

Application Note: Extending a TSP’s Analog Capabilities Using an Access Bank I

The Teltone TSP (Telecom Simulation Platform) supports up to 2 digital interfaces (T1/E1 DS1 channels, each with 24/30 DS0 subchannels) and up to 8 analog interfaces, or up to 16 analog interfaces if digital interfaces are not required. These interface capabilities are well suited for most product development, application testing, and production testing environments where the primary interface needed is at the digital DS1 level. For products that have a high number of analog interfaces and/or different types of analog interfaces, such as IADs (Integrated Access Devices) that have 24 or more analog POTS interfaces, a slightly different solution is needed.

This application note demonstrates how to interface a TSP with Carrier Access Corporation’s Access Bank I channel bankⁱ as a cost-effective way to extend the analog interface capabilities of the TSP (see Figure 1).

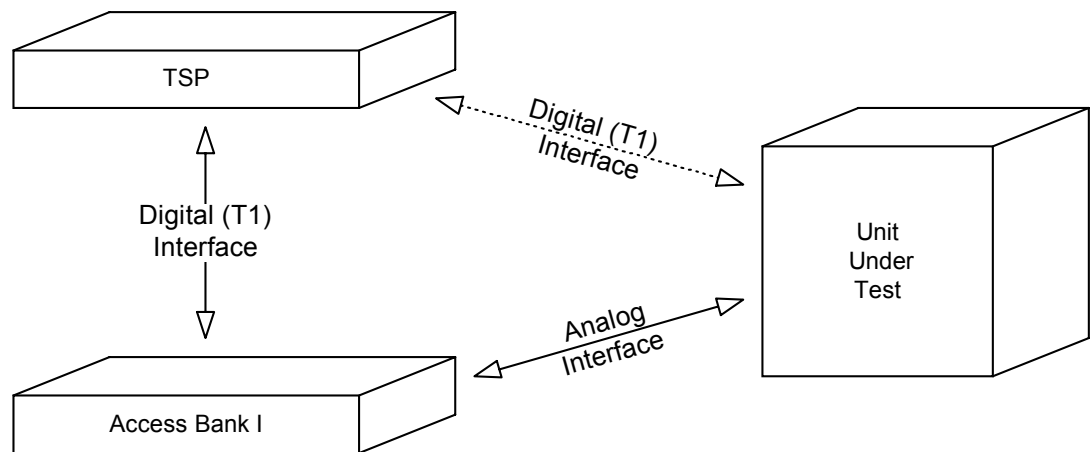


Figure 1. Extending a TSP’s Analog Capabilities Using an Access Bank I

This demonstration includes:

- Selecting appropriate hardware and accessories
- Mapping out test scenarios
- Configuring the TSP and the Access Bank I channel bank to perform the desired testing

ⁱ For information about obtaining an Access Bank I channel bank, contact Teltone Corporation Customer Service.

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Identifying Hardware Requirements

The test requirements of the UUT (Unit Under Test) must be identified before making any decisions about hardware. Some of the major questions to ask are:

- Does the test require connecting T1 to the UUT? If so, how many lines?
- For the UUT, how many of analog channels act like an “Office”? a “Station”? (see Table 1)
- Of the “Station” channels, how many use Ground Start protocol?

Table 1. Identifying FXS vs. FXO Protocols

Unit Under Test			Test Platform	
Description of UUT Channel	Protocol UUT Uses	Behavior of Interface at UUT	Protocol TSP Uses	Channel Bank Card Required
Office	FXS	Initiates outgoing calls by sending ringing signals. Acknowledges incoming calls by providing dial tone and expecting routing digits to be dialed.	FXO	FXO card
Station (or Subscriber)	FXO	Initiates outgoing calls by requesting dial tone and then dialing. Acknowledges incoming calls by responding to ringing.	FXS	FXS card

Table 2 shows samples of optimal hardware platform requirements to provide the UUT with analog channels using one or more channel banks. The TSP needs to provide one (24-channel) T1 line for each channel bank used — regardless of the number of channels used on that channel bank. Additional TSPs and channel banks can be added to increase the number of available channels.

