A Vision for Voice

High definition voice:
A sound technology for the future

Forecasting future growth of today's technologies and incorporating the shift toward Internet Protocol (IP) technology presents a daunting challenge for today's applications designers. Texas Instruments' Vision for Voice is of a seamless IP-based communication and networking environment providing voice – communication capabilities at every turn.

Indeed, TI expects that voice processing will become a function of nearly every IP-enabled device. No longer will voice communications be just another application riding on top of the IP network. Voice over IP (VoIP) will become one of the most common traffic types on the global IP network. In the not too distant future, voice processing will be integral to the IP network and how we use it.

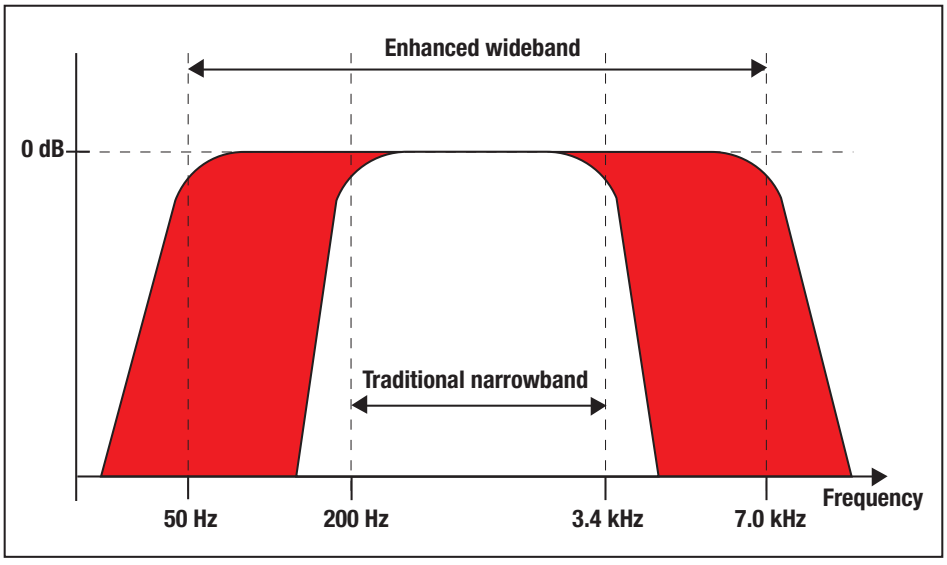
The convergence of several key technologies will usher in this new Vision for Voice. These advancements will result in real-time voice processing capabilities, with quality approaching that of natural speech. Advancements are being made in two basic areas:

1. The bandwidth and throughput performance needed to instantaneously carry large amounts of data over the IP network.
2. The high-performance processing capabilities required for enhancing, converting, manipulating, transmitting and managing the analog world in a digital IP domain.

In the meantime, the evolution of several key building-block technologies continues, such as high-definition (HD) voice, fixed mobile convergence (FMC) and dual-mode convergence in handsets. This position paper will take a closer look at one of these technologies – HD voice – and trace its evolution into a key enabler and critical function for tomorrow's Vision for Voice.

HD voice: more than a sound technology

Digital technology has brought significant change in almost every type of media application from HD television to CD music, digital photography to DVD video and many others. Perhaps the area most lacking, yet needy, is the voice quality of the telephone



network. Even as digital technologies were introduced into telephony, the standard for voice remained the same voice quality of decades past, the quality produced by the analog phone network or PSTN – public switched telephone network. However, VoIP will soon join the HD parade as wideband codecs become widespread.

The difference between the narrowband standard definition (SD) PSTN and the HD voice quality produced by wideband voice codecs can be likened to the difference between an AM radio broadcast and the robust music of a stereo CD. SD codecs sample an analog voice signal at 8K samples per second and convert this into an eight-bit code for a 64K (Kbps) channel. In contrast, wideband codecs double the number of samples per second over twice the frequency range, yet require no more than 32 Kbps of bandwidth due to their advanced compression capabilities. The resulting quality of voice is truly HD. HD voice will certainly enhance the voice-communications experience. Subtle nuances and inflections of face-to-face conversation will no longer be lost when people talk over the IP network. Speaking to someone on the other side of the globe will be as natural and unaffected as talking to someone across the room.

