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Software Version: **MonteCarlo 6.2**

Product(s):   **PIKA InLine MM**

Purpose: **Full duplex audio streaming with echo cancellation using the PIKA InLine MM and MonteCarlo 6.2**

Introduction

The release of PIKA MonteCarlo 6.2 SDK includes new firmware that gives the PIKA InLine MM additional cross-connections while maintaining 100% backwards compatibility with MonteCarlo 6.1 applications. This added functionality now makes certain applications possible with the InLine MM that were previously possible only with higher cost boards.

This article describes a full duplex audio streaming application with echo cancellation using the InLine MM under MonteCarlo 6.2. This application would be suitable for audio streaming to and from a host-based VOIP application or more commonly with a text-to-speech (TTS) or automated speech recognition (ASR) engine where echo cancellation is necessary to handle "barge-in" or "cut through" requirements.

The Application – Full Duplex Audio Streaming with Echo Cancellation

In this application, the user calls into an interactive voice recognition (IVR) engine that is speech recognition enabled. The IVR plays a prompt that asks, for example, "What country do you want to call?" The user may "barge in" with an answer: "Argentina". To prevent the prompt from interfering with the ASR, echo cancellation must be enabled.
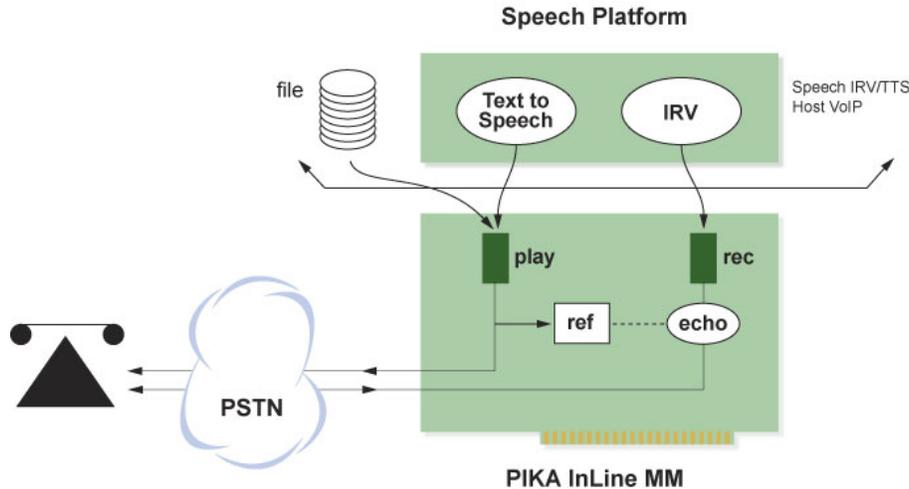
Figure 1.0 – The Application: Full Duplex Audio Streaming with Echo Cancellation for use with TTS and IVR engines

MonteCarlo 6.2 adds new connections to InLine MM while maintaining 100% backwards compatibility

The InLine MM is a 4-port analog computer telephony solution that offers high functionality at low-cost. The InLine MM is a cost effective choice to support a wide range of capabilities from the needs of basic voice applications to enhanced speech applications and VoIP.

MonteCarlo 6.2 includes new firmware that gives the InLine MM additional cross-connections that enable you to create new applications while maintaining 100% backwards compatibility with existing MonteCarlo 6.1 applications.

It is important to understand the following architectural features of the InLine MM:

- The InLine MM does not have a digital TDM switch. Connections are made either with on-board pre-defined cross connections (as described below) or using the DSP's conferencing capability.
- Stream 0, Timeslots 0-3 are physically connected in full duplex to trunks 0-3.
- In addition, all 32 DSP Timeslot outputs on Stream 0 are cross-connected to a corresponding DSP Timeslot input on Stream 1 on a one-to-one basis.

Firmware included in MonteCarlo 6.2 adds the following cross-connections:

- DSP Timeslot inputs on Stream 0 are cross-connected three additional times to other DSP Timeslot inputs on Stream 0 as depicted in the diagram; for example, Timeslots 0,4,8,12 are all "listening" to line interface "0".
- The new firmware connections MonteCarlo 6.2 maintain 100% backwards compatibility with existing MonteCarlo 6.1 applications.
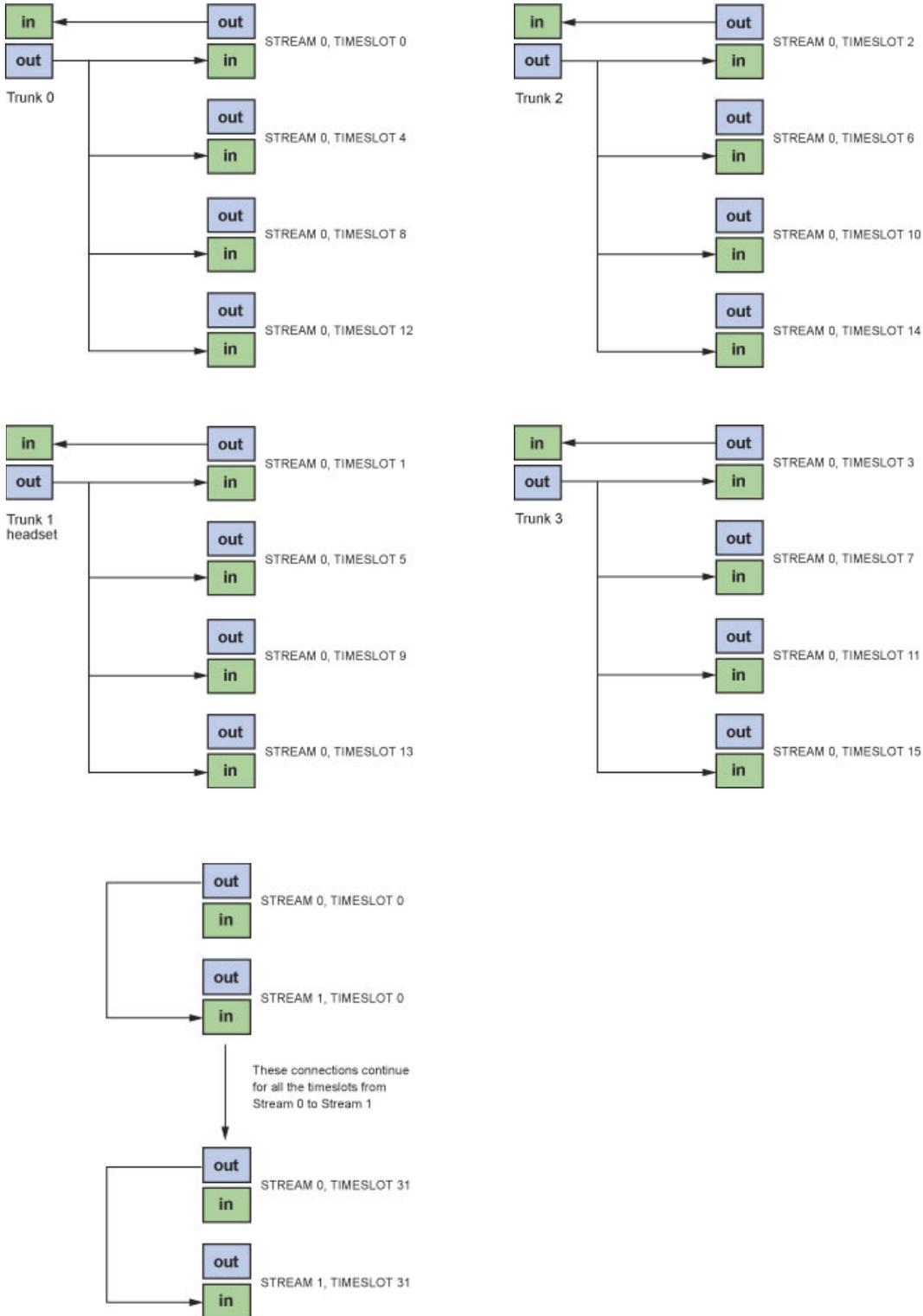
Figure 2.0 – Cross-connect diagram for InLine MM under MonteCarlo 6.2

Implementing the Application

We can implement this application using the InLine MM with MonteCarlo 6.2 as follows (see Figure 2.0).

From Figure 1.0 we see that trunk 0 is connected in full duplex to DSP port 0 (ST0, TS0). This port will be the play port. From it we can stream audio or play an audio file to the trunk.

The output from trunk 0 is connected in half-duplex to the input of DSP port 4 (ST0, TS4). This port will be the record port. We can use it to stream audio out to a VoIP application or record it to a file.

From Figure 1.0, we see that all 32 DSP Timeslot outputs on Stream 0 are cross-connected to a corresponding DSP Timeslot input on Stream 1 on a 1-1 basis. Therefore, the output of the play port (ST0, TS0) is fed to the input of the port at ST1, TS0. For that reason, we can use it as the reference for echo cancellation. We can associate the reference to the echo cancellation port using the PIKA API PK_EC_Initialize.
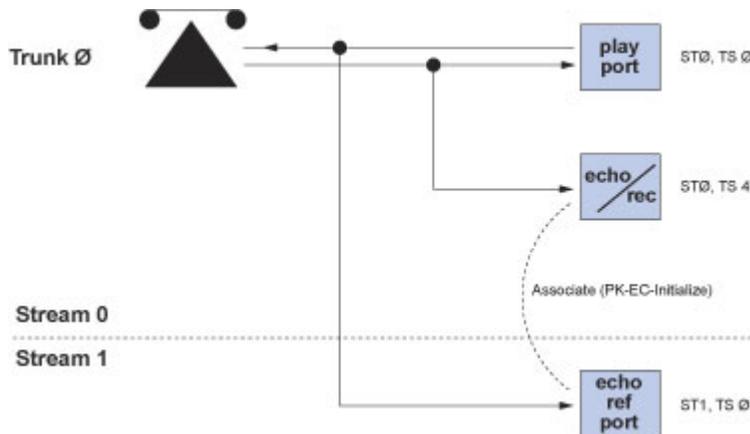

Figure 3.0 – Full Duplex Audio Streaming with Echo Cancellation using InLine MM with MonteCarlo 6.2

Enabling Echo Cancellation

To prevent the echo of the prompt from interfering with the speech recognition engine, echo cancellation must be enabled.