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Table 2. Optimal Hardware Requirements for Analog Linesⁱⁱ

UUT Analog Channels*			Test Platform				
			Channel Bank			TSP [†]	
# of "office" lines on UUT	Total # of "station" lines on UUT	Of "station" lines, # of GS on UUT	# of Channel Banks	# of FXS Cards	# of FXO Cards	TSP T1 Modules	TSP Analog Modules
up to 24	0	0	1	0	2	Single	
	up to 4	0	1	0	2	Single	4POTS
	up to 8	0	1	0	2	Single	8POTS
	up to 12	up to 12	2	1	2	Dual	
up to 12	up to 12	up to 12	1	1	1	Single	
	up to 16	up to 12	1	1	1	Single	4POTS
	up to 20	up to 12	1	1	1	Single	8POTS
	up to 24	up to 24	2	2	1	Dual	
0	up to 24	up to 24	1	2	0	Single	

* The TSP requires the channel bank to provide all the analog GS (Ground Start) channels; the TSP POTS modules are LS (Loop Start) only.

† When a test scenario does not require T1 connections to the UUT, a Single T1 module can be replaced, with a Dual T1 module to allow for two channel banks to be used.

The Access Bank I channel bank uses up to two channel cards with 12 channels each. A 25-pair connector provides the interface for its analog lines. Since it uses different cards for FXS and FXO, the first 12 pairs will either be all FXS or all FXO, and the second 12 pairs will also be all FXS or all FXO.

Table 3 shows when a standard 25-pair cable can be directly connected between the UUT and the channel bank. GS (Ground Start) versus LS (Loop Start) does not need to be considered in this decision because the cards allow per channel configuration of this parameter.

Table 3. Analog Combinations for Direct Connection Using 25-Pair Cable

UUT Channels 1-12	UUT Channel 13-24
"Station" only	"Station" only
"Station" only	"Office" only
"Office" only	"Station" only
"Office" only	"Office" only

If the UUT requires a combination that does not fit the criteria for using a standard 25-pair cable, an appropriately labeled custom cable provides an excellent interface for testing equipment that consistently uses the same channel mix. For more

ⁱⁱ If the UUT test scenario requires a T1 connection to the TSP, that connection can be made available by substituting a Dual T1 module in place of a Single T1 or by adding an additional TSP and T1 module.

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flexibility, 25-pair cables can connect the UUT and channel bank to breakout boxes where channels can be interconnected on an individual basis.

The TSP requires either an Ethernet or a serial connection for configuration and operation. The TSP comes with all the hardware required for a serial connection and with a “crossover” Ethernet cable for connecting directly from a PC, but a standard (uncrossed) Ethernet cable will be required when connecting via a hub or a server.

One T1 cable is required for each T1 line connected from the TSP to either a UUT or a channel bank. The TSP uses a T1 DTE (data terminal equipment) pinout vs. a DCE (data communications equipment) pinout. When the UUT is wired as a DCE, an uncrossed T1 cable is required. When the UUT is wired as a DTE (as the channel bank is), a “crossover” T1 cable is required. See the TSP user manual for details on cable connections.

Mapping Out the Test Scenario

A scenario map contains all the information required to configure your test equipment and to quickly confirm that a specific test is set up properly. This method is best explained by taking a sample scenario through the process.

In this sample scenario, the UUT requires a single T1 line (DTE pinout, external clock, D4, and AMI) and 24 analog channels. The UUT behaves as a “station” for analog channels 1-12 and as an “office” for the analog channels 13-24 — with channels 4 and 13-16 using Ground Start protocol and the other channels using Loop Start protocol. Because of the T1 line to the UUT, the TSP will need to provide one T1 line in addition to what is listed in Table 2.

The analog portion of the scenario has 12 “office” and 12 “station” channels (one of the station channels is GS), so Table 2 recommends using: 1 channel bank, 1 FXS card, 1 FXO card, and 1 TSP with a Single T1 module. To add the T1 line for the UUT, we substituted a Dual T1 module for the Single T1 module (another option is to use a second Single T1 module).

Looking at Table 3, we have met the conditions for using a 25-pair cable directly between the channel bank and the UUT. Since the UUT's T1 interface is wired for DTE, a “crossover” T1 cable (see TSP user manual for details) is needed for connecting the UUT to the TSP T1/E1 module.

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In summary, our scenario's test platform needs the following hardware:

- 1 channel bank
- 1 FXS card
- 1 FXO card
- 1 TSP
- 1 Dual T1 module (the UUT and the channel bank will need to use the same T1 framing and line coding)
- 1 standard 25-pair cable
- 1 T1 "crossover" cable (yellow cable provided with TSP)

The system-level test scenario map shown in Figure 2 represents our sample scenario.