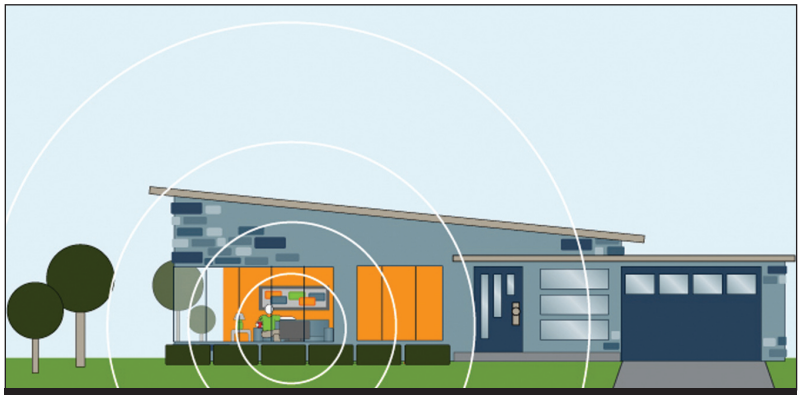
HD voice will be a significant enhancement in its own right, but it will also be a critical enabling technology for a host of exciting new applications.

The natural interface

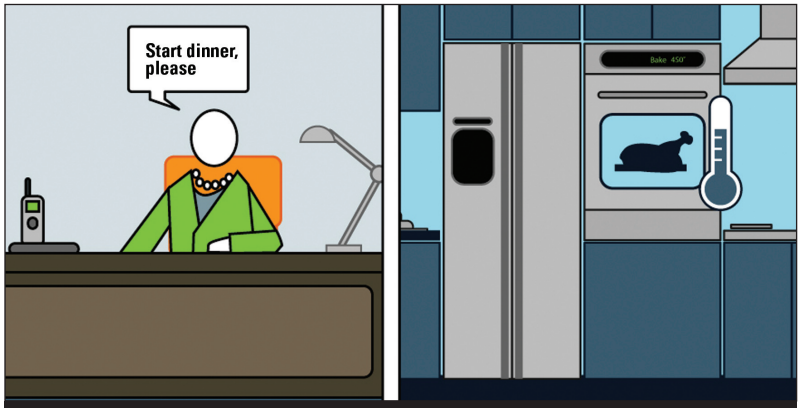
Benefits of having higher-resolution voice sampling and significantly better audio quality will be higher definition and more reliable speech interpretation. Speech recognition engines will understand a wider vocabulary of words, and could be trained to interpret the context within which words are spoken as well as the inflection of the voice. Given these higher-order speech-recognition capabilities, the human voice could emerge as the interface-of-choice on the IP network with various applications and types of devices.

For example, imagine a typical teenager at home after school watching television while

Appliance voice control



Device integration



Remote control voice

Real-time language translation

his or her parents are at work. Changing the channel would be as simple as speaking a descriptive word, like 'cartoons.' The voice signal would be picked up by a directional microphone embedded in the television or speakers in the room. This signal would be transmitted to the voice-processing engine in the home's residential gateway (RG), which manages the home's IP devices and connects the local wireless and wired networks to the external IP network. The speech recognition engine knows the teenager's voice, interprets his request and switches the television to a cartoon channel he has visited in the past.

Next the teenager asks the inevitable question of "What's for dinner?" Speaking "Mom" would activate Mom's presence server to determine her location between the office and the car and initiate a VoIP call. Perhaps dinner is already in the oven. A voice command spoken by the still-distant "Mom" would turn on the IP-connected oven and set appropriate temperature and time settings.

In a business setting, real-time language translation could ease international video conference calls. Each participant could speak their own language, and the local speech recognition engine would perform real-time translation into the language needed for local listeners.

Realizing a vision

Making TI's Vision for Voice a reality will require technical advancements on many fronts including hardware, software, security, voice-processing algorithms and speech-recognition systems. But the groundwork has already been laid on every front. Indeed, digital signal processors (DSPs) from TI have already transformed and greatly accelerated many of the basic capabilities that form the foundation for this vision.

The bandwidth and throughput capabilities of IP, home and wireless networks have recently undergone astonishing growth. Within the last few short years, wireless home networks based on IEEE 802.11 Wi-Fi® technology have gone from throughput speeds of one megabit per second (Mbps) to hundreds of megabits. DSL and cable connectivity to the IP network has mushroomed from 600 Kbps to 50 Mbps. And passive optical networking (PON) technology could deliver 100 Mbps. This bandwidth growth is critical to breaking the barrier to real-time voice.

As the processing capabilities of DSPs continue to expand dramatically, the chips themselves shrink in size and consume substantially less power. Not long ago, a single dedicated DSP was needed for a single voice channel. Now, hundreds of voice channels can be processed by a single DSP. In the future, the voice-processing power of DSPs will drive new applications, such as voice firewalls for security, high-definition IP video and voice processing, and voice-actuated man/machine interfaces.

Many of TI's current silicon and software platforms can achieve the high-performance bandwidth, high-speed throughput and processing power that are essential to today's networking and communication environments. And for voice, TI envisions a day where voice communications is so pervasive that it will be an expected capability of every networked device: refrigerators, picture frames – even jewelry.

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