PJ2T CW Skimmer Server Design Notes

I. Purpose of this Document

This document will provide the details of the PJ2T/VERONA CW Skimmer Server installation. It will serve as a design document, as well as long-term documentation to aid in operation and maintenance.

II. Purpose of the Curacao PJ2T/VERONA CW Skimmer Server

The PJ2T CW Skimmer Server node will copy CW signals from 192-kHz of each of the six contest bands (160-10 meters) and will issue spots to interested stations via telnet. It will operate 24 hours a day, 7 days a week, 365 days a year. Spots from this Server will be available to anyone on the Internet as a telnet node, and it will be made public on the Reverse Beacon Network (RBN).

Our primary purpose for this installation is to have the spots from an off-site CW Skimmer for use at PJ2T during CW contests. In order to make this legal for CQWW and ARRL contest, it must be made publically available for all to use if they want.

Although intended mostly for its value during contests, it will also allow long-term study of propagation on the contest bands from Curacao. It will spot all signals and report the signal strength of each, allowing study of band opening and closing patterns.

III. Location of the PJ2T/VERONA CW Skimmer Server

The PJ2T Skimmer Server will be installed at the VERONA club station site at Red Cross on Schottegatweg Zuid in Willemstad, about ¾-mile WNW of Punda/Otrabanda. The Maidenhead Grid locator is FK52nc, and the latitude/longitude is 12 deg 6.534 minutes N, 69 deg 54.957 minutes W.

A map and Google Earth satellite image of the site are shown below.

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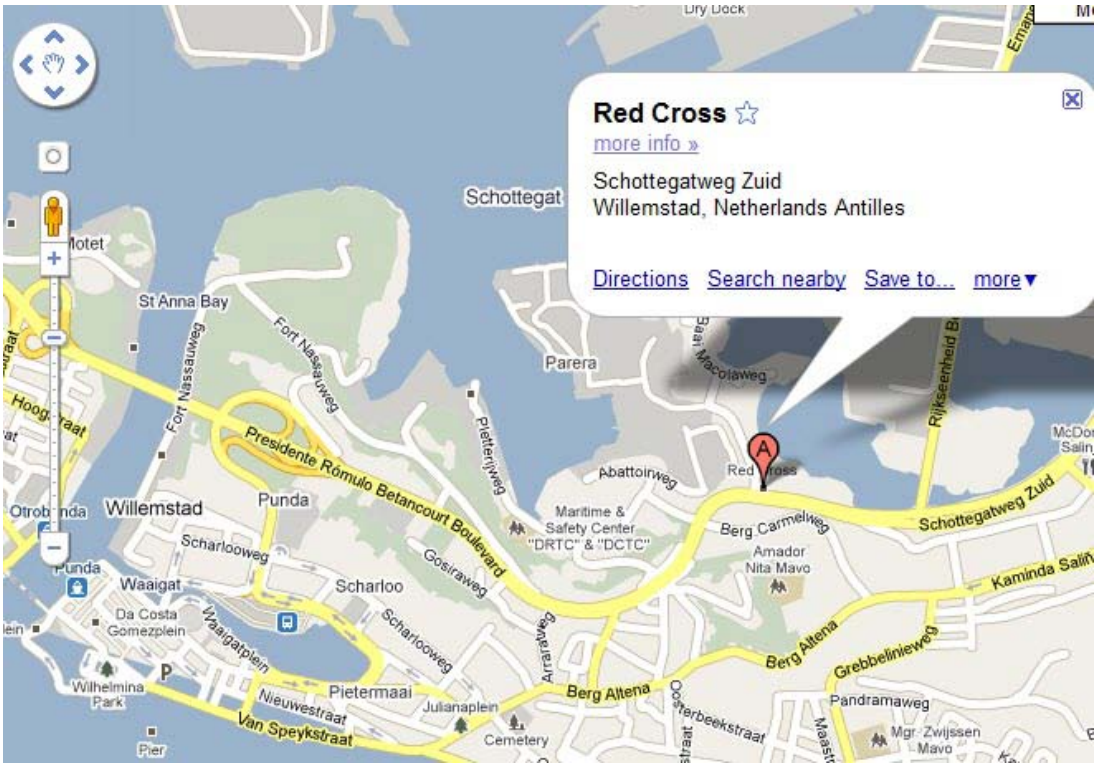