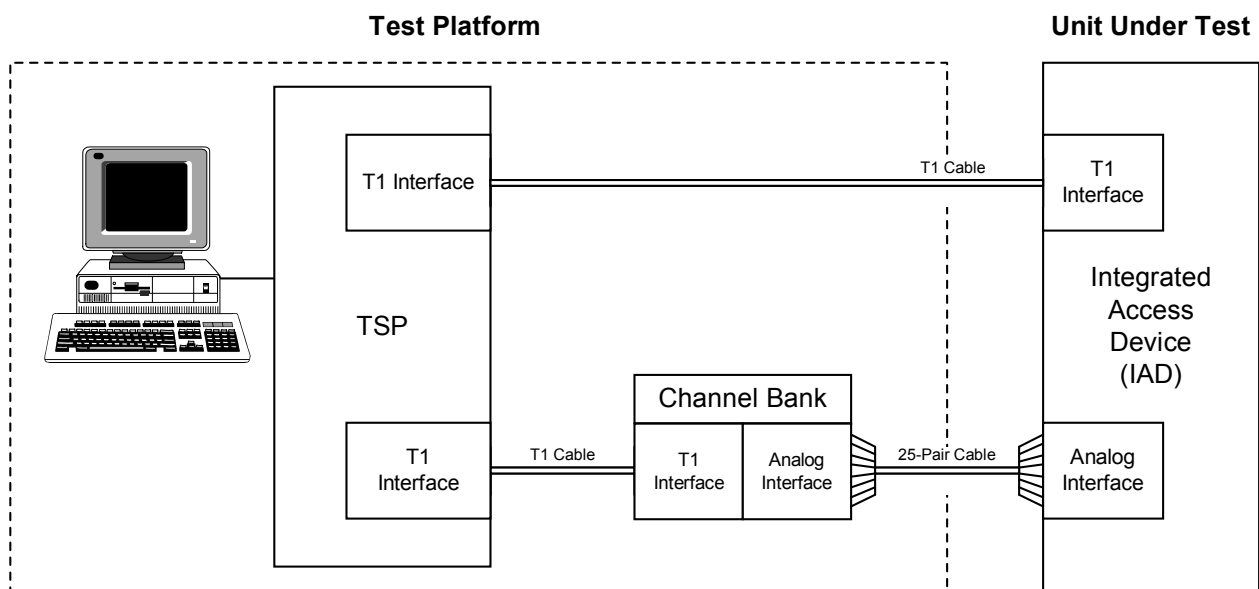


Figure 2. System-Level Test Scenario Map Example

Once the system level setup has been defined, each individual channel needs to be assigned a protocol and an operation. Table 4 shows each channel assigned with a specific protocol and a single Control Set Type. If testing requires a given channel to perform more than one type of operation (e.g., call originate *and* call terminate), the most efficient method is to use multiple project files and switch between them (see the TSP user manual for details).

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Table 4. Analog Protocols and Control Set Assignments for Sample Scenario

UUT Analog Channels			Test Platform			
			Channel Bank		TSP	
Channel	Protocol	Control Set Type*	Card Type	Card Setting	Channel†	Protocol
#1-3	LS "station"	Call Originate	FXS	LS	2.1.01-03	T1 LS FXS
#4	GS "station"	Call Terminate	FXS	GS	2.1.04	T1 GS FXS
#5-12	LS "station"	Call Terminate	FXS	LS	2.1.05-12	T1 LS FXS
#13-16	GS "office"	Dialed	FXO	GS	2.1.13-16	T1 GS FXO
#17-24	LS "office"	Call Terminate	FXO	LS	2.1.17-24	T1 LS FXO

* Control Set Type describes what the scenario wants the test platform to do on that channel. For example, a call originate on channel #1 means the TSP will originate calls through channel #1 on the channel bank.

† The channels listed are from Port 1 of the Dual T1 module. TSP Port 2 is being reserved for the UUT to provide more flexibility when configuring.

A table for T1 channels between the UUT and the TSP would also be part of mapping the scenario, but the process is similar enough that it will not be covered in this sample scenario.

