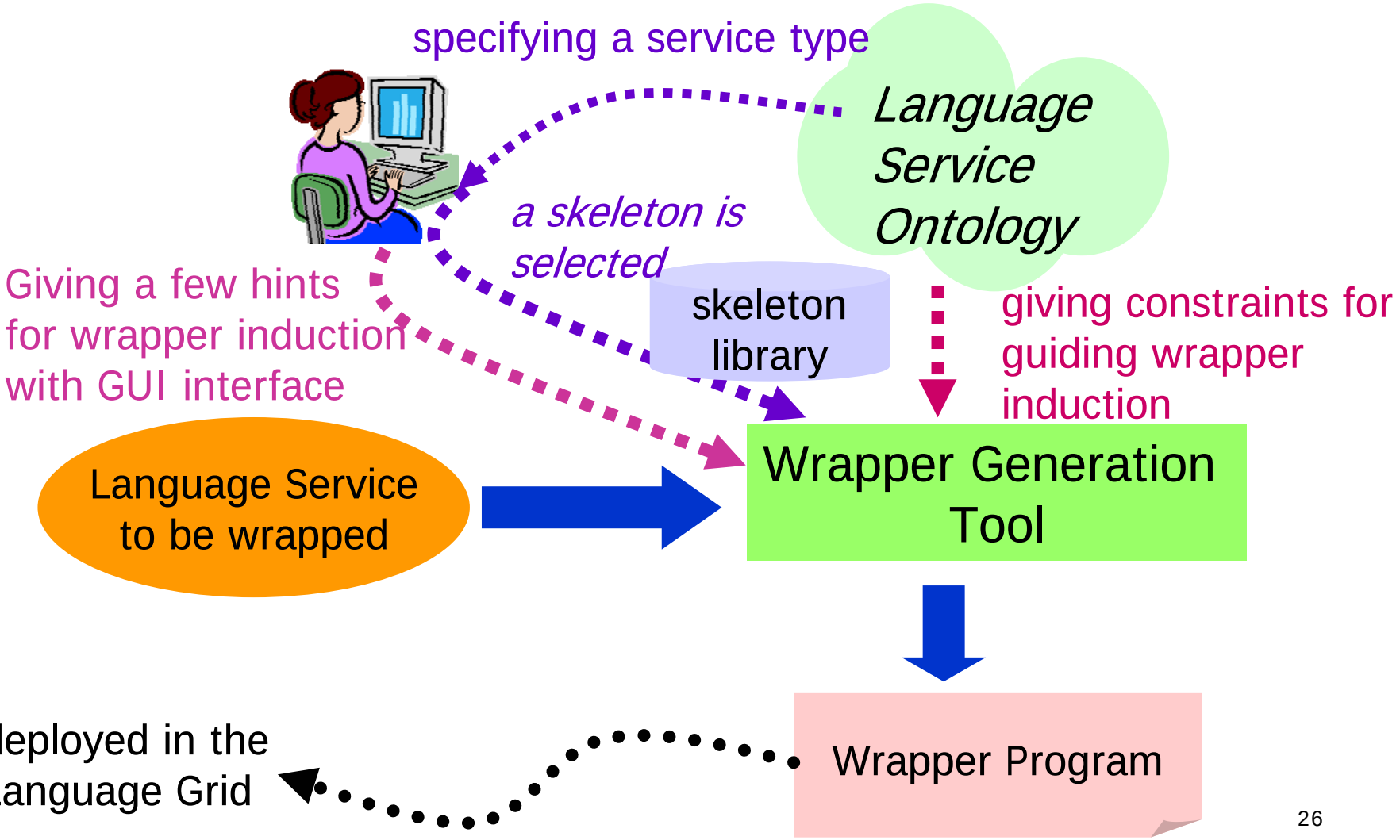
Yoshihiko Hayashi. Conceptual Framework of an Upper Ontology for Describing Linguistic Services. *International Workshop on Intercultural Collaboration (IWIC-07), Lecture Notes in Computer Science, 4568*, Springer-Verlag, 2007.

Yoshihiko Hayashi, Thierry Declerck, Paul Buitelaar, and Monica Monachini. Ontologies for a Global Language Infrastructure. *International Conference on Global Interoperability for Language Resources (ICGL),* 2008.