In PikaSetup, an echo cancellation Timeslot and an echo reference Timeslot must be enabled. The echo reference port must be on a different Timeslot than the echo cancellation Timeslot but can be enabled on a Timeslot where other applications are enabled.

In the application, make a call to PK_DSP_DEVICE_SeizePort with the DSP application mask set to PK_ECHO_CANCELLATION; this will seize an echo cancellation resource DSP port.

Then, another call to PK_DSP_DEVICE_SeizePort with the DSP application mask set to PK_ECHO_REFERENCE must be done in order to get the handle of a reference port.

Afterwards, PK_EC_Initialize must be called to associate the echo reference port with the echo cancellation port.

Finally, echo cancellation must be enabled by calling PK_EC_Enable.

Other API Considerations

Note that calling PK_CTBUS_FullDuplexConnect to connect trunk 0 to DSP port 0 will return "PK_SUCCESS" (even though the hardware didn't really do anything -- the connection was already there).

However, attempting to use PK_CTBUS_FullDuplexConnect to make an invalid connection will return "PK_CTBUS_ERR_RESOURCE_NOT_AVAIL" indicating either that resource is not supported by the switch, or a free Stream/Timeslot on the CT Bus cannot be found. This follows because the InLine MM does not have a TDM switch.

Timeslot Configuration in PikaSetup

Figure 4.0 illustrates how Timeslots should be configured in PikaSetup for this application. For simplicity and clarity the Timeslot configuration is shown for one trunk only. Expanding the configuration below for all four trunks is a straightforward matter.

Because the trunk is connected in full duplex to DSP port 0 (Stream 0, Timeslot 0), Timeslot 0 is enabled for audio, tone generation, DTMF detection, etc. (Note: Stream 0 in this article corresponds to physical stream 32 on the InLineMM in PikaSetup.)

The InLineMM's standard cross-connects join the output of the play port (which is our echo reference) to ST1, TS0. Therefore, we must enable echo reference for that Timeslot.

The InLineMM's new cross-connections join the output of trunk 0 to the input of ST0, TS4. Because we wish to perform echo cancellation on that DSP port, we must enable echo cancellation for that Timeslot.
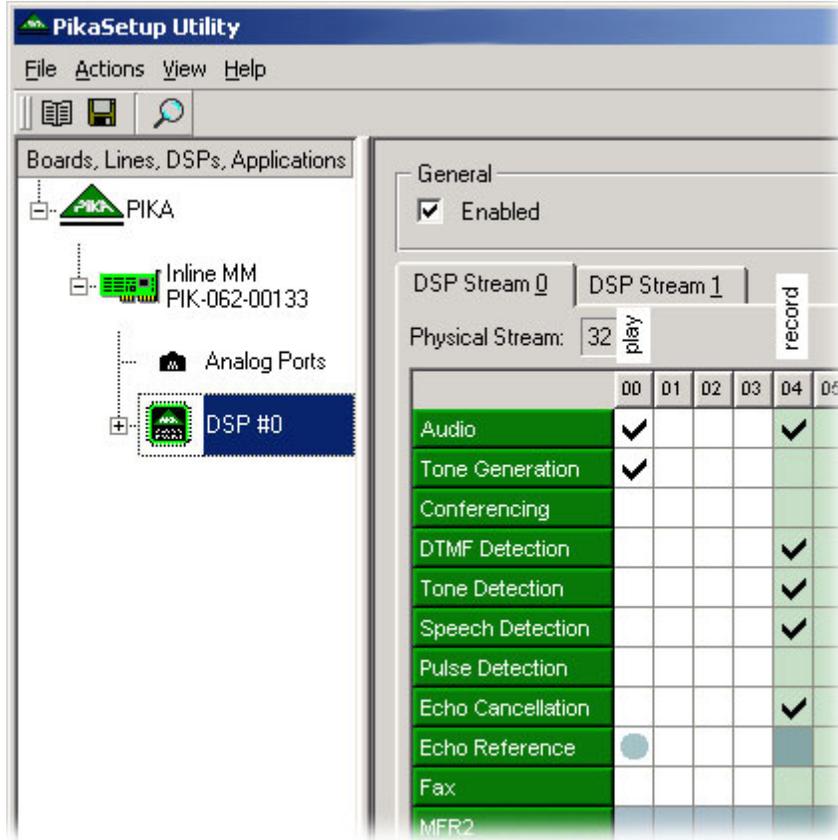
Figure 4.0 - PikaSetup Timeslot configuration for Full Duplex Audio Streaming with Echo Cancellation application using the InLine MM with MonteCarlo 6.2