Four channel Wide-band Recording System

System Description Guide

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1. System concept

The purpose of the recording system is to be able to capture and playback four analog signals. The analog signals can be baseband or IF signals. The supported IF center frequencies are 21.4MHz, 70MHz and 160MHz.

The recording system consists of four storage server PCs and a remote control laptop. Each storage server PC is responsible to capture or playback a single analog signal. Each storage server PC is equipped with a RF front-end, a wide-band analog to digital, digital to analog converter card and an adequate RAID storage system, therefore each storage server PC is operating independently from the others. The analog to digital, digital to analog converter card is capable to capture or playback a single analog signal with 80MHz sampling clock, or is capable to capture or playback two analog signals with 40MHz sampling clock. The RF front-end provides the necessary frequency mixing required to be able to capture and playback at the 70MHz and 160MHz IF bands. When baseband signals or the 21.4MHz IF band is used there is no need for frequency mixing.

Each storage server PC runs an instance of a software called SSS-3000 which controls the RF front-end, the capture and the playback. The remote control laptop runs four SSS-3000-Remote remote control applications that can be used to control the SSS-3000 applications running on the storage server PCs over TCP/IP.

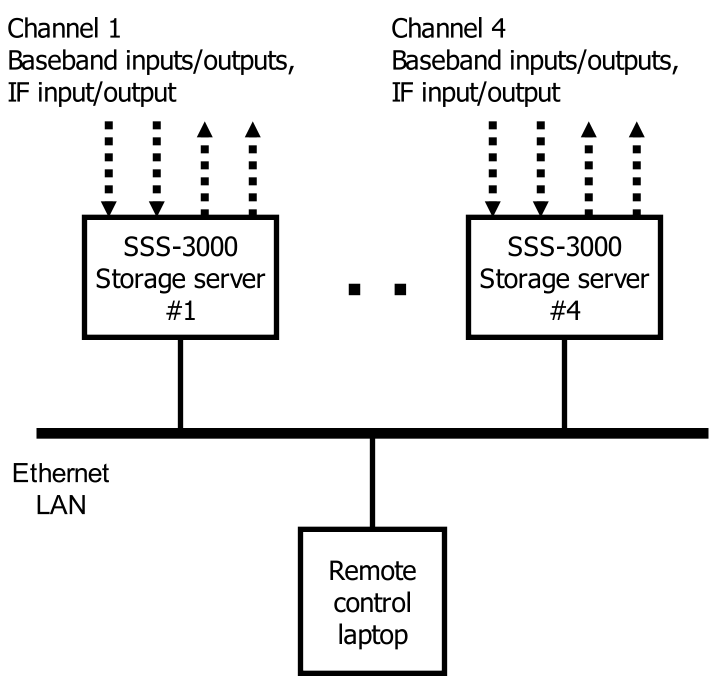

Figure 1: System concept.

2. Storage server components

2.1 RF front-end

The purpose of the RF front-end is to mix and filter the incoming and outgoing signals and to provide the sampling clock for the analog to digital, digital to analog converter card.

The block diagram of the RF front-end is shown on Figure 2. The upper half of the figure shows the connections from the storage server analog inputs to the domain converter card inputs, while the lower half of the figure shows the connections from the domain converter card outputs to the storage server analog outputs.

