STUDER – INFINITY CORE – Product Information

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Summary – Product Description

Studer Infinity Core is the new generation of backend processing. It follows a new technology approach that leverages standard IT-technologies like off-the-shelf server components for specific audio processing. The "Infinity Core" uses a completely different technology for audio signal processing to the traditional SHARC (Super Harvard Computing) and FPGA (Field Programmable Gate Arrays) previously used in many DSP engines.

1.1 The past! SHARCs and FPGAs

Digital mixers truly came of age when the SHARC chip became available around 1994, this offered mixer designers off the shelf silicon which runs well in clusters (audio processing needs to process many channels at the same time), has long word lengths and suitable software development tools are available to create audio processing functions. The latest STUDER use of SHARC chips in the Vista 1 uses only 8 of the current generation of SHARC chips to mix nearly the same number of channels like the 1st generation. There has been about a 22 fold increase in the processing power of these SHARC chips over the last 15 years.

Field Programmable Gate Arrays (FPGAs) have become quite widely used in the professional audio industry and they have also become larger over the years. They are basically a huge uncommitted “sea of gates” that may be linked together to form multipliers, registers, adders and so forth. However, programming them to process audio is extremely complex. The lack of suitable tools to build the FPGA code in the field also makes it impossible for customers to construct their own DSP configurations.

Flexibility of configuration is a huge benefit as it allows adapting individual mixer DSP to meet required changes to the configuration after purchase, for example, the provision of surround channels with the advent of high definition TV.

The use of both SHARC and FPGA devices for audio processing always requires significant programming for hardware and software; for this reason most audio DSP engines are replaced only every 5-7 years.

1.2 CPU chips

Standard CPU chips, the x86 types as used in huge numbers for general computing, are very suitable for non-real time signal processing. They are easy to program and many tools are available. Most importantly, the processing power of x86 chips has increased some 5000 fold in the same 15 years that SHARC chips have increased in power some 16 fold. This doubling of power every 18 months is known as “Moore’s Law”. The dream was to take advantage of this effect in STUDER’s new generation DSP engine.

Modern CPUs use multiple hardware “cores” to obtain the huge processing power offered today. Currently high-end CPUs have 8 to 10 cores, each of which may be set to run 2 threads thus doubling the processing power. This “multi-core” technology is very suitable for large scale audio processing due to the parallel requirements of audio mixing engines.

However, there is a huge challenge; x86 CPUs are designed as general purpose processors and every now and then they stop to do some housekeeping such as RAM refreshing or temperature sensing.
This is not a problem for most general purpose computing but a momentary “pause” that results in a single missed audio sample causes an unacceptable click in professional audio, especially working within the exacting standards of broadcast. In order to avoid this problem, normal x86 based audio signal processing adds audio buffering or delay so that CPU interruptions do not affect the flow of audio. For real time “live” audio, this delay or latency is not acceptable. Buffering also reduces the efficiency and thus reduces the channel count.

STUDER discovered a unique way of isolating several of the CPU cores leveraging the Linux OS and stopping these cores from being interrupted. One core is left to run the desk communications and housekeeping whilst the rest of the cores concentrate on audio processing for the highest channel count and without the need for buffering and the consequential audio latency.

### 1.3 Infinity 800 vs. Infinity 400 and Infinity 200

Different types of core are available, both are fitted into the same mechanical chassis; the Core 400 and Core 200 are fitted with a single Intel® Xeon® chip and are capable of processing approximately 400 and 200 Mono Equivalent channels (MEQ) respectively, the Core 800 is fitted with two Intel® Xeon® chips and is therefore capable of processing approximately 800 MEQ. Stereo channels use two MEQs and surround channels 6 MEQs.

Note Groups, Aux, Master “channels” and the like use CPU DSP processing for the channel path in the same way as input channels. However, they do not use the CPU power for the mixing or summing process, this is done by the FPGA in the core link card (see section 2. on the core link card functionality).

Control Group Masters (CGMs) and VCAs do not use CPU DSP power.

STUDER offers a configuration tool to allow users to compile their own DSP configurations. Thus, systems may be set up to exactly match the environment and application in which they will be used.