Starting with the analog channels, a call originate control set with channels 2.1.01-03 using LS FXO at the TSP and LS FXS at the UUT, the TSP initiates the call by signaling the channel bank to draw loop current, and then the TSP transmits that channel's DTMF Transmit Digits (if assigned to that channel). For convenience during configuration, this example assigns 555 followed by the channel number. After a delay, the TSP will play an audio message (if assigned). Figure 3 shows a method for organizing the information needed to configure this control set.

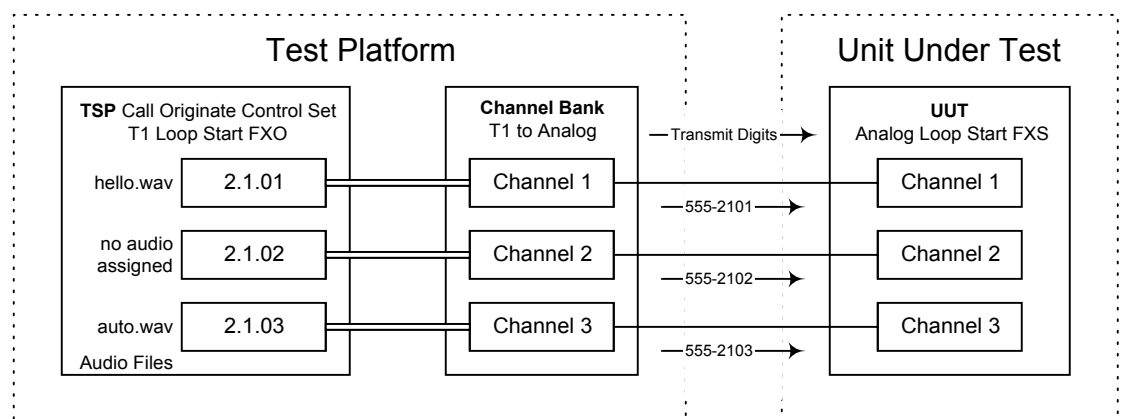


Figure 3. "Analog FXO Originate" Control Set Scenario Map Example

Continuing with the next control set, call terminate with channel 2.1.04 using GS FXO at the TSP and GS FXS at the UUT, the UUT initiates calls by sending ringing to that channel on the channel bank, which signals the TSP, and the TSP signals the

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channel bank to answer the call. After a delay, the TSP will play an audio message (if assigned). Notice that no digits are indicated in Figure 4; the call was from an office to a station, so Transmit Digits will not be used (even when assigned.) The other call termination control sets behave similarly to the one in Figure 4.

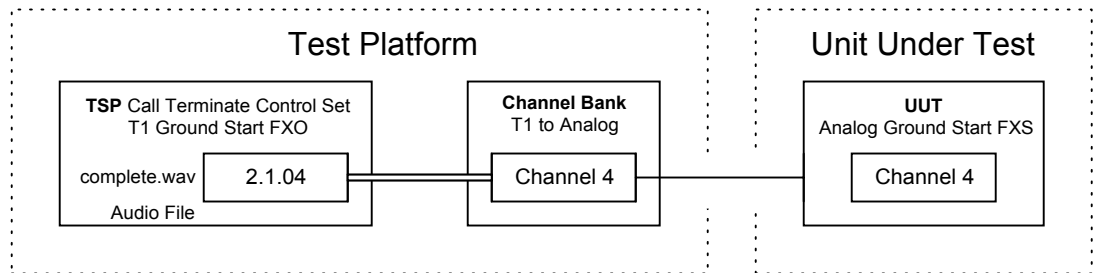


Figure 4. "Analog GS FXO Terminate" Control Set Scenario Map Example

In our scenario, Channels 2.1.13-16 use a third type of control set, which is a Dialed Control Set and can only be used when the TSP is representing an office or a trunk. This type of control set routes a call based on the numbers dialed into it. The arrows in Figure 5 indicate the channel where a call will be routed after one of the phone numbers is dialed into one of the other channels in that control set.