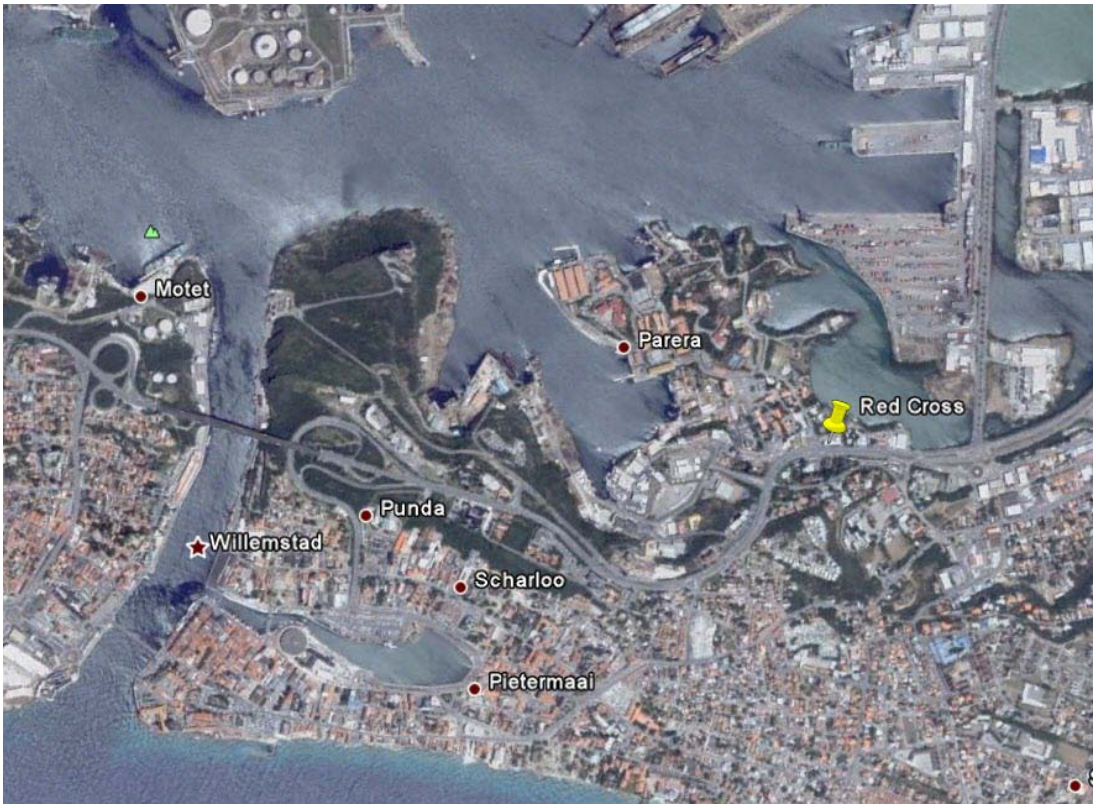

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The room in which the Skimmer Server electronics will be mounted is ***not*** air conditioned, and so all electronics must be capable of handling the ambient heat.

The antenna for the Skimmer Server (a DX Engineering active antenna with two 102-inch whips mounted horizontally) will be mounted on the VERONA crank-up tower, normally nested at a height of approximately 30 feet. When the tower is cranked up, the antenna height will be approximately 60 feet. A photo looking approximately Northeast from the top of the nested tower is below.

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IV. CW Skimmer Server Hardware

A. PJ2T/VERONA CW Skimmer Server Block Diagram

A block diagram of the system, with hyperlinks to information on each component, is shown in Figure 1 (not yet included). It is also online.

