PLASTIC Software Requirements Document

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Overview of PLASTIC Instrument operation

PLASTIC covers the full azimuthal range (ie. in the ecliptic plane) at all times, but needs to step through energies and polar angles. The polar angle steps from +20 to – 20 degrees in 1.25 degree steps (32 steps). In normal mode, the ESA voltage is stepped in logarithmic increments in 128 steps. For a full cycle, the ESA will sit at one voltage, while the deflector voltages sweeps through their full set of values. Then the ESA voltage will continue to the next step. Each ESA step with a full set of deflection angles will take 455.4 ms, and a full cycle will take 1 minute.

There are two entrance systems for the solar wind ions. One entrance has a large geometric factor, for the low abundance heavy ions, and one entrance has a small geometric factor for the H+ and He++ ions. The heavy ions are observed at the higher energies, while the H+ and He++ are observed at the lower energies in the solar wind. Therefore, when the ESA step has moved into the H+/He++ energy range, the configuration of the deflectors needs to change. The energy at which to switch between the two entrance systems is determined by the DPU.

The PLASTIC instrument is functionally divided into two halves, one which has Solid State Detectors (SSD's) as well as MCP's, and one which just has MCP's. There are two sets of time-of-flight electronics, one for each half. There are four sets of position electronics, one for each quadrant.

Signals and Events

SSD-half

The SSD-half contains two quadrants. Quadrant 0 contains the solar wind sector (45 degrees, centered) with 4 SSD's, and two additional SSD's which map to the wide angle partition. Quadrant 1 contains 4 SSD's and then 45 degrees blockage.

Signals:

Start Signal from MCP
Position signals from resistive Anode (one anode per quadrant) (2)
Stop-1 signal from MCP
Stop-2 signal from SSD
Energy signal from SSD

The exact event logic on this side is still TBD. However all events must have a "start signal" which starts the event, and a position signal. If no stop signal is received, a valid event is still generated, with a TOF of 1023 (maximum value).

Once an event has been processed, the following information is determined, and sent to the classification board.

	Name	range	bits	Notes
ESA step	SWPE	0-128	7	
Deflection step	SWPD	0-32	5	1.25 deg reolution for +/- 20 degrees. Only effects the SW sector (SECTION=0)
Quadrant	Quadrant	0-3	2	Determined from which anode is triggered
Which SSD in the quadrant	SSD_ID	0-5	3	
SSD Energy value	SSDE	0-1023	10	0 = no SSD measurement, SSDE<Threshold also considered zero. Threshold is tbd
Time of flight	TOF	0-1023	10	1023=no TOF
Position in quadrant	POS	0-63	6	(64 steps in 90 degrees is 1.4 degrees/stop)
Instrument section	SECTION	0-2	2	Which portion of the instrument is triggered: 0=SW, 1=ST_with_SSD's, 2=ST_wo_SSD's. This is determined from the quadrant and position in quadrant.

No-SSD half

The No-SSD half of the instrument consists of two quadrants, each with a large set of MCPs which provide the start, stop and position signals.

Signals

Start Signal from MCP
Position signals from resistive Anode (one anode per quadrant) (2)
Stop signal from MCP

The event logic is as follows:

An event starts with a “start” signal from the MCP’s. The electronics waits for a stop signal from the MCP and a position signal from the anode. If there is no stop signal the event is invalid (note this is different from the other half). If there is no position signal, the event is invalid. When a stop signal is received, a time-of-flight is determined, and the following information is sent to the classification board.

	Name	range	bits	Notes
ESA step	SWPE	0-128	7	
Deflection step	SWPD	0-32	5	These bits have no meaning in this half
Quadrant	Quadrant	0-3	2	Determined from which anode is triggered. Should be 2 or 3.
Which SSD in the quadrant	SSD_ID	0-5	3	Has no meaning in this half
SSD Energy value	SSDE	0-1023	10	0 = no SSD measurement
Time of flight	TOF	0-1023	10	1023=no TOF
Position in quadrant	POS	0-63	6	(64 steps in 90 degrees is 1.4 degrees/stop)
Instrument section	SECTION	0-2	2	Which portion of the instrument is triggered: 0=SW, 1=ST_with_SSD's, 2=ST_wo_SSD's. Should be 2 for this half

Data generated by PLASTIC

Classification Board

From E/Q, T, and E, an 8 bit mass bin (NM) and an 8-bit mass per charge bin (NQ) are determined. Events without a valid energy (ie. energy below threshold or Energy=0) will have NM = 0. Note that all events in quadrants 2 and 3 will have NM = 0. Events without a time-of-flight or energy are accumulated only from data in the SW sector.

