BBN Technologies

BBN Call Director White Paper

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1 BBN Call Director Overview

BBN's Call Director speech interface represents a unique and comprehensive solution to improving customer satisfaction and reducing costs in call centers. Call Director's natural language understanding capability enables callers to describe the reason for their call in their own words, as shown in Figure 1, rather than having to wade through menus. Built upon the BBN HARK speech recognition engine, callers can also enter data such as telephone or PIN numbers using speech, and any number of sub-dialogues can be developed to further automate the call. Leveraging 30 years of speech and language processing experience at BBN, Call Director shortens the time it takes customers to get their problems resolved, improving customer satisfaction. Call Director also dramatically improves call routing accuracy and overall automation, resulting in a more efficient use of call center resources and reduced operating expense.

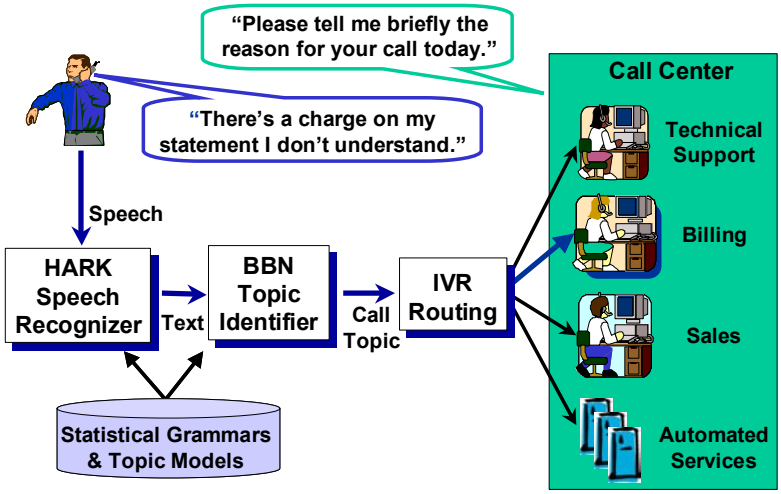

Figure 1: Call Director Functional Architecture.

BBN Call Director provides benefits by increasing:

- The number of callers delivered to the existing IVR.
- The number of callers delivered to agents with useful information.
- User satisfaction through faster, more natural dialog with the IVR.

What differentiates Call Director from other products is that it recognizes, understands, and responds to natural language using statistical grammars and topic identification. The result is a natural, intuitive, and satisfying experience for callers. Call Director is based on large vocabulary, language independent, statistical speech and topic identification technology that accommodates regional accents. This combination of technologies is unique in the industry and reflects BBN's expertise in both speech and language understanding technologies.

2 Performance in the Field & Competitive Outlook

BBN Call Director is a unique product whose performance is unmatched in the field. BBN has Call Director within Verizon, and it is now handling 15-20 million calls/year at Verizon Online Internet Services and 5-6 million calls/year at the Verizon Dallas Consumer Call Center. Both deployments were completed in 2002. Call Director's performance has exceeded all expectations of cost savings and customer satisfaction.

Prior to rolling out Call Director within Verizon, several trials were performed to establish the benefit of the technology, compared to the existing touch-tone applications. At Verizon Online, the average handling time (AHT) for the agents was reduced by 33 seconds, based on measurements made by the center. The system in the Dallas Consumer center is saves 21 seconds on average. The reductions in AHT result from substantial increases in routing accuracy, account number capture and automation in the IVR. Customer satisfaction, measured by agent surveys during the trial, was extremely high and consistent for the two pilots:

- 84% preferred describing their problems in words over selecting them from menus.
- 93% liked being given the choice to say or key-in their phone number.

A study performed by an independent firm confirmed the high customer satisfaction results. So Call Director not only lowers costs, it also improves customer satisfaction.

BBN Call Director uses a unique statistical approach to accurately route calls to agents. A recent independent study by a large IVR manufacturer demonstrated that Call Director's innovative approach marks a breakthrough improvement in routing accuracy. The improved routing performance translates to more successful routes than either touchtone or standard speech recognition approaches, as shown in Figure 2. In fact, it is only by using the statistical approach, for both speech recognition and topic ID, that a compelling business case can be made for deploying speech-enabled call routing.

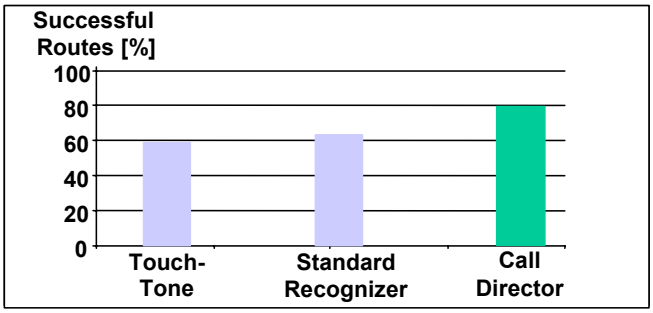

Figure 2: Call Director's natural language *understanding* results in more successful routes than a standard recognizer, resulting in a rapid return on investment.

3 BBN's Speech Recognition Deployments

BBN Call Director is built upon proven speech recognition technology. The two core BBN speech recognition products are the HARK™ Recognizer and the BYBLOS Recognizer. HARK

was the first real-time, speaker-independent, medium-vocabulary (few thousand-word vocabulary) speech recognizer to become available on standard computers. Thousands of copies of HARK are now operational in a large variety of applications, including telephony applications (for automated directory assistance, corporate name dialing, and call center automation), embedded applications (for control of telephone, climate, and entertainment functions in a car), air traffic control training systems (including the US Air Force and the US Army), and military applications.

