

***"Please Tell Me Briefly the Reason for Your Call"***

***Understanding Natural Language Call Routing***

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A new breed of commercial speech technology has emerged that combines language understanding with natural language speech recognition to create an intelligent call router. This new speech technology enables callers to request what they want in their own words, understands what they need, and routes them accordingly. Using statistical grammars and topic identification models, natural language routing improves routing accuracy and shortens the time it takes customers to get the service they need. The result is happier customers, a more efficient use of resources and reduced operating expense. Unlike most natural language call routers, which have a marginal business case, this *intelligent* call routing technology has a typical payback period of 6-12 months.

***Speech and Language Processing in the Contact Center***

Speech and language processing technologies can bring improvements to the Customer Contact Center (CCC) wherever customers use words -- spoken or written -- to communicate, as shown in Figure 1. The left side of the figure shows the communication among customers, agents and automated systems in the CCC. Here speech recognition turns the audio signal into words and language technology uses what the customer said (or wrote in the case of email) to connect them to the right agent or to respond to their email automatically. For the CCC, these technologies save agent labor, reducing overall cost or freeing up the agents for revenue-generating activities. For the customer, the technologies offer the opportunity to use their own words to say what they want and receive quicker and more accurate solutions.

On the right hand side of Figure 1 is the Enterprise, where managers of contact centers and business units need to know more about their customers in order to improve businesses practices. Speech and language technologies can provide a window into all of the communication that's going on in the CCC. Filtering and Prioritizing technologies

can select the most important messages for recording and review, making the most of managers' time. Quality Assurance (QA) can be aimed at the real problems: agents who need more training or customers who aren't getting their problems resolved. Data mining can use the content of the call to group all of the customers who have the same problems or bought the same products, and identify problems in customer service, trends in customer needs and interests, or new opportunities for product offerings.

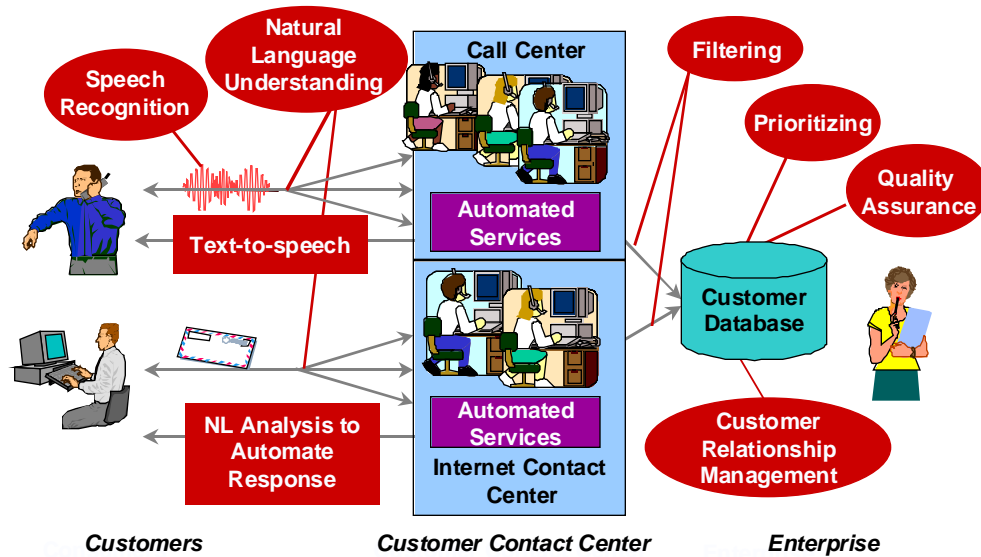


Figure 1. Speech and language processing in the customer contact center.

### ***The Routing Problem in Call Centers***

Call centers typically employ a complex hierarchy of touch-tone menus to provide self-service in the IVR or to enable skills-based routing. Skills-based routing attempts to match the caller to a customer service agent who has the skill set to handle their request. Ideally, it allows the call center to save on training costs while improving customer service. When it works well, customers are connected to someone who has the skills to help them.

However, as menu complexity increases, IVR usage decreases because callers become frustrated, and routing mistakes increase because of caller confusion. The enterprise can benefit substantially by increasing usage of the IVR and decreasing routing mistakes, in turn decreasing the amount of time that agents have to spend on each call. The less time agents spend on tasks that could be automated in the IVR, the more time they have to perform important revenue-generating functions such as sales.