We recommend that configuration is only administrated by experienced administrator or super user.

### 2 Hardware

The main board within the Infinity Core is a high-end, standard form factor server main board with an Intel chip-set. It is fitted with up to two Intel® Xeon® CPUs and one STUDER PCIe I/O card. Dual power supplies are fitted, with two AC inlets.

The complete electronics is mounted on a sliding frame allowing simple access for service and repair.

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1 an MEQ channel consists of channel input processing (gain, mono sum etc), four band parametric EQ, notch, and HP/LP filters, four section dynamics, insert, channel delay plus fader and pan/balance controls
2.1 Processor Board

Each processor has 10 hardware cores, these hardware cores are then split into 20 virtual cores with hyper threading. Each virtual core provides processing for approximately 25 fully equipped (high quality EQ, Dynamics, Insert, Pan and fader) audio channels of processing.

A single Intel® Xeon® CPU chip provides up to 400 mono equivalent (MEQ) DSP channels and up to 800 MEQ channels if two chips are fitted.

2.2 Core Link Card

A Core Link card installed in every Infinity Core provides two features.

Firstly, an audio interface system to connect the huge number of audio channels into and out of the CPUs. Secondly, it also provides the processing for the mix busses. The mixing or summing element is not provided in the main CPU DSP but is processed in a fast FPGA on the core link card.

![Core Link Card](image)

*Figure 1: Core Link Card*

STUDER has designed a new high capacity digital audio interface called A-Link.

This fibre based audio interface uses a 3 Gb data rate to offer up to 1536 24 bit audio channels per connection. The Core Link card is fitted with 12 A-Link interfaces.

(For more information on A-Link see chapter 7.2 A-Link)

2.3 Software

There are no user setup controls in the Infinity Core itself. The system software runs on a Linux OS and must not be changed or modified by the user. All management and monitoring of the Infinity Core is controlled from the mixer desk.
2.4 **Vista desk monitoring**

The core status can be monitored through the Vista supervisor on the Vista console.

![Vista Core Desk Monitoring](image)

**Figure 2: Surveyor Opening Screen**

### 2.4.1 Mixer Cloud

The opening screen shows the overall status of the system. A new communication protocol comes with the Infinity System, the “mixin cloud”.

This concept allows multiple consoles and cores to co-exist on the same Ethernet network providing enhanced redundancy and feature sharing. In this example, this simple system with one Vista X desk and one Infinity Core are set to “Cloud 1”. This basic setup links the two elements together. Basic setup includes one desk and one core.

The “Node ID” identifies the different elements within the cloud. Each Node ID must be unique within a network.

The Vista application is running a particular DSP configuration as shown in the line “VMC Config” (Infinity_Demo_450_NX.vmc). This is loaded automatically from the desk when opening a Vista title.

This configuration has a unique ID, created by the config tool at build time, and is shown in the mixer config line above (Node ID: 10 in example).
2.4.2 Infinity Core Status

As shown in Figure 2 and 3, clicking on the “Infinity Cores” a green square will open up a further tree showing details of the core.

Figure 3: Surveyor Infinity Core

This gives an overview about the status of the core, it is Online and set as master.

Note it shows the ID of the Mixer configuration; this must be the same as the desk configuration (shown in the fifth line above).

Further diagnostic information can be retrieved opening the I/O Link Node. This shows the status of individual Ports on the core.

Figure 4: Surveyor Infinity Core
3 Redundancy

Complete redundancy is designed into the Infinity system with the overall concept of “no single point of failure” as the overriding design rule. Within a single unit, “no single point of failure” is extremely difficult to achieve. For example, a clock controller, a TDM bus and even a change over switch are single points of failure. Therefore, the Infinity Series is offered as standard with two completely independent cores. Both cores run in the same cloud; they are controlled by the same console surface and get the same audio inputs to produce the same audio outputs.

![Redundancy Diagram](image)

*Figure 5: Typical Vista X redundant Installation*

In the case of a failure of either of the Infinity Cores, the A-Link audio inputs to the I/O frames and any external third party devices such as audio and video routers will instantly switch to receive audio from the other core with no audible disturbance.