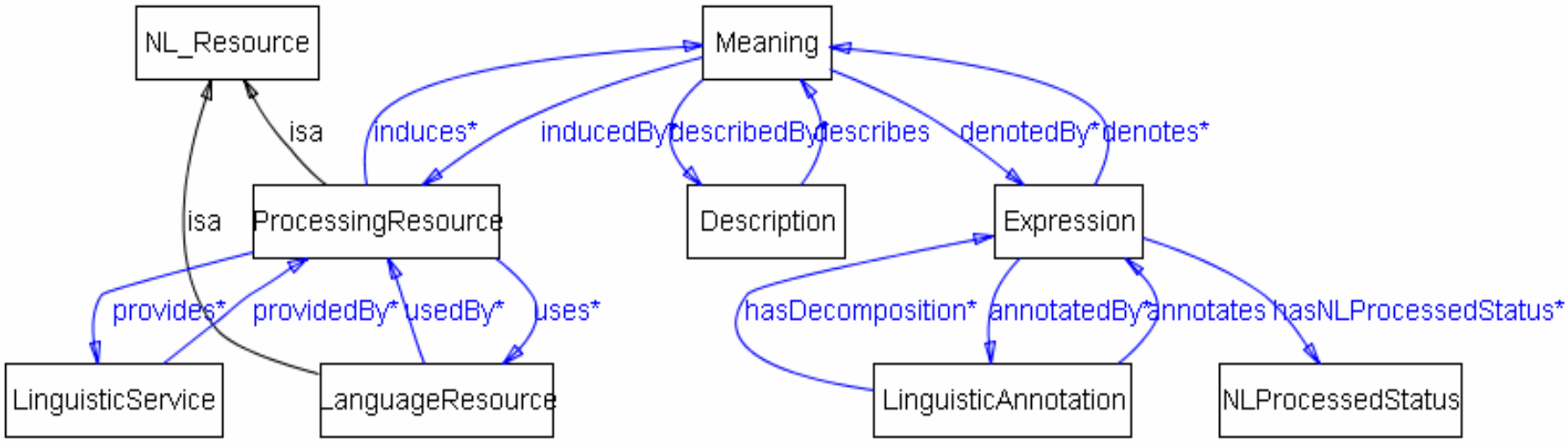
Language Service Ontology

- What is Language Service Ontology?
  - A set of formalized concepts necessary for describing elements of a variety of language services.
    - Static language resources (dictionaries, corpora, ...)
    - Algorithmic processing resources (NLP systems/tools)
    - Abstract linguistic objects (expression, meaning, description, annotation, ...).
  - It will enable wrapper program generation (Semantic Wrapping).
    - *Standard APIs* can be defined based on the ontology.
    - *Skeleton of the wrapper program* for a type of language service can be configured in advance based on the ontology-based description.

Semantic Wrapping



Sketch of the *Upper* Ontology



Future Plan:

2006~2008: Establish a strawman proposal through discussions by an international research community including DFKI (Germany), CNR-ILC (Italy), Osaka U (Japan).

2009~: Make a proposal to international standardization body such as ISO TC37/SC 4.

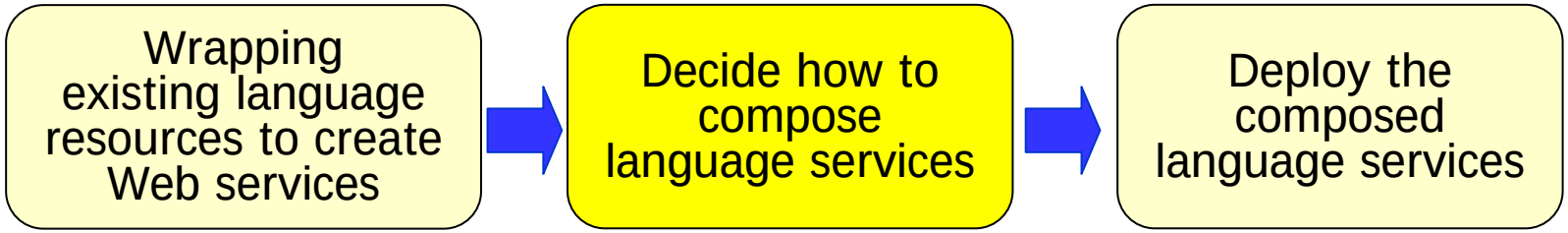
Research Issue 2

Constraint Based Web Service Composition

Ahlem Ben Hassine, Matsubara Shigeo and Toru Ishida. Constraint-based Approach for Web Service Composition. *International Semantic Web Conference (ISWC-06),* pp. 130-143, 2006.