In our assessment of a call center for a large wireless telecommunications service provider, we looked at how effectively their complex menu hierarchy routed their customers. Our end-to-end analysis of calls showed that 25% of all calls were routed to specialists, but only 80% of these –20% overall – went to the correct specialist. Callers misrouted themselves at one of four menu layers because they could not determine which touch-tone option best matched their question. When a mistake is made, the process typically ends because the caller hangs up out of frustration or waits for the customer service agent.

Natural language call routing helps to solve these problems by cutting through the tangle of call flow options and letting callers state their purpose in their own words. As Figure 2 illustrates, what once took many layers of sub-menus with touch-tones can be handled by a single open-ended prompt using natural language call routing.

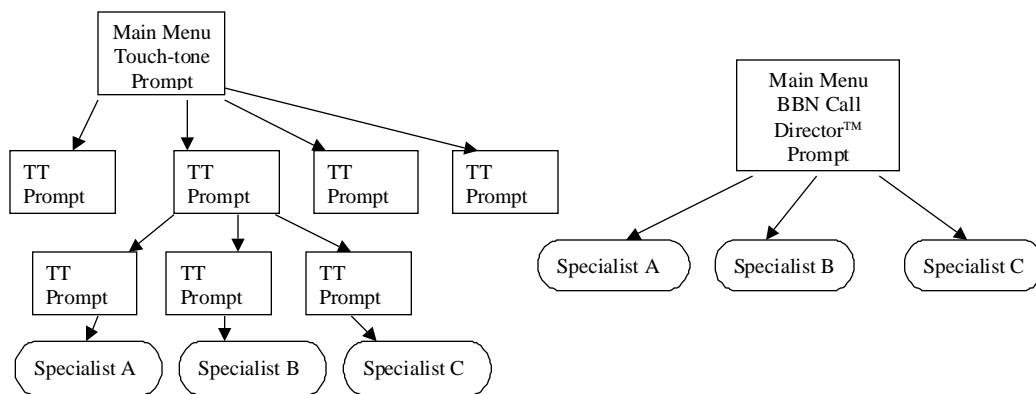


Figure 2. Routing with hierarchical touch-tone menus vs. natural language call routing.

Although research has explored natural language call routing for several years, only recently has its performance risen to a point that makes it a viable alternative to complex touch-tone menu hierarchies. Table 1 summarizes the benefits of natural language call routing vs. touch-tone menus.

Table 1. Benefits of natural language call routing vs. touch-tone menus.

<b>Touch-tone Menus</b>	<b>Natural Language Call Router</b>
Long prompts Difficult to identify choice that matches caller's problem Multiple menu layers if more than five routing destinations	Lets caller express problem in own words Language Understanding Technology figures out the reason for the call Much faster routing More user friendly More cost effective

### ***The Natural Language Call Router***

With BBN Call Director , a state-of-the-art natural language call router illustrated in Figure 3, the caller is greeted with the open-ended prompt, "Please tell me, briefly, the reason for your call today." Our research has shown that this prompt is the most effective at eliciting useful responses. Callers may then respond in their own words. Speech recognition transforms the spoken response into a sequence of words. The language understanding engine then uses statistically-based topic identification technology to determine the reason for the call from the sequence of recognized words. Finally, the IVR router transfers the call to an area of the IVR where the caller can self-serve, or to a customer service agent. In cases where the system is not sufficiently confident of the topic, the caller will hear a directed re-prompt that lists the available options. This style of re-prompting guides the caller to an acceptable response and increases the overall routing accuracy.