When using this redundancy mode opening the surveyor will show the following tree structure:
Figure 6: Surveyor Infinity Core in Redundancy Mode

Two cores now shown in the surveyor (marked in red box above).

Figure 7: Surveyor Infinity Core in Redundancy Mode

As the redundant core has the same Cloud ID and is running the same mixer configuration it will become the redundant DSP engine to this mixer system. Notice the Node ID is different to the main core but it is running the same mixer config.

It is ready to go so is showing “Online” but is not feeding the I/O frame so is not shown as “Audio Master”.
4  IDs

What do IDs mean?

IDs are used to identify each element in the system. Each element (desk, DSP engine, I/O frames) in the mixing console system is connected via Ethernet. The Node ID is used to identify each element uniquely so the software can communicate correctly. Thus each Node ID must be unique.

It is often the case that several consoles will be connected together via Ethernet for resource sharing (such as Studer’s ReLink). It is therefore necessary that each element must also have a second ID to allow each element to know which console system it is a part of; each Vista desk must know which Infinity Core DSP engine (or engines) is processing its audio. This second ID is known as the “Cloud ID” and must be set uniquely for each system.

So in the example above we have a desk with Cloud ID 1 and two Infinity Cores also with Cloud ID 1 (so they are working on the same desk as a redundant pair), each has a different Node ID; respectively 10 for the console, and 42, 43 for the two Infinity Cores.

5  System Setup

The infinity-core offers a web based configuration facility called “Infinity Panel”. It is accessible from the desk or any computer in the network using a Web Browser. It runs by default on port 4000. (Factory Default: 192.168.1.42:4000)

Configuration items of each core are:

- Settings (Cloud Id, Node Id, Communication Port, UPD Multicast settings, Log level)
- Network (Primary and secondary network address)
- Software (Portal for software updates and information about installed SW)
- Control (Remove restart and reboot of the device)
- Log (Log files of the system)

![Infinity Panel Web portal](image)

*Figure 8: Infinity Panel Web portal*
6  Service Mode

If a complete re-imaging or factory reset of the core is required, this can be done using a bootable USB stick and connect a monitor to the VGA port and a keyboard to the USB port.

The USB stick contains software to re-image the core and some further tools for diagnostic purposes like memory checkers.

Software updates and general support is managed from the console using the web interface described in section 5.

7  Connections

7.1  Basics

The Infinity Core has only three types connections; AC power, Audio and Ethernet. All connections are on the front panel.

The unit may be recessed (as shown) to allow the connectors to be protected from inadvertent damage and if a door is fitted to the rack.

It may also be flush mounted or even reversed by moving the side panels. Dual PSUs with two IEC AC inlets are provided.

The two Ethernet connections are normally connected directly to the two switches on the Vista console.

7.2  A-Link

A-Link is a new «super-fast» optical interface comprising a duplex fibre pair of connections capable of carrying up to 1536 24 bit audio channels (plus channel status data).

In this application 11 interfaces are configured to provide 768 mono channels of inputs and 768 mono channels of outputs, port 12 is configured as an Ethernet port to allow embedding of Ethernet data via A-Link to the connected D23m frames.

This allows a total of 8448 inputs and 8448 outputs to and from the Infinity Core. Normally the config tool reduces the quantity of these ports “visible” to the desk operator to those that are connected to active hardware.
These pre-defined settings may be factory adjusted should the user require more than 768 channels to and from specific ports. This may be the case if a large video router is connected on one of the A-Link ports or if newer high channel count D23m I/O cards are used.

A-Link ports must be synchronous to the core word clock.

The A-Link interface uses SFP modules as connectors

![Figure 9: SFP](image)

SFP stands for Small Form-factor Pluggable. These are small modules that plug into the carrier on the card and are available in various optical frequencies and powers according to transmission distance, fibre type and data load. They use “LC” fibre connectors.