B. SRL Quicksilver QS1R Receiver, s/n 100087

The QS1R Receiver is the most advanced open source software direct sampling receiver on the market. It features a Linear Technologies LTC2208 16 bit, 130 MSPS Analog Digital Converter (ADC) and an Altera EP3C25 Cyclone III FPGA. Connectivity to the PC is through a high speed USB 2.0 interface. QS1R covers 10 kHz through 62.5 MHz in its standard configuration and can be used in undersampling applications to 500 MHz.

The QS1R receiver, when used with the Afreet Skimmer Server software, can provide CW decoding of up to 192 kHz of each of seven bands simultaneously, and provide all decoded callsigns heard in the form of telnet spots. Full specifications are at http://www.srl-llc.com/files/qs1r_revd_specs.pdf.

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Connectors: The RF input is by a BNC connector, USB by USB (Type 2/"fat") connector, and power by 2.1mm coaxial connector.
The QS1R, when decoding 7 bands, runs very warm. In operation within a cabinet and in the Caribbean environment, some enhanced cooling is advisable. The QS1R used for the PJ2T CW Skimmer Server has been modified by W8WTS to add a fan and ventilation holes to allow airflow directly on the electronics. See the photos below.

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C. VERONA Network Modem

Nothing is known at this time about the nature of the ISP-provided modem in the VERONA club station / Red Cross room.

Brett Ruiz PJ2BR, provides the following information on the internet connection in use at the VERONA station:

> *"At the moment we have a Linksys DD-WRT (I believe it is called, the hacked 54G model) which is the firewall for the D-Star system. It is planned to move the D-Star to a better location, but the co-location area is not yet ready for us. I would like to move the router along with it, since it took me some time to configure it for D-star op's.*
>
> *"The ISP feed is a Proxim Tsunami MP60 wireless bridge radio, fixed Public IP. The name of the ISP is Scarlet.an*
>
> *"I don't think port 7300 is in use.*

D. Dell Vostro 230 Minitower PC

The Skimmer Server PC was ordered from Dell on 7/23/10 and received on 7/30/10.

Windows 7 Professional 32-Bit
Intel® Core™ 2 Quad Q9500 w/ VT (2.83GHz, 6M, L2Cache, 1333FSB) Q9500
2GB Dual Channel DDR3 SDRAM 1333MHz - 2DIMMs
250 GB SATA Hard Drive (7200 RPM)
Integrated PCIE 10/100/1000 Network Interface
16X (DVD+/-RW) Burner Drive
Norton Internet Security 2010 15-Month subscription

Note that there is no display, keyboard, or mouse included with this PC. Management of this PC will be by Remote Desktop Protocol (RDP). This protocol uses TCP port 3389.

E. Network Router/Firewall: Netgear FVS318G

The Netgear FVS318G gigabit firewall/router will provide the interface between the VERONA/Red Cross network and the Skimmer Server PC. It is a rugged metal-cased device with remote management capability.

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F. Preamplifier Module

The Preamplifier Module includes two preamplifiers, which may be selected manually by re-routing internal coaxial jumpers. The two preamplifiers provide different gains and different operating characteristics.

a. Clifton Labs Z10040B Preamplifier

The Clifton Laboratories Z10040B preamplifier is a low-noise broadband amplifier, providing 10.5 dB of RF gain from 100 kHz to 30 MHz. Power required is a minimum of +13.8 Vdc (to a maximum of +15 Vdc) at around 100 mA.

The Clifton Laboratories Z10080A bypass relay kit is installed, providing a signal path even when power is removed from the preamplifier.

Connectors: The preamplifier has BNC connectors for input and output. Power is provided with a 5.5/2.1 mm DC power connector.

b. DX Engineering RPA-1 Preamplifier

The DX Engineering RPA-1 preamplifier is a low-noise broadband amplifier providing 16 dB of RF gain from 300 kHz to 35 MHz. Power required is 10 – 18 Vdc at 140 mA.

Connectors: The preamplifier has one F-connector and one RCA (phono) connector (in parallel) for both input and output. Power is provided with a 5.5/2.1 mm DC power connector.