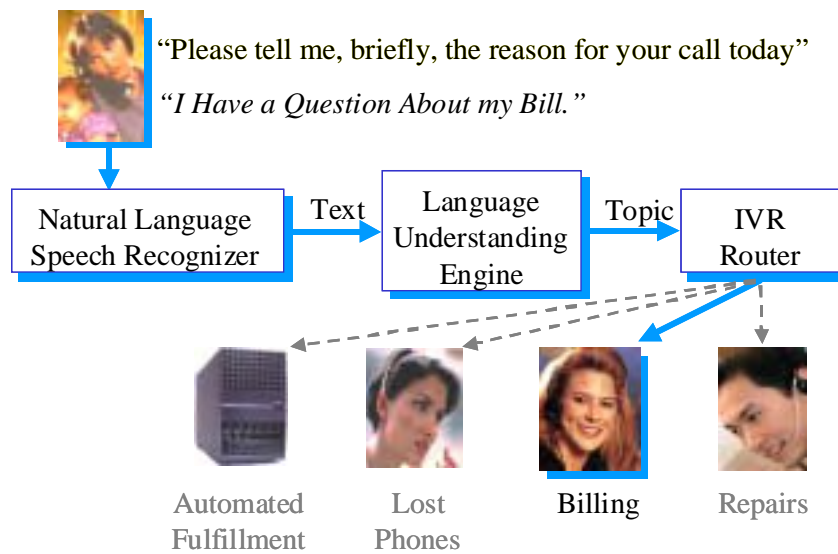


Figure 3. Architecture of a natural language call router.

### ***Deploying a Natural Language Call Router***

Deploying a natural language call router on a production IVR is a well-defined process. Configuration and installation generally proceed in four steps:

1. First, the topics that will form the basis for routing calls in the call center are identified and defined. These topics should cover the range of reasons why customers call the center. Typically, each topic should receive at least 2% of caller traffic; any topic receiving less than this should go to a general agent.
2. Second, responses to an open-ended routing prompt must be collected from real customers. This can be done with a "Wizard-of-Oz" system, in which customer service agents listen to and route the calls, using pre-recorded prompts to guide the callers. This gives callers a simulated experience of a natural language call router without any actual investment in speech recognition technology. The customers' responses are recorded for later analysis.
3. Third, the customer responses collected in step 2 are transcribed and annotated with the correct routing topic.
4. Finally, using the annotated data, the speech recognition and the topic identification models are trained to correctly classify caller responses to the initial prompt. The output of this step forms the initial configuration for the natural language call router.

With the completion of steps 1 through 4, the call router can be deployed on a production IVR platform. Aside from replacing the touch-tone routing menus with the natural language call router, the call flows remain unchanged.

As with regular touch-tone IVR applications, a natural language call router requires periodic updates. This ensures optimal call center performance as new products or features are introduced. Updating a natural language call router follows a process similar to that used during the initial configuration stage. The open-ended prompt remains unchanged. When new topics arise, a sufficient number of caller inquiries about the new topics must be collected. The calls are transcribed and annotated with the correct routing topic. Before the call router can confidently recognize and route the new topics, the speech recognition and topic identification models are retrained to arrive at an optimally tuned configuration. The additional training can be done in the normal course of operation.

### ***Field Trial Results***

Results from a recent trial at a large customer contact center show that natural language call routing delivers significant improvements over touch-tone menus, both in terms of customer satisfaction and agent labor savings. Over the course of seven weeks, more than 10,000 callers experienced the BBN Call Director and were asked for their feedback. An overwhelming 82% said that they preferred describing their problem with words to navigating touch-tone menus. Most said that they preferred it because it was easier, more natural, and more efficient to use than touch-tone menus. Many liked the fact that it took less time to get to a customer service agent. Others liked it because they could get routed totally hands-free.

Along with customer survey responses, we collected statistics on the paths callers took through the call flow as well as on the callers' spoken responses. We then analyzed the data to evaluate the performance of the system. The analysis showed the natural language call router met or exceeded all expectations. Overall, the number of successful routes in the IVR increased by a factor of three over the original touch-tone system. After accounting for the part of the gain that could be attributed to call-flow redesign, the speech-enabled call router practically doubled the effectiveness of the IVR.

The natural language call router delivered significant operational cost savings, as shown in Figure 4. During the trial, the level of automation achieved by the natural

language call router was determined through a call center automation assessment<sup>1</sup>. We distinguish three automation categories: (1) correct routing to fulfillment service, such as a specialist agent; (2) information delivered to the user, such as account balances; and (3), information captured from the user, such as account number. Compared with the baseline measured for this call center, the natural language call router nearly doubled the automation benefit. This corresponds to millions of dollars per year in annual cost savings for the call center, which handles 15 million calls per year. A typical payback period for the required investment in hardware and software to deploy a natural language call router is 6-12 months.