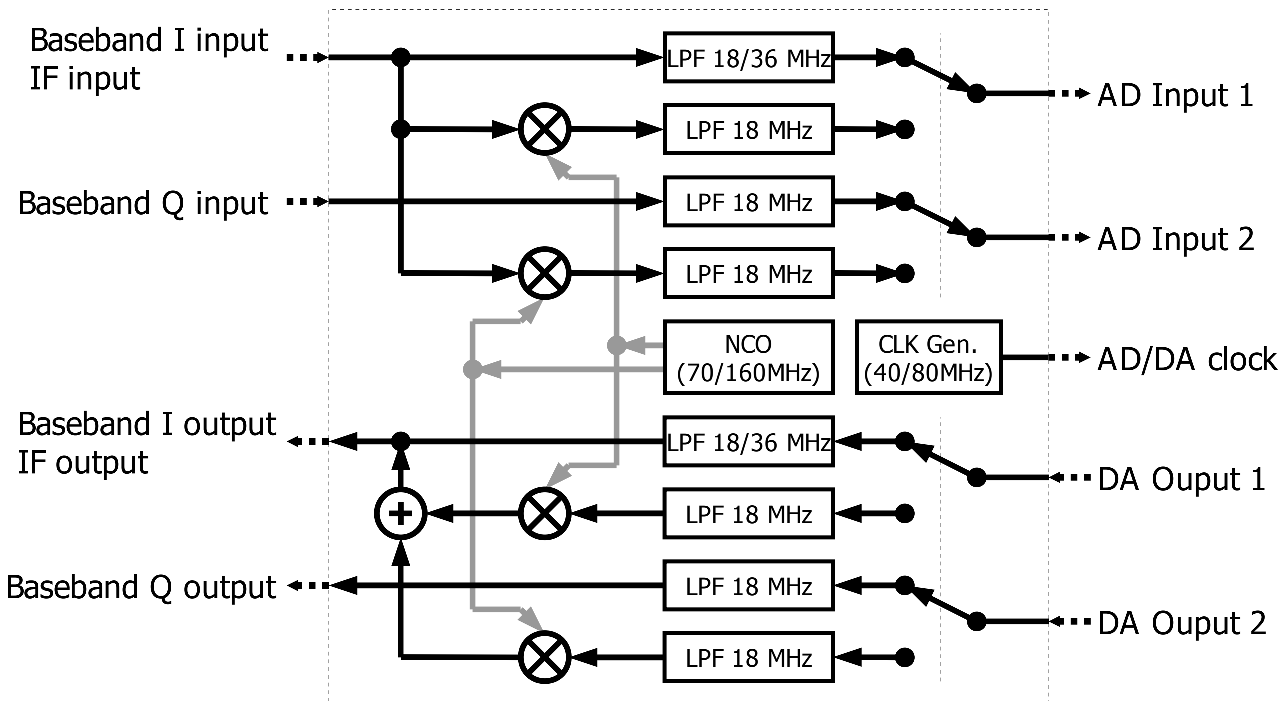

Figure 2: Block diagram of the RF front-end.

When baseband signals are used, the RF front-end connects the Baseband inputs to the AD inputs, and the DA outputs to the Baseband outputs using 18MHz LPFs. The sampling clock is 40MHz in this case, therefore the domain converter card can access 2 channels in the 0-18MHz band. When 21.4MHz IF signals are used, the RF front-end connects the IF input to the AD Input 1, and the DA Output 1 to the IF output using 36MHz LPFs. The sampling clock is 80MHz in this case, therefore the domain converter card can access the 0-36MHz band. When 70MHz or 160MHz IF signals are used, the RF front-end connects the IF input to the AD Inputs, and the DA Outputs to the IF output using 18MHz LPFs and the mixers. The sampling clock is 40MHz in this case, therefore the domain converter card can access 2 channels in the 0-18MHz band, which is after/before the mixing is equivalent to the 70±18MHz (52-88MHz) or 160±18MHz (142-178MHz) band.

The following table summarizes the signal routing in the RF front-end depending on the input or output signal band:

Signal band	AD Input 1	AD Input 2	DA Output 1	DA Output 2	NCO freq.	AD/DA clock
	… is connected to the ...					
Baseband	Baseband I input using a 18MHz LPF.	Baseband Q input using a 18MHz LPF.	Baseband I output using a 18MHz LPF.	Baseband Q output using a 18MHz LPF.	NA	40MHz
IF 21.4MHz	IF input using a 36MHz LPF.	NA	IF output using a 36MHz LPF.	NA	NA	80MHz
IF 70MHz	Mixed IF input using a 18MHz LPF.		IF output using a 18 MHz LPF and the mixer.		70MHz	40MHz
IF 160MHz	Mixed IF input using a 18MHz LPF.		IF output using a 18 MHz LPF and the mixer.		160MHz	40MHz

2.2 Domain conversion

The domain converter card is responsible to convert between the analog and digital domain at 40 or 80MSPS sampling speed. This requirement is fulfilled with the Sagax DCU-304 wide-bandwidth converter card. This card is an 80MSPS, 2 channels per direction, 14-bit resolution analog to digital and digital to analog converter card connecting to a 64bit/66MHz PCI-X bus. (The conventional 32bit/33MHz PCI bus has a theoretical bandwidth limit of 133MByte/sec. The recorder uses a single channel at 80MSPS or two channels at 40MSPS, 2 bytes/samples, that is 160MByte/sec. This is the reason behind the need of the 64bit/66MHz PCI-X interface).

