

# MODERN SPEECH PLUS DATA SYSTEMS

*WHITE PAPER*



+ 1 833 55-ITALK



INTERTALKSYSTEMS.COM



INFO@INTERTALKSYSTEMS.COM

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White Paper

## **INTRODUCTION**

InterTalk Critical Information Systems is at the forefront of innovation for mixed data and voice communications systems. For example, our Speech Plus Data (SPD) system, which was originally conceived as a low-cost mechanism to provide railroads with concurrent voice and data over low bandwidth circuits, can tie together large numbers of both data and voice circuits and connect them to console systems and data applications.

The original SPD system used Digital Signal Processing (DSP) techniques to divide the available bandwidth into voice and data segments allowing simultaneous speech plus data with no co-interference. These systems were deployed by Canadian Class 1 railroads to provide a switchable, multi-base station voice interface at wayside bungalows that were connected with a mixture of T1 and radio trunks. The “data” part of SPD was a low speed, full

duplex, constantly-on data channel used to control the base stations, to indicate when call-ins were received and to provide alarm/alerts from the remote locations. The data channel was embedded into the voice circuit at frequencies above the voice channel.

SPD has expanded to provide sophisticated IP-connected interfaces for multiway, simultaneous voice and data paths to multiple base stations at multiple remote sites. The remote site controller is called “Citadel” which is a word that means “a fortress or stronghold located on high ground protecting a city or the countryside”. Given InterTalk’s home city features a prominent military Citadel of its own, we felt the name was appropriate.

This White Paper provides a quick overview of modern SPD, its applications and capabilities.

## **TECHNICAL OVERVIEW**

Please refer to the drawing on page 5 that shows a generic block diagram of an InterTalk SPD system.

The SPD system provides a quick and easy solution for adding mixed IP, wire-line and microwave connectivity to remote sites from a traditional voice console. The drawing shows a typical way that the system can be employed. The SPD data center server connects to the traditional console system using a software controlled interface that can be set to terminate at 600  $\Omega$  or, if the system design demands, the circuits can be bridged at high impedance.

The InterTalk SPD server can be set up as two redundant servers to provide five-9s (99.999%) availability in the data center. The SPD server can be equipped with a wide range of interface types including: T1/E1, fiber-optic connections, conditioned trunks, telephone POTS trunks (for dial-up services), ring-down services and IP connections.

The SPD server connects to third-party data applications such as alarm systems, track monitors, PTC back ends, and Computer Aided Dispatch (CAD) systems. These applications are typically connected via a Local Area Network (LAN) IP connection, however, other data bearer arrangements can be handled such as RS-232/422/485 and even X.25 or similar vintage schemes. It can transcode data to any appropriate format at the interface and it can encapsulate the data within the IP WAN to guarantee delivery. The SPD server can emulate any terminal, and even handles polling protocols.

The number of trunks circuits that can be terminated on the SPD server is, practically speaking, unlimited because its architecture allows it to grow by adding additional physical servers that act to spread the switching and aggregating load across all the available machines.

The DSP nature of the SPD means that it can provide nearly any imaginable signal processing that might be required. For example, data can be multiplexed on

multiple slow speed circuits and then re-assembled at the far end. Automatic circuit equalization can be applied to bearer circuits that suffer from poor frequency response. Annoying tones and noise can be reduced or eliminated using advanced filtering and adaptive response circuits. One advantageous feature surrounds using Automatic Level Control (ALC) to ensure that signals are always optimized before they reach the console system.

Another valuable feature available with InterTalk's SPD is automatic receiver site voting. Normally, voting within a mixed bearer environment is notoriously difficult to get working well due to the difference in delays of the different types of circuits. Coupled with jitter and bit errors of the IP trunks, traditional voters often provide poor service in such environments - but InterTalk's voter works differently than traditional systems. Instead of trying to bring a faithful, undistorted and level equalized signal from each site's receiver to a central comparator, our voter uses an IP-connected Citadel Base Station Controller at the remote sites that performs all the measurements locally and reports the results to the comparator. Noise, jitter, level twist and all of the other typical impairments that trip up traditional voters have no effect on InterTalk's SPD voter.

