Concept–based Machine Translation and Interpretation

Bärbel Ripplinger

IAI, Saarbrücken, Germany
babs@iai.uni-sb.de

1 Knowledge–based Machine Translation

Recent developments in Machine Translation (MT) systems are designed either as *transfer–based* systems or *interlingua*, also known as *knowledge–based* systems. What both approaches have in common is that the role of meaning representation plays an important role. In transfer systems this representation is distributed over the lexicons; in particular a bilingual lexicon is used to feature disambiguation information. Such an approach is for instance implemented in the EUROTRA system [Copeland *et al.* (Eds.) 1991].

In knowledge–based systems the sentence meanings are represented in a language–independent artificial formalism. As 'device' for the representation, formalisms taken from Artificial Intelligence (AI) are mostly used where the application domain can be sufficiently described.

1.1 Motivation

The idea behind knowledge–based MT is to integrate, via a domain model the extra–linguistic knowledge necessary for the disambiguation process. This information is applied to the syntactic knowledge of the source language and semantic information pertinent to the source text/sentence in order to produce a *language–independent* meaning representation, the starting point for the generation of the target language sentence.

The integration of world knowledge in the parsing process is used to constrain possible PP_attachments, to facilitate reference disambiguation and thus to minimise overgeneration. This requires careful specification of the knowledge base that describes the concepts and their relationship inherent in the application domain. The complexity should be deep enough to allow for all interpretations possible but narrow enough to rule out irrelevant interpretations.

A representation of the sentence meaning which is more or less language independent or at least language neutral, can reduce the transfer rules because compositional or structural transformations are only necessary in a few cases. The linguistic realisation (i.e. the verbalisation of conceptual meanings) is then the task of generation.

The advantage for the generation module lies in the fact that the output of the transfer component contains no syntactic structure and no lexemes, therefore this component is totally free in structural and lexical choices which leads to better quality in the target language sentence.

1.2 The Knowledge Base

In interlingua systems like KBMT–89 (cf. [Goodman/Nirenburg 1991]) the heart of the systems is built by a concept lexicon based on a model of the domain. The input sentence is analysed by an LFG–parser. As soon as the f–structure is created, a semantic interpreter applies mapping rules in order to substitute source language lexical items and syntactic structures with instances of domain concepts and conceptual relations. The result is an *interlingua text (ILT)* which is used as input for the generation component.

The power of the system depends on the expressive power of the interlingua, thus the design of the knowledge base used as interlingua is one of the most challenging tasks in such a system.

Knowledge-based systems refer to entities in the domain considered in order to specify what kinds of things exist and what their general properties are. A well–designed framework for that must take into account:

- the application domain, i.e. which concepts exist and how best to describe them, the same is true for the relations between concepts,
- the overall purpose of the system.

To represent domain knowledge, the concept of ontology has been suggested as being most appropriate for NLP. An *ontology* is, in the AI context, concerned with which categories one can usefully quantify and how those categories relate to each other. One of the following tasks adopted in NLP should be covered:

- organizing 'world knowledge',
- organizing the world/domain itself,
- organizing 'meaning' or 'semantics' of NL expressions,
- providing an interface between the domain model and the linguistic components,
- serving as interlingua in an MT system,
- supporting the construction of 'conceptual' dictionaries.

It has a potential value in relating such organisations of knowledge to linguistic system levels like grammar and lexica.

1.3 Advantages and Limitations of Concept–Based Systems

Introducing world knowledge in the translation process helps to clean up syntactic as well as semantic errors, the disambiguation of references is facilitated and the resolution of some PP_attachment problems is provided. Due to the better translation quality the post- and pre-editing is minimised.

Knowledge–based systems allow a multilingual translation because the source and the target language module interact via a language independent representation. This approach does not depend on a certain language pair, therefore other languages on the source as well as on the target side can be easily adapted.

Another advantage of knowledge–based systems lies in the fact that this approach can easily be extended to deal with texts by adding a knowledge source containing pragmatic or discourse information, knowledge about text coherence and stylistics as well as grammar roles taking this information. This kind of knowledge is mostly language independent and thus predestined to be represented in a knowledge base. The pragmatic aspects are an indispensable component of the overall meaning, dealing with speech, this information has an important role.