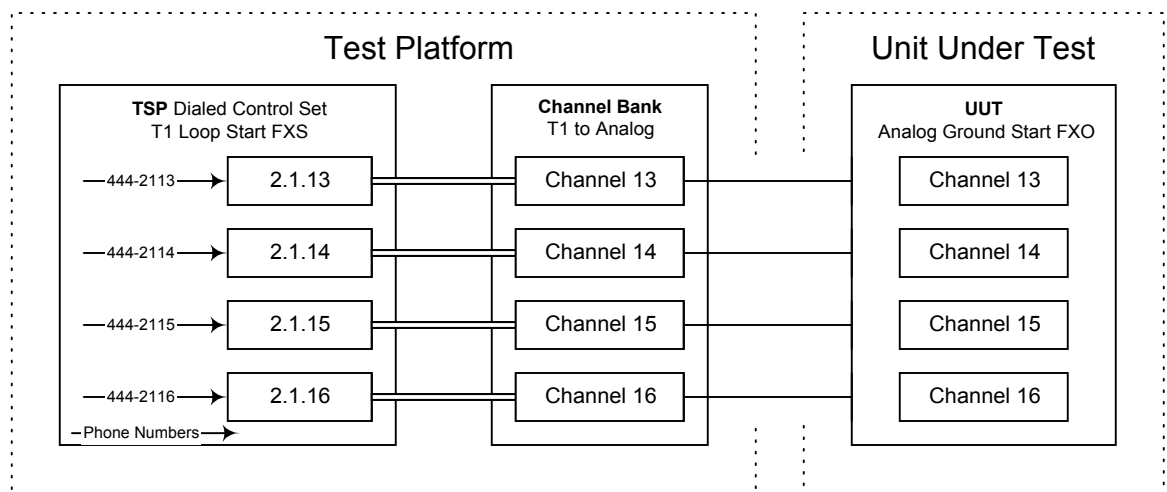


Figure 5. "Analog Dialed" Control Set Scenario Map Example

Notice that Transmit Digits are not indicated in Figure 5. FXS protocols are designed for communicating with stations, which do not expect digits.

After all the control sets have been mapped, create a table listing all the channels in the first column and the phone numbers, transmit digits, and audio messages in the following columns. This table will be very useful when configuring the TSP.

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Configuring the Access Bank I Channel Bank Card

In our sample scenario, one FXS card and one FXO card are used. There are six switches per channel on the circuit side of each type of card. These switches adjust the signal gain of the analog digital interface.

Switches 1-3 adjust the signal level received from the TSP and heard at the UUT. They come preset to -6dB (off, on, off) and can be used to adjust the attenuation from 0dB to -9dB. It is best to start at the factory default and then adjust the levels if necessary (see the top of the Access Bank I chassis for details.)

Switches 4-6 provide the same range of adjustment for the signal level transmitted from the channel bank to the TSP. For dialed control sets, the level could affect testing and should be adjusted only as necessary. For call termination and call origination, the signal level going to the TSP will not significantly affect testing, so these switches may be left in their default positions (on, off, on).

The Loop Start or Ground Start T1 FXS protocols use dissimilar signaling, so the FXS card has an auto-detection feature to set each T1 channel for LS or GS. However, the T1 FXO signaling is identical for LS and GS, so auto-detection is not possible on the FXO card. Instead, each channel has a selection switch located on the circuit side of the card to set the protocol manually to LS or GS.

The GS/LS switches come from the factory in the LS position. According to Table 4, channels #13-16 are the only GS lines on the FXO card in our sample scenario, and the other FXO channels are LS. Position switches for channels marked 1-4 (these will be 13-16 when the card is inserted in the second slot of the channel bank) to the GS position and verify that the switches for channels marked 5-12 are in the LS position.

At this time, the cards can be inserted into the back of the channel bank. Remove the back cover from a de-energized channel bank. Slide the cards (FXS in the first slot in our scenario and FXO in the second) fully into their slots and latch them into place, then re-install the back cover.

Verify that all test switches on the back panel are in the off position.

Configuring the T1 Parameters of the Access Bank I

The Access Bank I uses 10 option switches on the front panel for configuring T1 parameters. Switch 4 selects the T1 framing between 4th generation super frame (D4) and Extended Super Frame (ESF). Switch 5 configures the line coding to use Alternate Mark Inversion (AMI) or Bipolar 8 Zero Substitution (B8ZS). When the TSP has no direct T1 connections to the UUT, D4 with AMI is recommended.

When a Dual T1 module is connected to both a UUT and a channel bank (as in our sample scenario), both need to use the same of framing and line coding. Set switches

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4 and 5 per Table 5 to configure the channel bank to whatever is appropriate for the UUT. Using D4 and AMI, our scenario has both of these switches set to off.