Transmitter steering is used with the voter to return TX audio to the most appropriate site's transmitter. Many sophisticated algorithms are available that can accurately predict the best TX site based not only on voting patterns but also on the history of which receivers were unswitched. This feature is of particular value in mountainous regions.

Using voting and TX steering, a very effective railway system can be deployed that will allow the train engineer to remain on the same frequency/channel at all times – the voter and TX steering feature of the infrastructure will handle sorting out the best receive signal and the best place from which to transmit.

### **CITADEL BASE STATION CONTROLLER**

Each InterTalk Citadel can connect up to four (4) independent 2/4-wire base stations with PTT and COR control lines via a single IP connection. Special order units are available for controlling up to eight (8) base stations. Besides its audio capability, each unit can sense up to 12 input lines for switch events or to provide analog to digital conversion. Up to 12 outputs can be configured as dry (relay) switched or as high-side drivers capable of sourcing up to 50 mA at selectable voltages of +12, +5 or +3.3 volts DC or -48 VDC with an external DC power supply. Alternately, the outputs can be configured as solid-state sinks for up to 50 mA.

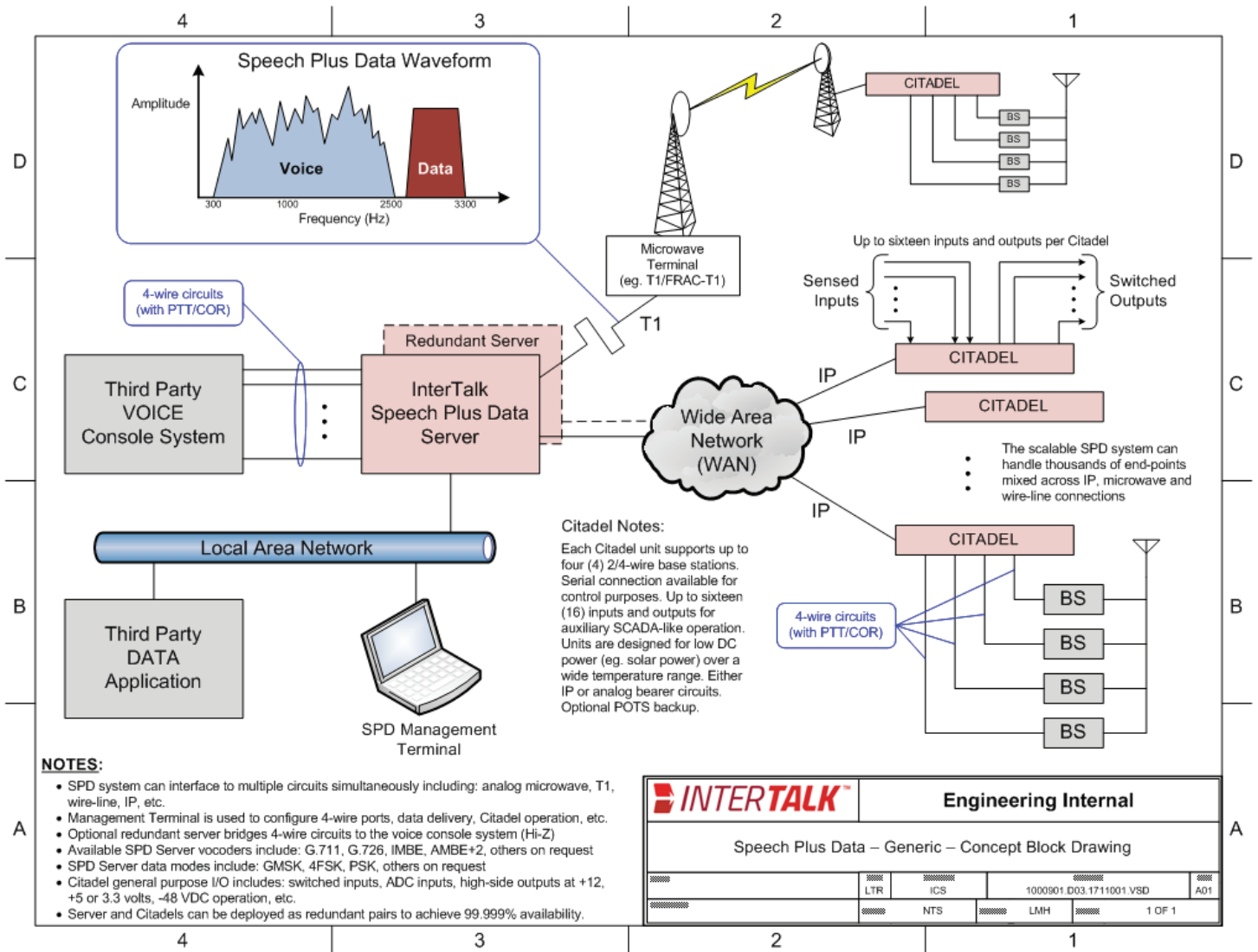
Citadel has been designed as a low-power device that consumes only 3 watts of DC power, making it a suitable choice for solar sites. Its components support a wide temperature operation from -40°C to +65°C, with up to 95% non-condensing relative humidity. Citadel is easy to install, using standard RJ-45 modular jacks for each 8-wire base station connection comprising TX, RX, PTT and COR.