Due to the complexity of the knowledge base, most interlingua systems are limited to a certain application domain. A detailed analysis of the domain, monolingual as well as contrastive, is absolutely necessary in order to identify the common concepts and the conceptual mismatches. The resulting concept model should have a balanced degree of granularity to support the linguistic processing effectively. Limited to a special domain and a certain sublanguage, the ontolgy can act as a kind of control as is discussed in [Schütz 1994].

Nevertheless at the ISI within the PANGLOSS project, a knowledge base not limited to a special domain is under development. This ontology is a synthesis of PENMAN Upper Model and the ONTOS concept hierarchy which are merged manually to build the upper model of the new knowledge base. The so–called Middle Model is constructed by knowledge extracted from LDOCE and the lexical database WordNet. A detailed description of the ontology, its construction as well as the merging processes can be found in [Knight 1993] and [Knight et al. 1994] as well as in [Okumura/Hovy 1994]. Together with statistical methods knowledge, gaps which occur whilst dealing with general language texts can be effectively filled.

This point of having a large scale knowledge base handling general language is very interesting for the adaptation of a knowledge–based system to a translation system dealing with spoken dialogues. This kind of application domain is rather difficult to restrict even when speaking about a particular subject.

In the following section, the impacts of knowledge–based MT on MT systems dealing with spoken dialogues will be investigated and a proposal for an architecture will be presented.

2 Machine Translation for Speech

Machine Translation systems dealing with spoken language take over a similar function as human interpreters do by performing a kind of consecutive interpretation. But this means they should also have the same knowledge and inferencing capabilities as humans, and this is definitely not the case. Therefore we speak not about Machine Interpretation, which goes far beyond the capabilities of a machine regarding the various strategies and capabilities that human translators use, but about Machine Translation systems for spoken language or dialogues.

2.1 Knowledge Sources for Speech Translation

Machine translation systems applied to speech provide, through the interaction with a human, a richer capability than conventional MT systems do. Consequently the requirements a translation system for spoken dialogues is faced with are much harder which is also due to the fact that the whole processing is constrained by the *real time paradigm*:

- In contrast to transfer of written language which deals with whole sentences as transfer units, in spoken dialogues there are often only fragments since the primary organisation level is the classification in communicative units which are not urgently grammatically well-formed. Also hesitations, breaks, and redundancies within an utterance can hardly be tackled.
- A modification, which is typical of speech, results from the changes in the illocutionary potential of an utterance through the speaker, i.e. the speaker fits her utterance to the situation or the hearer's reaction. She expresses also her own attitude towards the proposition of her utterance.
- Speech specifies the information units incrementally. In the first step, the syntactic skeleton is built in which some argument positions are occupied by pronomina which get more specific in the successive phrases.

The first task of designing a machine translation system for speech is to identify the knowledge sources and inference mechanisms that such a system should have in order to handle the phenomena described above.

Just as in knowledge–based systems for written text, an ontology describing the concepts and their relations to the application domain is necessary. But MT systems applied for speech processing systems go one step further than systems dealing with written text, as not only does the domain have to be represented, but the interpretation process of utterances is highly dependent on information about

- the situation,
- the background information about each participant (a kind of user profile), and
- the pragmatics, i.e. how language is used.

In spoken language the hearer receives some communicatives signs, called illocutionary force, together with the propositional content of an utterance. The illocution is mainly relevant for the translation when the content is distinguished from the structure of the intention. The utterance *"We meet in the entrance hall."* is unambiguosly an assertion, i.e., the intention corresponds to the realisation. The utterance *"On Monday I'll have a conference."* can be a rejection, the limitation of a possible time interval or the reason for a rejection. Which meaning is intented depends thus on the current state of the dialogue. Disambiguating the utterance information about the possible dialogue course is necessary as well as getting information about the current situation or context. For instance, a rejection can only follow a suggestion, and the speaker must be in a position in which he is allowed to reject something.

Intentions and surface realisations have multiple correspondences, the same intention can be conveyed by various realisations, see the following examples for 'to make a proposal to meet on Monday afternoon':

- *I propose Monday afternoon.*
- *How about Monday afternoon?*
- *I can offer Monday afternoon.*
- *Is Monday afternoon possible?*

The first sentence is a direct realisation by using a performative verb, the second is a realisation by means of a conventional phrase, and the last two sentences fall under the category of so-called *indirect* proposals. *Indirectness* plays an important role in spoken dialogues, socio-linguistic differences are often expressed by indirect realisations of a certain speech event. On the other hand a large degree of indirectness also means the omission of the propositional content (for instance 'OK' as acceptance). But an explicitly phrased proposition can also require indirectness for reasons of politeness. For the translation it is thus necessary and sometimes sufficient to understand utterances on the level of indirectness. Transferring the right degree of indirectness to the target side improves the quality of the translation by being more fluent.