G. Highpass/BCB Filter: Clifton Labs Z10020

The Clifton Laboratories Z10020 AM Broadcast Band Reject Filter will reduce the chances of overload of the receiver by nearby AM broadcast transmitters. A performance report of the swept response for this filter was generated by Clifton Labs for this filter.

Connectors: The filter has BNC connectors for input and output.

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H. Signal Limiter: DEO Receiver Guard 2000U

The DEO Receiver Guard 2000U device is a diode-activated switching device which will switch the antenna automatically to ground in the presence of a high-power RF field. It offers protection with very low insertion loss. It is available exclusively from Universal Radio in Reynoldsburg Ohio. Jim, W8WTS reverse-engineered the device to provide a schematic diagram.

The RG-2000U includes a light bulb to serve as a fuse in the signal path. The bulb is a 6.30 Volt 0.150 Amp G-3/12, Miniature BiPin Base 0.350 MSCP, C-6 Filament Design, 5,000 Average Rated Hours, 0.94" Maximum Overall Length. Replacement bulb/fuses are available a Universal Radio, p/n 0339 “DEO Fuse”.

Connectors: The RG-2000U has SO-239 connectors for both input and output.

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I. Active Antenna: DX Engineering DXE-ARAH2-1PE / FVI-1

The antenna for the PJ2T Skimmer Server will be the DX Engineering DXE-ARAH2-1PE Active Horizontal Receive Antenna System.

This antenna offers excellent receiving performance from 100 kHz to 30 MHz using antenna elements only 210 inches long. DX Engineering's unique design makes it vastly superior to traditional active antennas in both strong signal handling and feedline decoupling.

This receiving antenna system operates over a very wide bandwidth with superior strong signal performance. The output Third Order Intercept (TOI) is approximately +30 dBm, which is significantly better than most aftermarket amplifiers and receivers, making this one of the cleanest active antennas on the market. This exceptionally high Third Order Intercept (TOI) reduces or eliminates spurious signals.

The antenna should not display significant directivity, however it will be oriented on the tower essentially broadside North-South.

Power (+13.8 Vdc) to the active antenna is provided on the RG-6 feedline, inserted by the DX Engineering FVI-1 Feedline Voltage Injector. A 1-Amp fuse is in the power lead for the FVI-1, as a short in connecting/disconnecting the feedline can result in damage to this voltage inserter (the feedline carries voltage to the active antenna).

Connectors: The DXE-ARAH2-1PE antenna assembly has an F-connector. The FVI-1 voltage injector has an F-connector for input from the antenna and an RCA connector for output to the receiver.

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J. Power Supply (+5Vdc @ 2+ Amps; 13.8VDC, 2.5+ Amps)

A PC-type power supply (CoolerMaster 500W Extreme Power Plus: RC500-PCARA-US) will provide +5 Vdc for the QS1R receiver, and +12.0 Vdc for the preamplifier, router/firewall, and the DX Engineering active receiving antenna.

K. Feedline Jumpers (BNC)

Commercial instrument BNC cables will be used to connect all internal parts in the RF signal path (the QS1R, preamplifiers, signal limiter, and filter).

L. Feedline: RG-6 (F-Connectors)

The feedline from the DX Engineering FVI-1 Feedline Voltage Injector indoors to the DX Engineering active antennas outside will be RG-6, with F-connectors on both ends.

M. Receiver Parts Packaging

The Skimmer Server receiver electronics are packaged in a PC-type Mini-Tower case, which when combined with the Dell Vostro PC will constitute the complete in-station CW Skimmer Server package.

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N. PJ2T/VERONA CW Skimmer Server Expenses

The cost of this system is substantial, although a portion of the cost is donated. A spreadsheet provides current details.

