EVLA Correlator

Network Traffic Performance Analysis

NRC-EVLA Memo# 027

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ABSTRACT

This memo provides an estimate for the amount of traffic among the EVLA correlator subsystems that communicate via network. The estimate includes only "payload", i.e. correlation products and monitor & control data; overhead introduced by the underlying protocols (UDP, Ethernet) is not considered.

Introduction

This memo provides an estimate for the amount of traffic between the following subsystems:

a) MCCC and Station Board – configuration and models

b) MCCC and Baseline Board - configuration

c) Station Board and Fast Formatter – Station Board products data and engineering data

d) Station Board and Radar Data Repository – raw output of the Station Board filter

e) Baseline Board and Fast Formatter – engineering (monitor) data

f) Baseline Board and Correlator Backend (CBE) – data products

g) Correlator Backend and Fast Formatter – data products

Traffic between the following subsystems is not considered in this document:

- EVLA Monitor & Control System (EMCS) and MCCC. Connection between EMCS and MCCC is an external connection. The amount of traffic between EMCS and MCCC will be similar to the amount of traffic between the MCCC and Station Boards.
- MCCC and Correlator Backend (CBE) Master. MCCC and CBE Master will reside on the same computer and will not use the network resources for communication.
- CBE Master and CBE Nodes. Monitor & control data will flow between the CBE Master and CBE Nodes in both directions. Preliminary estimate is that amount of traffic between the CBE Master and CBE Nodes won't exceed the amount of data between the MCCC and Baseline Boards.

- MCCC and Correlator Power Control Computer (CPCC). MCCC and CPCC will reside on the same computer; configuration and other messages that will be exchanged between these two subsystems will *not* use network resources.
- Station Boards and Baseline Boards. Station Boards are directly connected to Baseline Boards; filtered and re-quantized astronomical data from Station Boards does not use network resources (routers).

Terminology

In the tables bellow, data generated by the correlator sub-systems is presented both as the amount of data (number of bytes per second) and amount of traffic (number of bits per second). Although these numbers may be easily derived one from the other, both are shown to allow reader to quickly get appreciation of the required storage and network capacity.

Station Boards

Table 1 shows the worst-case estimate for the amount of output data/traffic generated by the Station Board. Estimates are based on the currently used format. It is assumed that radar mode data will se saved as binary data. The estimate does not include overhead added by the underlying protocols (UDP, Ethernet).

Table 1 Station Board – "worst case" (no integration, radar mode on all the boards)

	Board		Rack	Correlator[1]
Monitor & Control Data	**Amount of Data**	**Traffic**	**Traffic**	**Traffic**
To/from FORM, estimate	2KB/sec	16Kbps	256Kbps	2Mbps
To/from MCCC, including models	6KB/sec	48Kbps	768Kbps	6Mbps
Total M&C Data	8KB/sec	64Kbps	1Mbps	**8Mbps**
Station Board Output				
To FF Computers				
Stats counts and misc.data – no integration	[2]4531KB/sec	35.4Mbps		
Tone Extraction[3] – no integration	360KB/sec	2.8Mbps		
WBC Products - no integration	100KB/sec	0.8Mbps		
Total output without Radar Mode Data	4.8MB/sec	39Mbps	624Mbps	**4.8Gbps**
To Radar Mode Data Repository Radar Mode enabled on all the boards	[4]6.2MB/sec	50Mbps	800Mbps	**6.2Gbps**
Total output with Radar Mode Data	11MB/sec	89Mbps	1.4Gbps	11.1Gbps

[1] Aggregate traffic for all the Station Boards (16 boards per rack * 8 racks = 128 boards)
[2] Total amount of data collected per interrupt 45KB. CRC counters 20KB/640msec.
[3] One tone per filter, for 16 filters, 3.6KB per filter per interrupt
[4] 32KB per filter bank per interrupt (for 8 bit sample).

Table 2 shows a more realistic estimate for the amount of traffic generated by the Station Board; it provides an estimate for the case when integration is performed for all the types of output data where integration is possible (stats counts, clip counts, CRC errors, tone extraction, WBC products). Estimate for the amount of radar data is for the configuration where radar mode is enabled for one baseband pair per station (i.e. per Station Board Quad).