As the few examples above show, the translation of on utterance can not be limited either on the propositional content or the pragmatic information. To convey correctly the speaker's intention it is necessary to consider both. To this end the translation component in an MT system dealing with speech must take into account pragmatic information in a higher degree than MT systems for written text do. In written texts (not written dialogues) there is no possibility for the author to manipulate the intention behind a sentence with prosodic information or indirectness.

2.2 A Potential Architecture for a Speech Translation System

There are only a few MT systems dealing with spoken language. In Europe besides the new project VERBMOBIL there is only one other system. SLT an English-to-Swedish MT project under way at SICST. But the translation component of this system does not take into account any pragmatic information, only the propositional content is considered and translated (cf. [Gambäck/Bretan 1994]). Systems which are of more interest for our purpose are/were under development in Japan, in particular the systems NADINE and ASURA briefly described below.

2.2.1 Related Work

[Kogure/Kume/Iida 1990] propose an intentional translation method based on a semantic transfer approach. There are two different translation processes: one extracts intentions in utterances and the other transfers the propositional content. Both representations are translated separately.

The propositional content is represented by recursively defined relationships in terms of source language concepts. These concepts will be converted in target language concepts during transfer. The information about the intention which is more or less language-independent is simply conveyed through to generation. This kind of architecture was applied within an experiment with the spoken language MT system NADINE to translate Japanese utterances into English.

In another speech-to-speech translation system, ASURA, a project currently under development at ATR, the translation component for the Japanese-German module works on feature structures produced by an analysis module. These structures are close to the source utterance and contain source language symbols. The transfer provides a modified feature structure containing target language symbols which are then transformed by a generation module to a target language string. The architecture of the translation component itself looks as follows:

There are three main phases:

- *Pre-transfer* must do among other functions:
  - recognise illocutionary acts
  - assign values for pragmatic factors like politeness.
- *Main-transfer* replaces source language symbols by target language symbols.
- *Post-transfer*
  - performs various structural adjustments,
  - supplies indications of time and aspect,
  - and makes some word sense disambiguation.

The transfer in ASURA is defined in a broad sense: pre- and post-transfer do tasks which might belong to syntactic analysis or generation. Operating on concepts makes transfer rules for syntactical structures (i.e. compositional transfer) unnecessary and reduces the translation step proper to a simple mapping process (source to target language concept) (cf. [Seligman et al. 1993]).

In both systems the translation component works on language dependent concepts; the transfer can obviously be further minimised by operating on language independent representations. We therefore propose the following architecture for an MT system for spoken dialogues.

2.2.2 The Translation Component

The architecture proposed in the following is exemplified in the VERBMOBIL project[1], a long-term project on the translation of spoken dialogues in a face-to-face situation (cf. [Wahlster 1993]). It is applied to the domain of negotiation dialogues for appointment scheduling. The long term goal of the project should be a portable translation device which can be used in conferences with speakers of different foreign languages. The VERBMOBIL translates on demand, unknown words or phrases in the dialogue language which is English. This requires at least a passive knowledge of English by each participant. In the current phase a module for German-English is under development, in a next step a Japanese-English module will be provided.

The overall system architecture for such a speech translation system consists of a speech recogniser, an analysis module - syntax and semantic analysis - which provides as output a semantic structure enriched already with pragmatic information and in an ideal case also with sort/concept information for the semantic relations. The translation module operates on this structure. The output will be a conceptual representation of the complete utterance meaning. The generation module transforms that conceptual structure under consideration of the provided pragmatic information in a target language string which is then vocalised by a speech synthesiser.

The current architecture of VERBMOBIL as described in figure 19 - 1 can be classified as sequential. The sequential architecture has been selected for a demonstrator implementation and will be substituted by a more complex one for the research prototype.

[1] VERBMOBIL is sponsored by the German Ministry of Research and Technology.