SRL Quicksilver QS1R Receiver & Power Supply	$1127.38
Clifton Labs Z10040B Preamplifier + Options	$ 120.50
Clifton Labs Highpass/BCB Filter	$ 87.50
DEO Receiver Guard 2000U (x2)	$ 89.98
DX Engineering DXE-ARAH2-1PE Active Receive Antenna	$ 477.35
Dell Vostro 230 MT w/Q9500 Quad-core CPU	$ 989.59
Netgear FVS318G Firewall/Router	$ 136.75
Afreet CW Skimmer / Skimmer Server Software	$ 75.00
Power Supply	?
RF Cables & Adapters (Pasternak)	$499,45
Elecraft PR6 6-Meter Preamplifier	$179.25
Stridberg MC102 Passive Multicoupler	$79.90
RG-6 Feedline (Receiver to Antenna)	?
Total	**$3862.65**

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V. CW Skimmer Server PC Software

A. Windows 7 32-Bit Professional

The Dell Vostro PC was received with the Windows 7 32-bit Professional operating system pre-installed.

B. NTP / Time Server Coordination

The Skimmer Server PC must be configured to keep it's time accurate by utilizing an NTP or Windows time server.

C. Afreet Software, Inc. Skimmer Server

Skimmer Server is a companion package to the CW Skimmer program, created and supported by Alex Shovkoplyas VE3NEA doing business as Afreet Software, Inc.

Skimmer Server is licensed along with the CW Skimmer for $75. A license was purchased on July 30, 2010 specifically for PJ2T by Jeff Maass K8ND.

At the time of installation, Skimmer Server Version 1.2 was the current version, and so the one installed on the PJ2T Skimmer Server PC.

D. Reverse Beacon Network (RBN) Aggregator

The Reverse Beacon Aggregator is a software program that sends the spots from the CW Skimmer Server to the Reverse Beacon Network (RBN) for access by all. This public access is required by contest rules for off-site receivers.

Note that the RBN accepts only Skimmer spots tagged with "CQ", rejecting those with "DE" or no tag identifying the type of transmission decoded.

Some early discussion of the use of the Reverse Beacon Network within the newly-announced ARRL requirements for Skimmers was an email from Pete N4ZR on the CQ-Contest reflector. It is now generally accepted that participating in the RBN satisfies ARRL and CQ rules concerning remote receiver facilities.

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E. K1TTT WinTelnetX Telnet Stream Combiner

WinTelnetX provides protocol translation service between the Skimmer Server software and the AR-Cluster software. The explanation for its function is below.

AR Cluster is able to make one outbound protocol connection.

The outbound protocol connection is usually used to connect to the next higher level in the global spot network. Since node PJ2T-1 is not connected to the global spot network, we don't use this connection.

AR Cluster is also able to make several outbound passive connections. The outbound passive connections provide data redundancy by making non-protocol connections with lateral nodes, i.e., nodes at the same network level. Since node PJ2T-1 is not connected to the global spot network, we don't use the outbound passive connections either.

AR Cluster is purposely not able to make outbound telnet connections (it can accept many inbound telnets, but it can't initiate outbound telnets). This was done to avoid network loops, where the same spot keeps running in circles. Even if AR Cluster could initiate an outbound telnet to SkimmerServer, the connection would not work. The reason is that in order for PJ2T-1 to receive and process spots, the spots have to be in protocol format.

For example, a spot in human format that looks like:

DX de W8/PJ2T-#: 14050.9 F5DM 7 dB 14 WPM 0000Z

would not be processed by AR Cluster. To be processed it needs to be in protocol format:

PC11^14050.9^F5DM^6-Sep-2010^0000Z^ 7 dB 14 WPM^W8/PJ2T-#^w8wts-11^H1^~

WinTelnetX does two functions.

1) It makes two outbound telnet connections, one to SkimmerServer and one to AR Cluster, and plumbs them together. When it makes the connection to the Skimmer Server, it does the logon sequence that SkimmerServer wants to see. When it makes the connection to AR Cluster, it exchanges a few go-arounds of protocol spew that convinces AR Cluster that it is talking to a node, not to an interactive user.