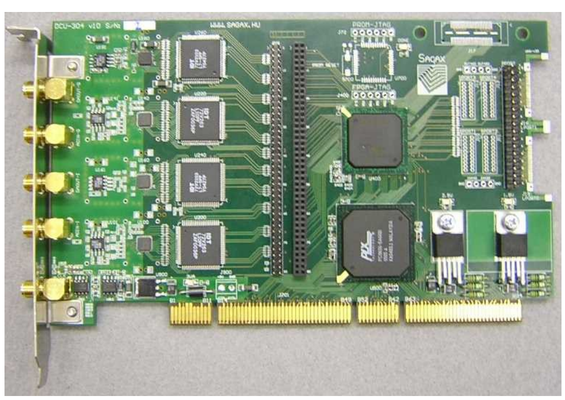

Figure 3: Sagax DCU-304 wide-bandwidth converter card.
(Note: this photo is for illustration purposes only).

2.3 Data Storage

In order to be able to capture or playback a single 80MSPS channel or two 40MSPS channels with 2 bytes/samples, a storage system capable to handle continuous 160MByte/sec writing/reading speed is a must. In order to be able to capture long streams, high capacity disks are required. The RAID system built from five Seagate Barracuda SATA disks with 500GB capacity per disk, fulfills these requirements. The RAID system is only used for striping the data stream between the disks, the array is a RAID 0 array, and therefore it does not utilize redundancy to protect against disk faults. The storage servers can not access each other's storage, therefore at the maximum bandwidth the capacity of the storage system limits the recorded stream to approximately 4 hours and 20 minutes. Note that halving the signal bandwidth doubles the maximum length of the recorded stream.

2.4 Control application

The control application is called SSS-3000, the Sagax Server Storage application. This is a tape recorder like application for the Sagax DCU-304 analog/digital domain converter card, allowing real-time bandwidth decimation during captures and interpolation during playbacks and is also capable to control the RF front-end. The control application can be controlled remotely over a TCP/IP network. For more detailed information on the use of the SSS-3000 application please refer to the *SSS-3000 Sagax Server Storage User's Guide*.

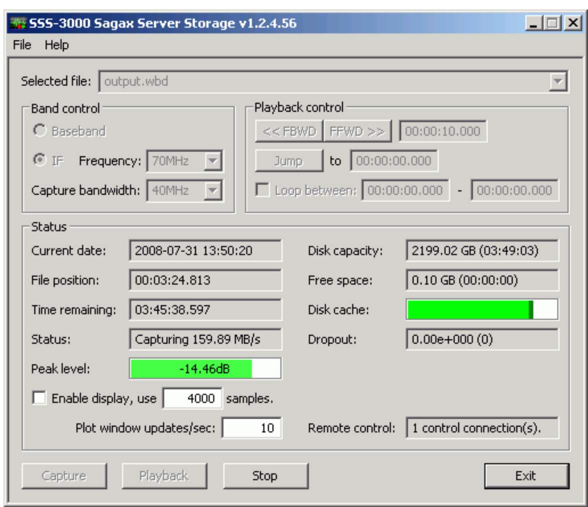

Figure 4: Snapshot of the SSS-3000 control application main window.

Captured signals can be played back at the supported IFs or in baseband, except for when the 21.4MHz IF is used with the full bandwidth (40MHz) configuration. A signal captured at the 21.4MHz IF with full bandwidth can only be played back at the 21.4MHz IF, and full bandwidth signals can be played back at the 21.4MHz IF only if the signal was captured at the 21.4MHz IF.

The following table summarizes the possible Band control settings and the respective bands the storage server can access:

Band mode setting	Bandwidth setting [MHz]	Resulting bandwidth [MHz]	Accessible (pass-)band [MHz]
Baseband	40	36	0 - 18 on both channels
	20	18	0 - 9 on both channels
	10	9	0 - 4.5 on both channels
	5	4.5	0 - 2.25 on both channels
	2	1.8	0 - 0.9 on both channels
	1	0.9	0 - 0.45 on both channels
IF 21.4MHz	40	29.2 (IF centered)	0 - 36
	20	18	12.4 - 30.4
	10	9	16.9 - 25.9
	5	4.5	19.15 - 23.65
	2	1.8	20.5 - 22.3
	1	0.9	20.95 - 21.85
IF 70MHz	40	36	52 - 88
	20	18	61 - 79
	10	9	65.5 - 74.5
	5	4.5	67.75 - 72.25
	2	1.8	69.1 - 70.9
	1	0.9	69.55 - 70.45
IF 160MHz	40	36	142 - 178
	20	18	151 - 169
	10	9	155.5 - 164.5
	5	4.5	157.75 - 162.25
	2	1.8	159.1 - 160.9
	1	0.9	159.55 - 160.45