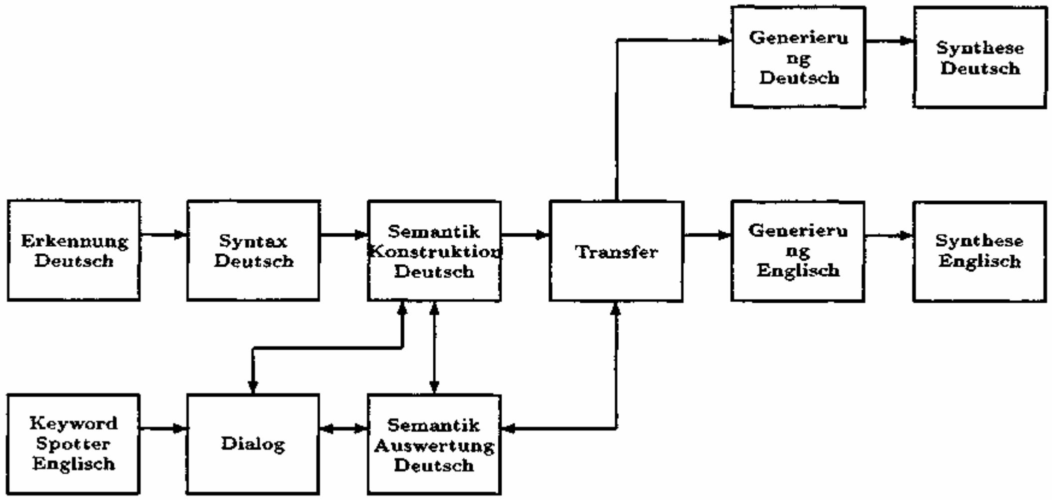

Figure 19 - 1 The VERBMOBIL Architecture for the First Phase

This architecture also has some impact on the translation component wrt. the translation depth. Within such an architecture, a translation directly on syntactic structures is impossible because the translation component gets its input from Semantic Construction and only has the possibility to call the Semantic Evaluation component in order to get more disambiguation information. Therefore a concept–based approach as described below is most appropriate because the syntactic structure necessary is reduced to a minimum.

The Ontology

The architecture proposed here operates on a semantic representation with a limited access to syntactic information. The central role is due to an ontology consisting of an upper model (the sorts) which is mainly used by the semantic component. But the syntactic processing could use this sort of information to control the parsing process. The sorts of the upper model are relatively underspecified; they provide only a rough information about the core concepts and relations of the application domain.

The other part of the ontology consists of the *domain model*, a concept hierarchy which is based on a contrastive analysis of the domain. Source and target language are compared on the basis of the concepts underlying the linguistic realisation of the utterance. The resulted concept hierarchy contains then concepts which are common for both languages, and is therefore a *language independent* representation of the domain. The way this concept hierarchy is really independent of any language can be proved by adding a further language which belongs ideally to another cultural system. It is not only the concepts, but also the relations between them that are relevant for the application domain represented. In order to show the multidimensionality of a concept represented by different relations from and to this concept, the ontology is not only organised along an *is_a*–hierarchy; also other types of relations like *part_of, contained_in* etc. are used for the overall organisation. The resulting structure is then a graph and not necessarily a tree. Consequently, the inference mechanisms are more complex.

The domain model contains concepts and relations which allow all the meaning interpretations applicable in the current domain. But the basis of the ontology is a contrastive analysis and may not be a detailed investigation of the domain itself. This has some impacts on the completeness of the knowledge base. Gaps in the ontology can lead to bad results by translating slightly different new texts also dealing with the same subject field. On the other hand, spoken dialogues can often not be restricted to a special domain. Speakers tend to use general language, for instance to give the reason for a rejection of a proposal to meet on Monday like *"Monday afternoon is impossible; there's my Grandmother's birthday."*, *"Monday at 10 o'clock I have a rendez-vous at the dentist's."* or *"According to my horoscope, Monday is not good to meet."* Looking at these few examples, the integration of a large knowledge base for general language as is done in the PANGLOSS project should be taken into account, at least as a long term goal.