Each of Citadel's 4-wire connections can be independently set to bridge or terminate mode. This is useful where existing equipment is to remain connected to the base station. As an example, say that you want to maintain your older system until the new system has been burned in. The Citadel's RX pair can be remotely set to reflect 10 kΩ so as not to double terminate the receiver. You can then add a new Citadel and not have to worry about level changes affecting the existing system. On the TX side, Citadel only connects to the TX pair when it is transmitting. When configured for bridging operation, the Citadel automatically adds 3 dB to the TX output because it recognizes the double termination condition. However, when it is not transmitting, the TX pair is open, so the existing system's TX levels are unaffected.

### **BENEFITS OF SPEECH PLUS DATA**

- Server amalgamates voice & data; aggregates data
- Connects seamlessly to existing console systems with direct connection or tone remote control
- Voice & data can share the same limited BW bearer circuit
- Handles any mix of traditional and IP circuits
- Transcodes data to appropriate format; encapsulates data and delivers in proper format
- Emulates any terminal (DTE or DCE)
- Handles polling protocols
- Allows T1 circuits to be handled over IP
- Redundant data center for 99.999% availability
- Web browser based Management Terminal can be anywhere with IP visibility to server
- Intuitive Management Terminal configures circuit paths, features, security, and more
- Allows easy addition and integration of an IP-based console
- Simple reduced-feature consoles can be used
- Easily add full-featured IP-connected console positions at a later date
- Older radio trunk circuits or DS0 can carry voice plus data in band
- Replaces old T1 channel banks with new maintainable equipment
- Parses out any DS0 and apply mixing, filtering, etc., then direct to another DS0, even in a completely different DS1
- Sense alarm inputs at remote sites; integrate with SNMP
- Senses ADC inputs at remote sites (fuel levels and temperature)
- Dashboards are available to display data
- Can intercept and/or add signaling such as MDC1200, G-STAR, DTMF, selcall, and more
- InterTalk's *optional* Transcript™ Archival Logging Recorder can archive everything, including older console system audio and data
- Uses inexpensive and readily-available COTS servers
- IP-connected Citadel Base Station Controller can allow any radio to be connected to IP
- Citadel has four-in-one density in 1 RU package
- Citadel is engineered for low/solar power operation
- Citadel operates from -40°C to +65°C (-40°F to ~150°F)
- Citadel allows fast and inexpensive "exact fit" solutions

**SPEECH PLUS DATA SYSTEM GENERIC BLOCK DIAGRAM**



 **INTERTALK**™

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 [INFO@INTERTALKSYSTEMS.COM](mailto:INFO@INTERTALKSYSTEMS.COM)