Table 2 Station Board – one second integration (integration number 100)

	Board		Rack	Correlator
Monitor & Control Data	**Data**	**Traffic**	**Traffic**	**Traffic**
To/from FORM, estimate	2KB/sec	16Kbps	256Kbps	2Mbps
To/from MCCC, including models	6KB/sec	48Kbps	768Kbps	6Mbps
Total M&C	8KB/sec	64Kbps	1Mbps	**8Mbps**
Station Board Output				
To FF Computers				
Engineering data, integration number=100	45.3KB/sec	362.4Kbps		
Tone Extraction, integration number=100	3.6KB/sec	28.8Mbps		
WBC Products, integration number=100	1.0KB/sec	8.0Kbps		
Total output without Radar Mode Data	50.0KB/sec	400.0Kbps	6.2Mbps	**50Mbps**
To Radar Mode Data Repository Radar Mode enabled on one baseband pair per station	6400KB/sec	50.0Mbps	200Mbps	**1.56Gbps**
Total output with Radar Mode Data	6450KB/sec	50.4Mbps	206.2Mbps	1.61Gbps

Baseline Board

Table 3 provides an estimate for the Baseline Board input and output traffic. The estimate for the monitor and control data is based on the size of Baseline Board configuration messages.

Baseline Board correlation products are transmitted as frames. Frame size is 1068 Bytes (267*4).

According to the EVLA Project Book, Chapter8, the minimum required integration time for the Baseline Board products is 100msec (Correlator Chip integration + LTA integration). If the minimum integration time is configured for all the products on all the baselines the amount of the output data is as follows:

1068 Bytes * 16 * 64 = 68352 Bytes * 10 = 10MBytes/sec

Table 3 Baseline Board Input & Output

	Board		Rack	Total[5]
Monitor & Control Data	**Data**	**Traffic**	**Traffic**	**Traffic**
To/from MCCC, estimate	5KB/sec	40Kbps	400Kbps	6.2Mbps
To FF Computers, estimate	10KB/sec	80Kbps	800Kbps	12.5Mbps
Total M&C Data	15KB/sec	120Kbps	1.2Mbps	**18.7Mbps**
Correlation Products				
To CBE, integration time=100msec	10MB/sec	80Mbps	800Mbps	**12.5Gbps**
To CBE, at max. output speed 110,000 frames/sec	112MB/sec	896Mbps	8.75Gbps	140Gbps

Conclusions

Figure 1 is a simplified depiction of the EVLA correlator. Dark arrows represent network traffic. Numbers beside arrows represent aggregate network traffic for all the Station Boards, all the Baseline Boards and all the baselines. Numbers in the Figure 1 are based on the Table 2 and Table 3.

Figure 2 shows aggregate traffic for the "worst" case, i.e. for the maximum amount of traffic that can be generated by the Station Board and Baseline Board.

[5] Total for all the Baseline Boards in the system (10 boards per rack * 16 racks = 160 boards)