A further task of the translation component consists of the formulation of selectional restrictions which can be also represented on the conceptual level. For instance *anbieten* can be translated in one context as *offer* (To offer someone a coffee) and in a formal situation as *tender* (The minister has tendered his resignation.). However, some of these restrictions denote a language dependent aspect by determining only the linguistic realisation in a certain language. The selection of the right preposition is one of such cases. The following examples[2] should clarify this point:

1. *im Haus → in the house*
2. *nach Hamburg → to Hamburg*
   nach 12 Uhr → after 12 o'clock

In the first case the preposition is not ambiguous; in the second there is a difference between German and English: In German the preposition is the same for locations and temporals. In English one has to differentiate between *to + location* and *after + temporal.* Integrating these language dependent differences in the conceptual hierarchy could weaken the language independence of the representation. To circumvent this the information inherent in the selectional restriction should be stored outside of the conceptual hierarchy. A mapping table which also contains the links from the source language lexemes/phrases to the corresponding concepts and the links from the concepts to the target language lexemes/phrases can be used for the management of such selectional restrictions. Alternatively this information can be stored as well in the lexicons.

The speech events[3] are also described as part of the domain model. Besides a set of general speech events like ASSERT, INFORM, QUESTION ... we define a set of domain dependent speech events like EXPLANATION, PROPOSAL, REJECTION .... These speech events are described as concepts in the domain model. Also some relations between these events can be described (The EXPLANATION speech act is always realised by ASSERT.). The information relevant for the translation will be provided in the pragmatic part of the semantic structure. As transfer relevant we consider

- The realisation, i.e. direct via performative verb or indirect by focusing on the context.
- The perspective, i.e. speaker, hearer, both, or neutral.
- The modification of the speech event. i.e. weak, neutral, intensified, or categorial[4]

The ontology used in VERBMOBIL is based on a contrastive analysis (german–English) of some negotiation dialogues, and is described in [Quantz et al. 1994]. It contains also a

[2] I'm grateful to Rita Nübel for the examples and the discussion.

[3] We speak here about speech event types because we do not want to refer to the speech acts defined by Searle. The set of speech acts we use are highly domain dependent.

[4] This classification is provisional and can be extended if necessary.

subhierarchy for speech event types.

Additional to the extended domain model a stack administering the dialogue course, participant profiles (which language, which culture, which kinds of social relations, etc) and a tool that fixes which speech event can succeed another to compute heuristics about the possible next speech event type are also useful information sources for an MT system dealing with spoken dialogue. These are partly realised in the Dialogue component of VERBMOBIL.

```
(phrase_s &
  sem:(sem_t &
        lambda:[] &
         ind:(D &
                named_var &
                sort:ZUSTAND) &
          drs:(drs_t &
                dom:[] &
                conds:[(ynq_expr &
                         ynq_arg:(drs_t &
                                   dom:[(marker &
                                          ref:D)] &
                                   conds:[(modal_expr &
                                            modal_op:poss &
                                            modal_inst:D &
                                            modal_arg:(drs_t &
                                                        dom:[(marker &
                                                               ref:(E &
                                                                     named_var &
                                                                     sort:EREIGNIS))] &
                                                        conds:[(alfa_expr &
                                                                 alfa_arg:(F &
                                                                            named_var &
                                                                            sort:ZEIT) &
                                                                 alfa_restr:(drs_t &
                                                                              dom:[(marker &
                                                                                     ref:F)] &
                                                                              conds:[(basic_cond &
                                                                                       pred:oktober &
                                                                                       pred_concept:!(MONAT) &
                                                                                       inst:F &
                                                                                       args:[])])),
                                                                (basic_cond &
                                                                 pred:in &
                                                                 pred_concept:!(IN_TIME_C) &
                                                                 inst:named_var &
                                                                 args:[(arg_roles &
                                                                         arg:F &
                                                                         role:theme)]),
                                                                (eps_expr &
                                                                 eps_arg:E)]))]))]) &
          quants:[] &
          anchors:[]) &

      prag:(illoc:PROPOSAL:(realisation:CONVENTION)&
             perspective:neutral&
             tone:neutral))
```

Figure 19 - 2 DRS for *"Wie wäre es im Oktober?"*

The Translation Method

It is assumed that the input structure is a semantic representation of the source utterance already associated with pragmatic information such as the speech event type like ASSERT, PROPOSAL ... and conceptual sort information[5]. The input in the translation in the VERBMOBIL translation component consists of a DRS or a sequence of DRSs enriched with pragmatic information. To be short a DRS is a data structure containing a number of objects represented in terms of semantic sorts and relations between these sorts.