The BYBLOS recognizer, which can handle vocabularies exceeding 100,000 words in real-time, has now become a product that has been licensed commercially and has been deployed in both commercial and government applications (for transcribing and indexing broadcast news off the air). BYBLOS is currently being used to provide a voice interface for several audio-indexing systems being developed for the U.S. Government. For the NHK Corporation (Japan's dominant television broadcaster) BBN developed a BYBLOS-based real-time system to transcribe and subtitle Japanese.

In addition to the deployments mentioned above, HARK and BYBLOS have been used as ASR engines for a the following efforts:

- BBN, in collaboration with major industry player, has deployed Directory Assistance Automation (DAA) systems that currently automate over one million calls per day. The deployed DAA systems, some of which have been operational for about a year, are based on the BBN Hark recognizer and provide robust 24x7 performance in the field at correct to false automation ratios that exceed 20:1. BBN has also developed the next generation of DAA systems based on the BYBLOS statistical n-gram recognizer that uses a patented two-pass search to deliver faster than real-time recognition on large vocabularies. The new system has been demonstrated to be capable of automating between 15-20% of DA queries (on data from an operational DA node) without any change to the existing call flow and without a confirmation prompt. This is industry-leading technology.

- Parlance's NameConnector® (www.nameconnector.com) utilizes the HARK engine to enable callers to dial one number, say the name and get connected to anyone in the enterprise. Two million calls per month are handled by the technology.

- Virage (www.virage.com) has supplanted IBM's ViaVoice™ speech recognition engine with BBN's WatchWord™ engine which uses BYBLOS. WatchWord transcribes speech, and identifies speakers, proper names, and topics. Virage offers WatchWord as part of its SmartEncode Suite™.

- Sail Labs Technology (www.saillabstechnology.com), an Austrian firm with a global presence, has integrated WatchWord and BYBLOS into its major offerings, Media Miner and Conversational Systems.

- UmeVoice, Inc. (www.umevoice.com) is recognized as a leader in developing voice recognition systems for Wall Street. By integrating the BBN HARK speech recognition

technology with current trading platforms, they have enabled traders to carry out transactions much more easily and efficiently than with manual entry systems. Some of the clients using the system are Goldman Sachs, Merrill Lynch, Credit Suisse First Boston, and the Union Bank of Switzerland.

- Recognition for Automobiles: In a project with Ford Corp., BBN tailored the commercial HARK recognizer to the noisy car environment, using a combination of spectral subtraction and noise modeling techniques; the result was a reduction in the error rate by a factor of two. The product appeared in the Jaguar S-type.
- VALAD: The Voice Activated Logistics Anchor Desk is an interactive system that lets military logistics experts ask questions of a logistics system. BBN demonstrated problem solving in 1/3 the time using speech recognition.
- VoiceLog: portable voice and pen interface for accessing vehicle repair information.
- GTN-Phone: a telephone-based interface to USTRANSCOM's Global Transportation Network; callers ascertain the status of their shipments.
- Voice EMALL: supported natural phone dialogs to let logistics personnel order spare parts from the Defense Logistics Agency's E-MALL ordering system.
- Talk'n'Travel: a live system for travel scheduling is part of the DARPA Communicator program.
- COVE (Conning Officer Virtual Environment): supports natural spoken interaction between the Conning Officer and a virtual helmsman, who responds to commands just as a human helmsman is trained to do. The work is funded by the Office of Naval Research; the Surface Warfare Officers' School (SWOS) in Newport, RI, is the primary customer for the COVE testbed.
- ACN: Airborne Communications Node is a DARPA program that is employing HARK to recognize call signs for a prototype radio gateway.

4 Evolution of BBN's Speech and Language Processing Technologies and Products

- 1976 – HWIM (Hear What I Mean) one of the earliest continuous speech recognition systems incorporating language understanding
- 1979 – Developed a method to enhance the quality of speech degraded by acoustic noise
- 1985 – First demonstration of BBN's BYBLOS continuous speech recognition system
- 1992 – First software-only, real-time, large-vocabulary, speaker-independent continuous speech recognition for low-cost UNIX workstations
- 1992 – ATIS (Air Travel Information System) real-time speech recognition and language understanding enabled travelers to obtain flight information.
- 1992 – Call Router speech recognition system for routing company internal phone calls
- 1995 – HARK 3.0 reduces over-the-telephone error rates by nearly a factor of 2
- 1996 – Parlance Corporation spun-off to commercialize the Name Connector product
- 1998 – Developed WatchWord audio indexing technology
- 1999 – HARK 3.1 adds n-best, merged and improved wireline/wireless models, higher accuracy continuous density models, speed enhancements
- 2000 – HARK Automotive deployed in 2000 Jaguar S-Type for in Visteon's Voice Activated Controls module
- 2000 – HARK 4.0 – new software architecture developed
- 2000 – BBN deploys first Directory Assistance Automation (DAA) of Frequently Requested Listings using HARK at a major telecommunications company
- 2000 – BBN Call Director natural language routing software released and successfully trialed at Verizon Wireless
- 2001 – Successful trial of BBN Call Director at a Verizon Consumer Call Center
- 2001 – New HLT framework available incorporating HARK, BYBLOS, Call Director's Topic ID module, and information retrieval. Available for Solaris, Linux, Windows.
- 2002 – Call Director deployments at Verizon handle 20-25 million calls/year.