Why Horizontal Composition?

- To realize services where users can combine machine translation, dictionary, morphological analysis, etc.



- Two composite processes
  - Vertical composition → “best” combination of abstract Web services while satisfying all existing interdependent restrictions.
  - Horizontal composition→ “best” selection of concrete Web service, from among a set of available functionally equivalent ones.
- The number of language services included in a composite service is at most six or seven. On the other hand, there are more than 100 parallel dictionaries are available in the Internet.
  - Horizontal composition is more significant than vertical composition.

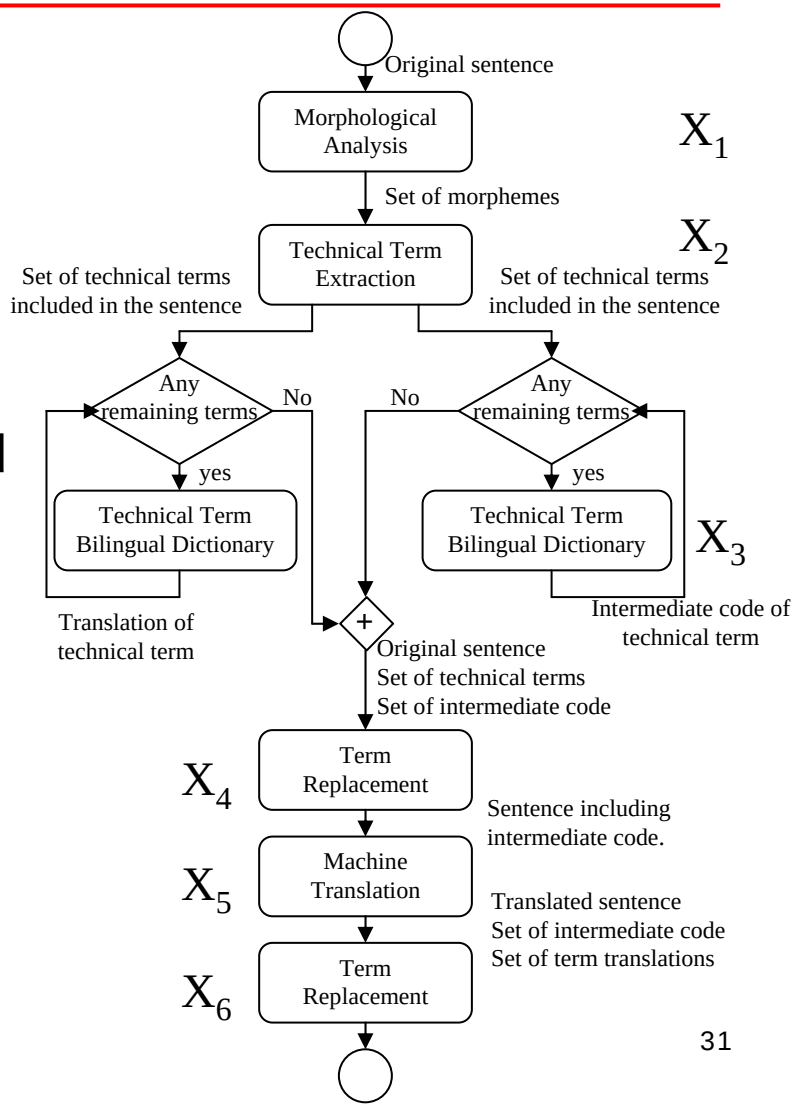
Why Constraint Optimization Problem?

- Users' preferences and constraints can be naturally represented.
- Existing algorithms on constraint optimization problems can be utilized.