In figure 19 - 2 one can find as an example the DRS for the sentence *"Wie wäre es im Oktober?"* (What about October). A detailed description of the semantic formalism is given in [Bos et al. 1994] and [McGlashan 1994].

For the translation the fact that the DRS already has some concept information is of some importance and that the semantic evaluation component has added the pragmatic information; i.e. the so-called *prag-feature* contains the concept for the current speech event and some realisation information (indirect, performative verb etc.) as well as information about the perspective.

In a first step, the translation component checks if the sorts associated with the semantic relationships are sufficient for the translation or not. If they are sufficient the conceptual structure together with the pragmatic information is passed through to generation. In case the sorts do not provide enough information for a correct translation, an inference mechanism over the domain model is called in order to compute the right concepts which are then more specific than the sorts given originally in the structure. Which concept with which specification degree is selected depends not only on the results of the contrastive analysis but also on the granularity of the conceptual description level used in the domain model. As to how such inferencing works, i.e. how the traversing of the domain model to find the right concept is controlled, is ongoing research.

In a second step the sorts in the semantic representation will be overwritten by the new concepts and the conceptual structure is equally passed through to generation.

In the sample sentence (cf. figure 19 - 2) the sorts have a sufficient specification degree. Because the output DRSs are very close to the German surface of the input sentence, some structural changes have to be carried out in order to come to an English target DRS. In the example, for instance, the part of the structure describing the preposition *in* has to be removed. In an ideal case the semantic structure is language neutral; this means no surface structure of the source utterance is reflected.

The pragmatic information is in principle language independent as already mentioned before. The speech event concepts contained in the pragmatic part are passed through to the generation module generally without any transformation or change. It is the task of the generation to select the appropriate linguistic realisation of the speech event type in the target language. This realisation is sometimes different from the one on the source side, German particles, for instance, do not always have an English equivalent. Also the level of politeness must be fitted to the target language requirements. In such cases the translation component can change information in the pragmatic part of the structure or this may also be due to the generation module.

The following example should show these advantages:
For the German utterance *"Wie wäre es im Oktober?"*, the possible translations are

[5] If this is not the case an interpreter similar to that used in knowledge-based systems like KBMT, which maps the sort information to the semantic relationships, is necessary.

1. I would propose October.
2. Is it possible in October?
3. How about October?

The DRS provided by the semantic component, only 2) and 3) are possible translations. Regarding the pragmatic information 3) would be the best translation, because the German conventional phrase *"Wie wäre es mit"* is translated by the corresponding English phrase *"How about"*. Together with the information provided by the modality operator of the semantic formalism, our method can translate the German sentence above in exactly this English one given in 3). Of course, this means a sharp tuning with generation.

This translation approach means a bigger task for the generation component. Because no syntactic information and only some speech event knowledge is transferred, the generation is completely responsible for the syntactic realisation of the target utterance.

Until now, only cases were considered where a common concept for both languages exists. But not all source language concepts have a correspondence each in the target language. In the following some of these *mismatches* are classified and a methodology is described to handle them.

Mismatches

In [Schütz 1994], a classification, for conceptual mismatches occurring in the translation process, which is based on a conceptual representation, is given. The following possibilities are distinguished:

- Inclusion,
- Overlapping,
- No co-incidence.

Inclusion means that a concept has some meanings in one language but not in another language; *overlapping* of concept meanings can be described as the intersection of the concept meanings in one and in another language; and *no co-incidence* means a "real" mismatch, i.e. a concept meaning exists only in one language.

The conceptual mismatches can also be classified according to their source, the following classes are identified:

- Cultural mismatches
- Register mismatches
- Structural mismatches

Cultural mismatches are often temporary because the concepts belong to a new subject field which exists first only in a particular culture before it is adapted by others. An example is the field of *Virtual Reality*, in English there exist a lot of concepts for new tools like *earphone, speaktacles etc.* which do not yet exist in German. But it is only a question of time before these concepts will equally exist in German. An example for a 'solved' mismatch is *zapping*, a term of the TV culture. It did not exist for years in Germany but with the introduction of various new channels, zapping is now also a known concept.