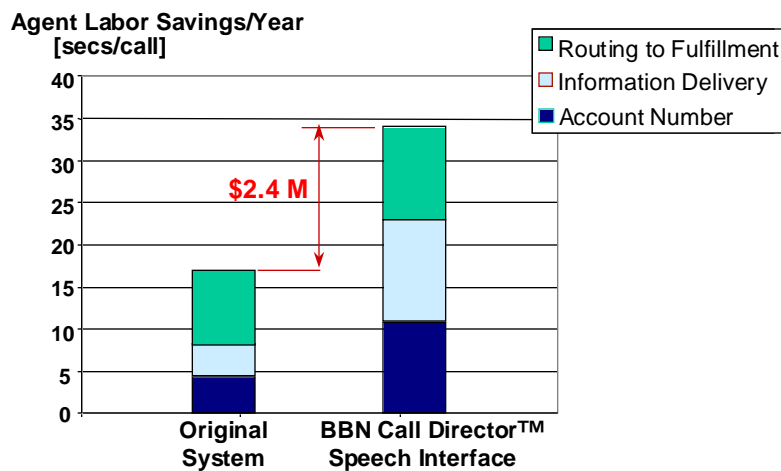


Figure 4. In a recent field trial, BBN Call Director doubled the benefit of the IVR, in terms of agent labor savings, over the original touch-tone implementation.

### ***Performance makes a difference***

To reap the benefits of a natural language call router, accuracy is crucial. BBN Call Director uses statistical models both for speech recognition and language understanding. An ordinary natural language recognizer (without the language understanding component) can be used alone to identify the topics for routing; however, this requires phrase-based grammars that must be individually constructed by experts, and the caller must match the prescribed words exactly. In contrast, with BBN Call Director the speech recognizer looks at the statistical relationship between the callers

<sup>1</sup> B. Suhm, D. McCarthy and P. Peterson, "Maximizing Benefit while Minimizing Risk in Speech-Enabling Call Centers", to be published in Speech Technology Magazine, June 2001.

words to determine what they said. Then the words are fed into a language understanding engine to determine the reason for the call. The language understanding engine, or topic identifier, is trained on responses from actual customers to capture all of the variability of their speech. In terms of error rate, BBN Call Director outperforms an ordinary natural language recognizer by a factor of 2 to 1. This can make the difference between a one-year return on investment versus no payback at all. Figure 5 shows the results of a recent independent study in which a phrase grammar implementation only achieved 6% more successful routes than touch-tone, whereas BBN Call Director achieved 21% more. The end result is that the business case cannot be made with a natural language recognizer alone!

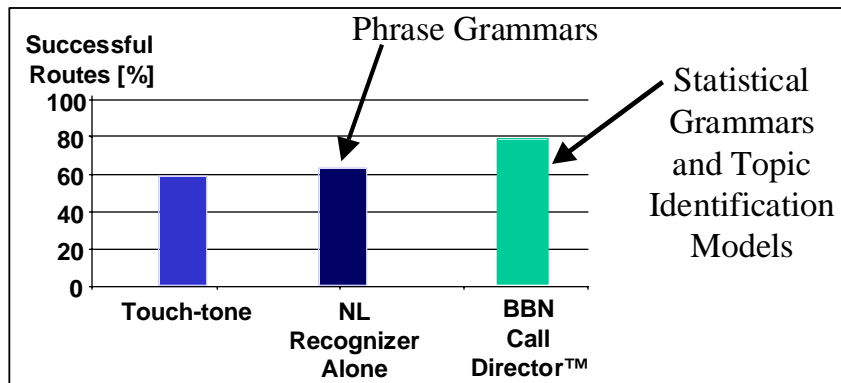


Figure 5. BBN Call Director uses statistical models to achieve superior performance and dramatically increase the number of successful routes over touch-tone menus or a speech recognizer alone.

## **Conclusion**

Speech recognition has emerged as a customer-friendly solution in call centers. Now, with natural language call routing, its prospects have never been brighter. A field study of a natural language call router exceeded expectations, resulting in large cost savings while improving customer satisfaction. The next time you call customer service you may not have to wade through tortuous touch-tone menus to get what you want; instead, you'll just ask for it.