- Create a constraint network from a Web service workflow.
- Control construct "Sequence"
  - Execute more than one atomic services in order.
  - Example: Invoke a Japanese-English translation service and then invoke an English-German translation service
  - Users have a variety of constraints and preferences.
- Control construct "Loop"
  - Specify iterative structure. The number of iterations is unknown at the beginning.
  - Example: REPEAT to replace technical terms to intermediate codes UNTIL the input set becomes
  - Apply a framework of dynamic constraint optimization problems.

Example Language Service Composition

- X_1: Morphological analysis
  D_1={LX-Suite, Postage-K, FreeLing, TreeTagger, HAM}
- Constraint:
  - Soft constraint: total cost
    C_1: $Cost(X_2)+Cost(X_4) \leq 100$
    ρ_{C1} denotes the penalty associated to soft constraints violation. For example,
    $\rho_{C1}=min((Cost(X_2)+Cost(X_4)-100)/100,1)$
  - Hard constraint: control construct
    C_2: X_2.morph= X_1.morph
- Objective function:
  The difference between user's preference and the penalty of violation against soft constraints.



Research Issue 3

Analysis of Machine Translation Mediated Communication

Naomi Yamashita and Toru Ishida. Automatic Prediction of Misconceptions in Multilingual Computer-Mediated Communication. *International Conference on Intelligent User Interfaces (IUI-06),* pp.62 - 69, 2006.

Naomi Yamashita and Toru Ishida. Effects of Machine Translation on Collaborative Work. *International Conference on Computer Supported Cooperative Work (CSCW-06),* pp. 515-523, 2006.

Research Question

- How do participants establish common ground using machine translation?
- Lexical Entrainment:
  When people refer repeatedly to the same object, they converge to use the same terms. (Susan E. Brennan)

  “the curved round fish with the green stripe down its back”

  “the curved round fish with the green stripe”

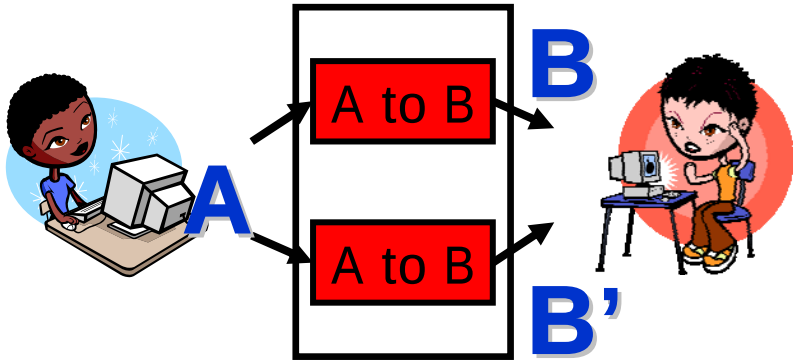
  “the curved round fish”

  :

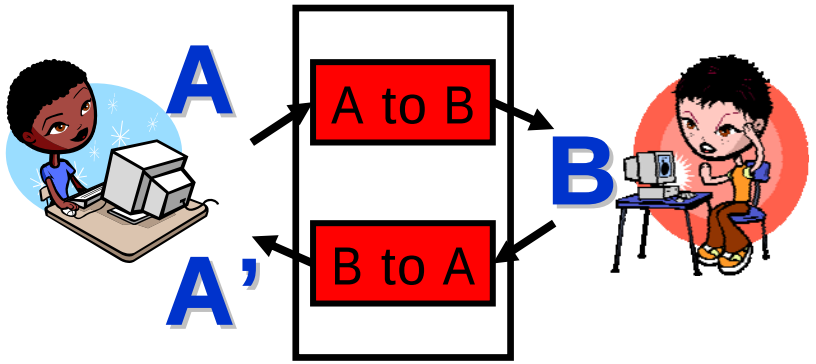
  During the process of convergence, speakers and addresses come to take the same perspective on a referent.
- If people use machine translation, can we observe the process of convergence?