Figure 1 Aggregate traffic for the Baseline Board integration time of 100msec

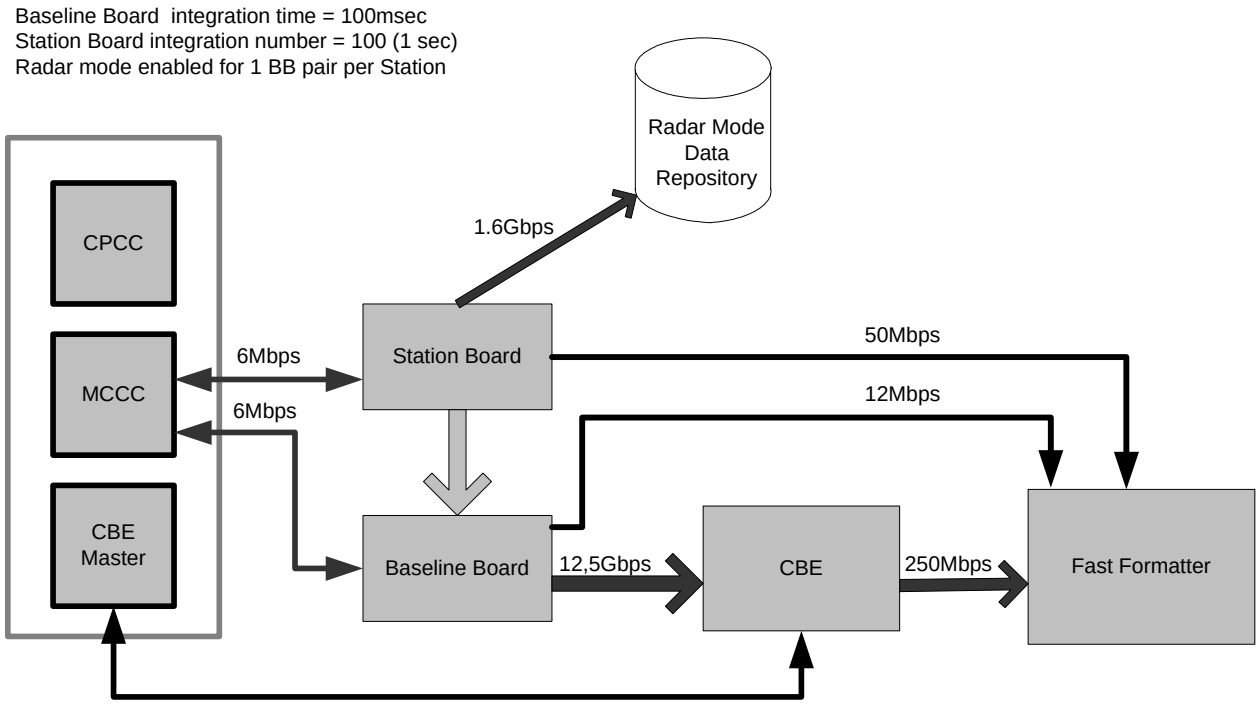
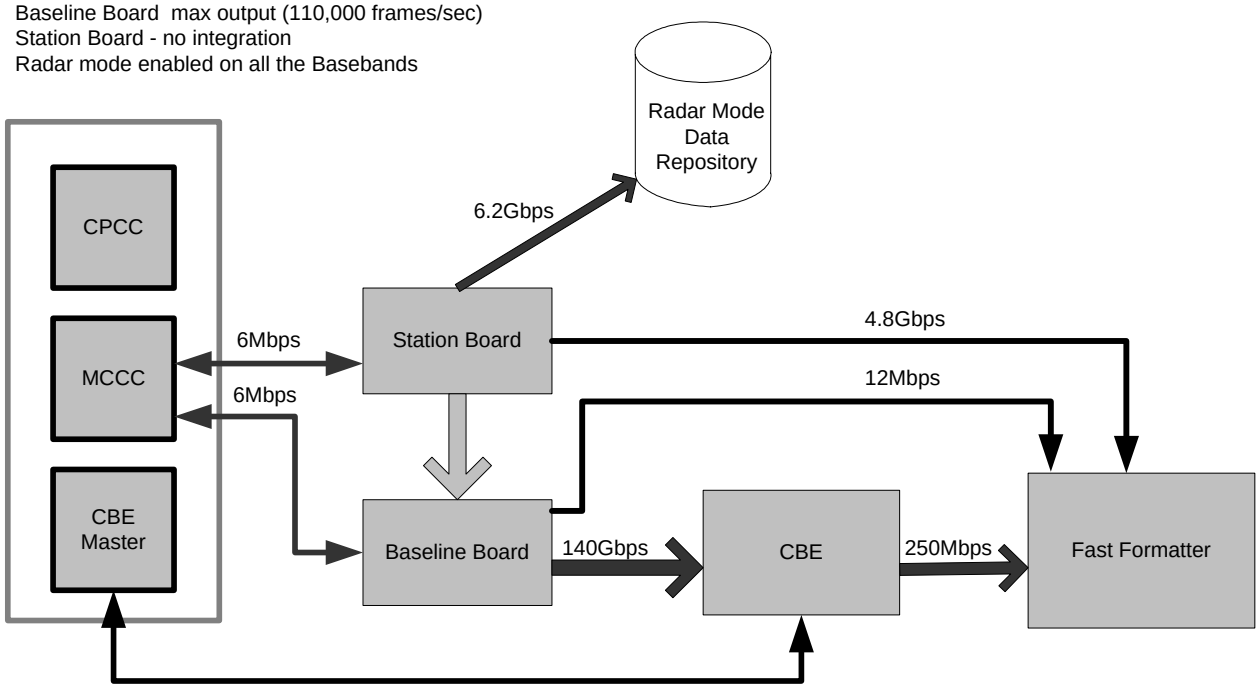


Figure 2 Aggregate traffic for the "worst case" scenario



References

1. The VLA Expansion Project: Construction Project Book, NRAO:

   http://www.aoc.nrao.edu/evla/pbook.shtml

2. EVLA Correlator Chip, Requirements and Functional Specification Document, DRAO Document A25082, Brent Carlson.

3. EVLA Correlator Output Data Format, DRAO Document A25205, Sonja Vrcic.