Table 5. Channel Bank Framing and Line Coding Configuration

Framing	Line Coding	Switch 4 Position	Switch 5 Position
D4	AMI	off	off
	B8ZS	off	on
ESF	AMI	on	off
	B8ZS	on	on

The other eight option switches (1-3 and 6-10) should all be placed in the off position. Verify the four other switches on the front panel are in the normal position.

Configuring the T1 Settings on the TSP

On the TSP Unit screen (refer to the TSP user manual), configure the T1 framing and line coding to match the UUT and the channel bank (see “Configuring the T1 Parameters of the Access Bank I”).

In Figure 6, the Dual T1 module is selected for Internal Clock, so the TSP is providing the clock on both T1 lines. In our scenario, both the UUT and the channel bank use external clocking.

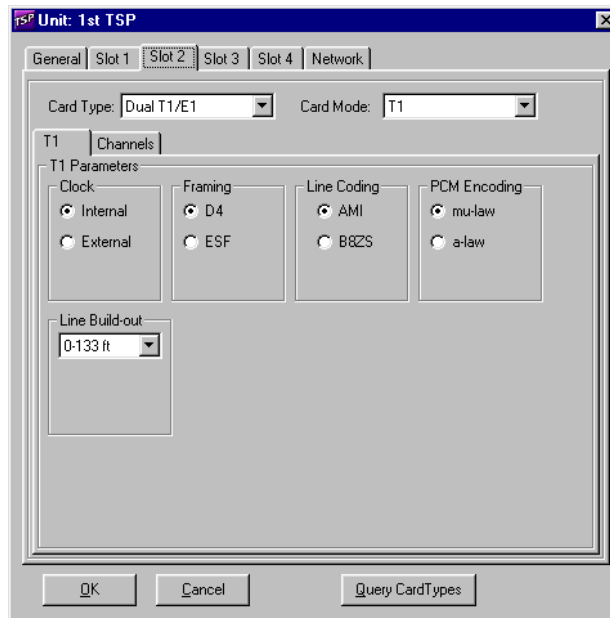


Figure 6. Unit Screen for “1st TSP” with the T1 Tab Selected

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Figure 7 has channel 2.1.01 selected. Transmit Digits and an Audio Message have been assigned per our table (final step of scenario mapping). The Wizard was used to assign the Transmit Digits globally with 555 for the first three digits followed by the channel number (the phone number was assigned at the same time using 444 followed by the channel number).

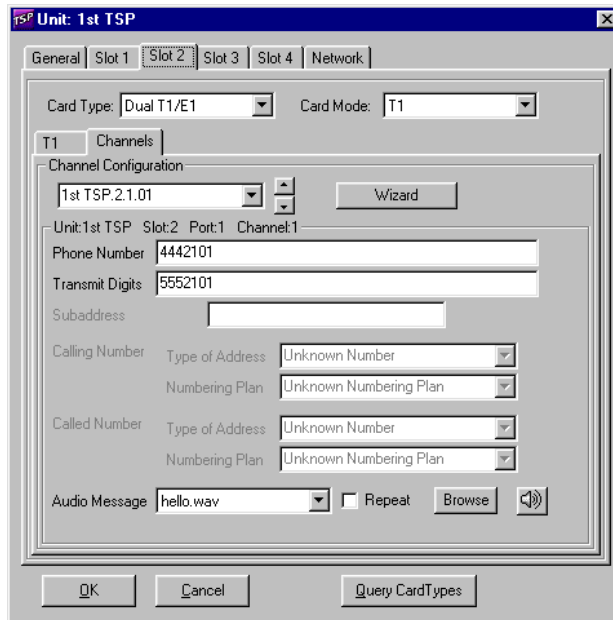


Figure 7. Unit Screen for "1st TSP" with the Channels Tab Selected

The Wizard also assigns audio messages globally. All channels will have the same Audio Message assignment immediately after using the Wizard. Since our scenario has different messages assigned to different channels, the individual assignment of Audio Messages should wait until after the Wizard has been used to assign the numbers.

Refer to the TSP user manual for configuring Templates and Control Sets. The channel assignment/protocol information is all contained in the Control Set Scenario Maps.

Now you are ready to connect the cables per your system-level scenario map, enable the control sets (see the TSP user manual), and begin testing.