2) It translates all of the spots posted by SkimmerServer from human format to protocol format and sets the hop count to 1 for all protocol spots. This prevents skimmer spots from escaping PJ2T-1 and ending up in non-local networks.

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F. AR-Technology AR-Cluster PacketCluster Front-End

The AR-Cluster Standard Version 4 PacketCluster front-end software package is used to provide filtering of the spots generated through the Skimmer Server. A currently-free license for Version 4 has been obtained for the use of the node IDs 'PJ2T-1' and 'PJ2T-2'. There is an upcoming Version 5, and no information whether the previous license cost of $300 will apply to it.

AR-Cluster was written and is supported by Terry Gerdes AB5K.

G. USB Drivers

The stock Windows USB drivers are suitable for use with the QS1R receiver.

H. Anti-Virus Software

The Dell PC was received with a 15-month subscription to Norton Internet Security 2K10 installed. This has *not* been activated, as annual renewal is expensive.

Instead, the AVG Anti-Virus Free Edition 9.0 was installed.

I. Telnet User IP Logging

It would be useful to log the identity (by IP address) of all users connecting to the Skimmer Server telnet port.

J. Remote Access Configuration

The Skimmer Server PC will be managed by the Windows Remote Console facility.

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VI. CW Skimmer Server Configuration

A. Login Message & Credits

The login message should identify a contact person (with email address) for the PJ1T-1 Skimmer Server, and should credit CCC and VERONA for the facility.

B. Monitored Bands & Bandwidths

The Skimmer Server should be configured to monitor “192 kHz”, which actually monitors 182 kHz of each of the configured band. The following bands should be selected for monitoring:

The Skimmer Server software, when used with the QS1R receiver, can monitor up to seven bands simultaneously. In the most likely configuration, we will operate with the six “contest bands” 160-10 selected plus the 12-meter WARC band. Including the 12-meter band allows it to act as an “early warning” for possibly imminent 10-meter openings.

BAND	MONITORED FREQUENCIES
160 Meters	1800.0 - 1982.0 kHz
80 Meters	3500.0 - 3682.0 kHz
40 Meters	7000.0 – 7182.0 kHz
20 Meters	14000.0 – 14182.0 kHz
15 Meters	21000.0 – 21182.0 kHz
12 Meters	24890.0 – 25072.0 kHz
10 Meters	28000.0 – 28182.0 kHz

With the addition of a duplexer, 6-meter preamp, and a 6-meter antenna, we could monitor six meters instead of 12-meters during non-contest periods. The configuration of the Skimmer Server bands can be done remotely, and without any hardware changes.

The bands would be configured as below for this case:

BAND	MONITORED FREQUENCIES
160 Meters	1800.0 - 1982.0 kHz
80 Meters	3500.0 - 3682.0 kHz
40 Meters	7000.0 – 7182.0 kHz
20 Meters	14000.0 – 14182.0 kHz
15 Meters	21000.0 – 21182.0 kHz
10 Meters	28000.0 – 28182.0 kHz
6 Meters	50000.0 – 50182.0 kHz

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C. Spot Filtering – AR-Cluster

Configuration of the AR-Cluster filters are (tbd).

D. Number of Threads – Skimmer Server

The number of threads can be set from the Skimmer Server "Skimmer" panel. The optimal setting for this parameter will need to be determined experimentally, but the quad core CPU is expected to be four (4).

E. IP Address / Telnet Port

The PJ2T-1 Skimmer Server will be accessible (spots using telnet, administration using remote desktop) via the Internet at the Fully Qualified Domain Name (FQDN) 'dxc.pj2t.org' port 7300,

The fixed IP address is xxx.xxx.xxx.xxx port 7300.

F. QS1R Frequency Calibration

It is important that the QS1R receiver be frequency calibrated to make the reported frequency as accurate as possible.

There is a calibration procedure for the radio, and the correction is in the ServerFiles/qs1rserver.ini file. See the QS1R Wiki, Question 6 for some details.

It has been pointed out that the higher the frequency on which it is calibrated, the more accurate the frequencies will be across all the bands.

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