Due to the different cultures there are a set of mismatches which are as permanent as those described by [Kameyama et al. 1991]. For instance in Japanese there is no concept for *picture* but a more specific concept including paintings and drawings but not photographs. Another cultural mismatch comes from the fact that public holidays differ from one country to another, for instance the German *Allerheiligen* is not a holiday in England.

Register mismatches consist of mismatches in politeness or the use of special speech event types. Consider the following example: The utterance *"Könnten Sie vielleicht (auch) am Donnerstag"* is a polite question about whether it is possible to change a date for a meeting. In German the use of subjunctive, the sentence mood "question", and the adverb "vielleicht" is sufficient to make a polite proposal for another date. The possible translation *"Sorry, but can you make it also on Thursday"* can be a correct translation but instead of using subjunctive a marker of excuse (" sorry") is added. The degree of politeness is caught by a change of the speech event type. These kinds of mismatches which are a kind of type shifting are still under investigation. But register mismatches related to politeness play an important role if the translation component has to deal with Japanese as source or target language. In the first case the degree of politeness has to decrease for a translation in German or English and in the second case it has to be increased.

This adaption of politeness degree and speech event changes (from a simple question to an excuse) make the translation fluent. However, for an MT system this is due to impossible since such translation quality demands on huge knowledge bases containing cultural information and a deep analysis of language use in different situations and various social relations between the dialogue participants.

Under "structural mismatches" we do not understand cases like the German *"sich verwählen* and the English *"to dial the wrong number"*, rather cases in which concepts in one language do not exist in the same way in another language. For instance, the German *"Schwarzfahren, Schwarzarbeit, Schwarzmarkt ... "* means travelling without ticket, illicit work or black market and exactly in this way the word/concept has to be translated because no special concept for *Schwarz-xx* exists in either English or French. To express this on a conceptual level in these language as well a kind of concept composition has to be carried out. The problems lies then in the selection of the criteria for the composition, i.e. which relations can be considered as relevent. This is ongoing work.

The question is now how to tackle these kinds of mismatches in a translation system. In cases where a more specific or a less specific, i.e. a superconcept, exists, this will be selected by an inference process. In cases of register mismatches, the integration of detailed pragmatic information in the knowledge base and appropriate rules in the generation component can help to overcome some of these types of mismatches. For the third class of conceptual mismatches the translation component has to provide a new structure, i.e. a kind of compositional transfer on conceptual strucutres has to be carried out. This requires the formulation of explicit transfer rules.

In the current VERBMOBIL implementation mismatches are tackled by explicit transfer rules. As a result of the contrastive analysis, the possible mismatches are identified and can be treated by explicit transfer rules formulated over the whole SIGN–structure. The result will be an English target DRS representing the meaning of the source utterance by concepts.

For further treatment of mismatches which can be solved already in the semantic component see [McGlashan 1994].

3 Conclusion

The translation architecture proposed here can be described as "distributed transfer" because some tasks can also be done by the semantic or generation module. A clear separation which module does what is necessary to take the full advantage of this approach. This is more important for the sequential VERBMOBIL architecture because the interaction between the different components is restricted and clear interfaces must be defined. But this translation method avoids unnecessary transfer, reduces the number of explicit transfer rules and by using a domain model containing pragmatic information the advantages of knowledge-based MT, high quality translation, multilingual application etc., are kept for the MT system for spoken dialogues. The quality of translation plays an important role because in a system like VERBMOBIL there is no possibility for pre- or postediting.

This approach is highly appropriate for real time processing because the translation is restricted to these cases (i.e. occurence of mismatches) where an explicit transfer is necessary. Due to the fact that the inference mechanisms which could be useful to solve mismatches are not yet fully elaborated, in VERBMOBIL explicit transfer rules are applied.

The separation between proposition and pragmatics provides a kind of *fall*-back, i.e. if the propositon can be translated for any reason, maybe at least the speech event type (if it is unambiguous) can be realised; and vice versa if the speech event type can be determined, the translation of the proposition can be provided. Also incomplete or defective input sentences which can be translated by exploiting the domain model for missing concepts.

Due to the fact that human users are directly involved, an defective translation has not the same bad impacts as it has by dealing with written text. The hearer can always fit her reaction to the translated speaker's utterance, she can ask to resolve unclearness at once. This is the same way humans behave in dialogues even in situations where a human interpreter is involved unclear aspects are questioned.

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