Problems in Communication over MT

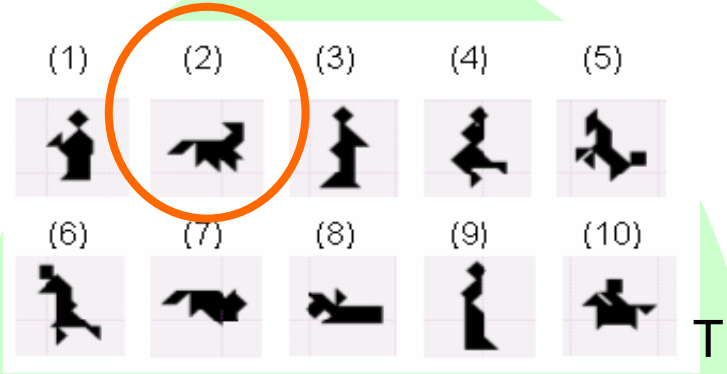
- Inconsistency
  Translations of same words in different sentences can be inconsistent.
  ← Machine translators translate each sentence separately.

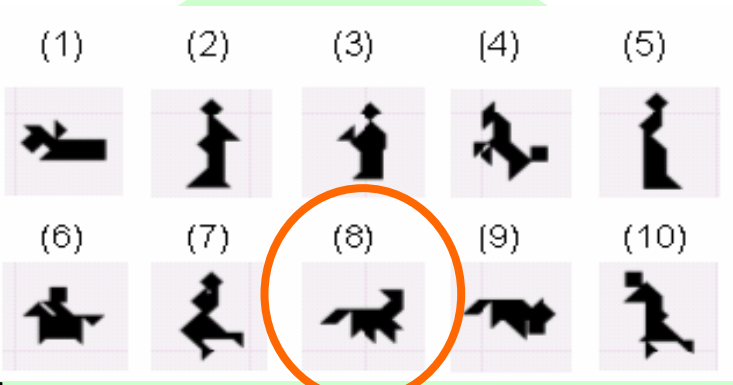


- Asymmetry
  Translations may not be transitive.
  ← A machine translator from language A to B is developed independently of a machine translator from B to A.



Controlled Experiment

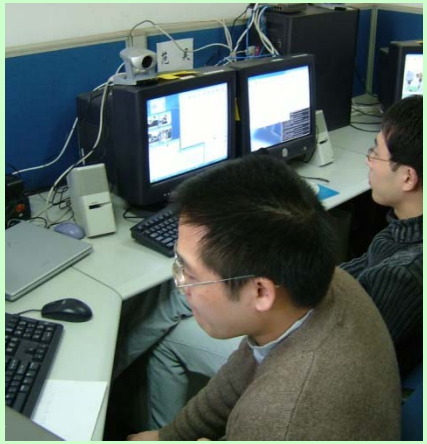




Try to match identical sets of figures

< Japan side>

Multilingual chat



< China side >

Translation Inconsistency

Japanese Screen (translated in English) <First Trial>	Chinese Screen (translated in English) <First Trial>
J: My second figure looks like an animal. J: It has four feet and a tail. C: *That's my the 9th.*	J: *My second figure is like an animal.* J: *It has four feet and a tail.* C: That's my 9th.
<Second Trial>	<Second Trial>
J: My second figure is an animal with a tail and four feet. C: *What kind of meaning and rice boy?*	J: *My role of a young handsome beau is a boy with a tail and 4 feet.* C: What do you mean? A handsome boy?

Shortening of referring expressions does not work!

Machine translation generates something quite different based on very small changes.

Translation Asymmetry

Japanese Screen (translated in English)	Chinese Screen (translated in English)
J: 1 is a dancing lady.	J: *1 is a dancing lady.*
C: *It jumped.*	C: Ok, a dancing one.
J: 3 is a person with his head down.	J: *A person looking down is 3.*

Echoing for ratification does not work!

J: *"I couldn't understand what my partner meant, so I decided to proceed with another figure, which looked easier to match."*

Summary of This Talk

- This talk is on a new language service infrastructure on the Internet
  - to combine existing language resources (machine translation, morphological analyzers, dictionaries etc.) to create customized language services, and
  - to provide those language services for non-profit activities.
- Kyoto University started operating the Language Grid from December 2007.
  - The Letter of Agreement for the Language Grid is available upon a request.
  - More than 30 organizations including CNR, DFKI, CAS, Kyoto U, and Osaka U will join the project.
  - It is our honor, if you will join the Language Grid.