Fitted as standard are 4.25Gb/s 850nm Multimode SFPs, this will allow distances of up to 150m with 50μm/125μm fibre between units. For longer distances use Single mode (9μm) types

- Multi-mode SFP Part No. 5042823
- Single-mode SFP Part No. 5042824

### 7.3 External Sync

The Core has no direct word clock input (due to single point of failure rules), and is synchronised directly from the A-Link audio input which has the highest sync priority. It is normal that the first A-Link port is connected to a STUDER D23m I/O frame; this frame should be fed with an external clock from the master Sync Pulse Generator (SPG). This may be AES Digital Audio Reference Signals (DARS), word clock or analogue video reference (Note video reference has no audio clock phase reference so is not recommended for audio applications).

The D23m frame detects if it has a valid external sync input and becomes the clock master by sending a flag to the Infinity cores (over the A-Link stream). All other D23m frames are then slaved to the Infinity Core.

For redundancy a second D23m frame should also be connected to external clock. The Infinity Core can detect this state and create a sync hierarchy; the lowest A-Link input has sync priority.
7.4 LAN

The system must be connected to the LAN of the Vista desk it is linked to. Two LAN connections are recommended for redundancy; one from each desk switch. Once connected it should automatically become visible to the desk.

IP set up is preformed using the web portal. Furthermore there is a need to set up a new core with the correct node and Cloud ID to match the desk settings. A web GUI may be run on the Vista desk to set these parameters. (See section 5)

8 Power and status

8.1 Power Supply and power consumption

A dual redundant PSU is fitted, input 90-264VAC, 47-63Hz, 600 W with twin AC power inputs on standard IEC fixed plugs. In the event that one power supply fails, the other one takes over the full load without interruption. A defective power supply may be exchanged during operation to ensure high system reliability.

Part Number 5045809

![Dual Redundant Power Supply](image1.png)

*Figure 11: Dual Redundant Power Supply*

8.2 Power Supply on/off

To turn the system on simply switch on the AC power by the switches next to the AC power plugs. The blue led ring around the on off button should illuminate to indicate power is available and the fans should start. If the AC is already connected then press the large button as shown here on the right to start up the core. To power down the core simply press the illuminated blue button, the system will shut down (this may take a few seconds).
8.3 Status LEDs on front panel

Three LEDs are fitted below the on/off switch; they display the following information from the Infinity engine.

<table>
<thead>
<tr>
<th>Status</th>
<th>Off</th>
<th>Blink Green</th>
<th>Green</th>
<th>Blink Red</th>
<th>Blink Red</th>
</tr>
</thead>
<tbody>
<tr>
<td>I/O-LINK</td>
<td>Power off</td>
<td>Power up</td>
<td>Core Link card OK</td>
<td>Core Link fan fail</td>
<td>Core Link card error</td>
</tr>
<tr>
<td>SYSTEM</td>
<td>Power off</td>
<td>Waiting for configuration</td>
<td>DSP Processing OK</td>
<td>Sync Loss</td>
<td>DSP or Hardware Error</td>
</tr>
<tr>
<td>ACTIVE</td>
<td>Power off or Slave DSP Processing</td>
<td>Offline Master DSP Processing</td>
<td>Master DSP processing</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

*Figure 12: Infinity Core Status LEDs*
Infinity Core Key Features

9.1 DSP

- Configurable DSP Core via provided configuration tool
- Supported Channel Count:
  - Core 200: 200 MEQ+
  - Core 400: 400 MEQ+
  - Core 800: 800 MEQ+
- Supported Bus Count
  - Up to 768 summation busses
- Tie line patching does not consume DSP (Direct input to output patching)
- Sampling Frequencies: 44.1 kHz, 48 kHz, 88.2 kHz, 96 kHz

9.2 I/O

- Ethernet tunneling via A-Link for connected D23m devices
- I/O Configuration
  - 11x A-Link, 768 Channels each
  - 1x Ethernet connection for Ethernet tunneling via A-Link

9.3 Communication

- 2 Ethernet Network Ports on Main Board
- Communication via UDP Broadcast or UDP Multicast (configurable)
- Static IP Addresses (configurable)
- Static Node identifiers (configurable)

9.4 Redundancy

- System Level redundancy - Multiple cores in parallel
- Redundant Network connections

9.5 Service and Maintenance

- VGA Port for external monitor
- USB Ports
- Web Interface for configuration and software updates
- Bootable USB stick for complete factory re-imaging (requires USB Keyboard and Monitor connected)
Dimensions are in mm