[See Data Definition Document for in depth discussion of NQ and NM]

We will define rectangular bins in this M vs M/Q space which enclose the major species and charge state groups.

Types of M vs M/Q bins:

Table 1. Accumulated products on Classification board.

Name	Class bins	Pos. bins	Def. bins	Energy steps	# of sections	SECTION *	Total bins	bits/item	Total Bytes	NQ	NM
SW-all	1	32	32	1	1	0	1024	16	2048	all	all
SW-H/alpha-Doubles	2	32	32	1	1	0	2048	16	4096	>0	0
SW_alpha_Triples	1	32	32	1	1	0	1024	16	2048	>0	>0
SW Z>2	15	16	8	1	1	0	1920	16	3840	>0	all
Wide-angle, Triples	15	8	1	1	1	1	120	16	240	>0	>0
Wide-angle, Double	7	8	1	1	2	1,2	112	16	224	>0	0
SW_PHA_Priority_rates	4	1	32	1	1	0	128	16	256	>0	all
WAP_PHA_Priority_rates	4	1	1	1	2	1,2	8	16	16	>0	all
PHA Data							512	48	3072		
Total									15840		

* 0-SW, 1-WAPwSSD ,2=WAP_no_SSD

Notes:
1) SW Z>2 may contain both double and triple coincidence rates
2) Events with no TOF and no Energy are not currently included in the priority rates, and should not go into the PHA. They are only included in the SW-all data product.

PHA Events:

The memory requirements on the DPU are smaller if it can process PHA events on a cycle by cycle basis, instead of on a 5-cycle basis. But our fundamental time resolution for the PHA (based on the Priority Rates) is 5 cycles. In order both to reduce the DPU requirements and to have an easy way to select data from different sections, we will set up the following PHA selection scheme.

During a particular cycle, the classification board will only accumulate the data from1 section. For the 5-cycle period, it will step through a programmable sequence of the sections. The default would be 2 cycles of Section 0 data, 2 cycles of Section 1 data, and 1 cycle of Section 3 data.

Option 1 (no deflection selection). We will divide the PHA buffer into 4 regions, one for each priority. There will be 64 positions for H+ events (P0), 64 for He++ events (P1), and 192 positions for each of two “heavy” priorities (P2 and P3). For each energy step, we just accumulate until each of the buffers are full.

Pros: Simple. Fills buffer if there are events anywhere in the deflection cycle.
Con: May not get an even sampling in the solar wind – will be biased toward the earlier angles in the deflection cycle.

Option 2 (with deflection selection): We will divide the PHA buffer into 4 regions, one for each priority. There will be 64 positions for H+ events, 64 for He++ events, and 192 positions for each of two “heavy” priorities. In order to get a good sample of events from different angles, we will space our collection out throughout the deflection cycle. At the start of the deflection cycle, the buffers are opened to accumulate up to 16 events. These 16 events are divided up: 2 priority 0 (normally H+), 2 priority 1 (normally He++) and 6 priority 2 and 6 priority 3. At the next deflection step, we increment the allowed number of events by another 16 events (agina 2-2-6-6). Note that if the 16 events are not filled on one step, it leaves open slots to be filled in the next steps. After 32 steps, we will have accumulated up to 512 events.

Pros – get sampling from different angles
Cons – If SW deflection step is toward the start of the accumulation interval, we would only accumulate a few of the solar wind ions.

Remember that the WAP does not have deflection, so Option 1 makes more sense for sections 1 and 2. Option 2 could lead to not accumulating all the heavy ions that came in.

This data is sent to the DPU once per energy step. One energy step is completed every 455.4 ms. So the data rate to the DPU from the classifier board is about 278.3 kbps. (or it takes 126.7 ms to read out the data at a 1 MHz rate.) The Classifier board is double-buffered, so that it can begin accumulating on the next energy step while the previous energy step is being read out.

Monitor Rates

The monitor rates measure count rates on individual signals, plus coincidence rates generated by the logic board. There are ~32 monitor rates, which are 16-bit words. PLASTIC will create a packet of monitor rates at each deflection step interval (every 12.8 ms) to be sent to the DPU. For 32*16 =512 bits of monitor rates, the data rate is 40 kpbs.

Housekeeping

The housekeeping will be sent to the DPU in two sets. A “normal priority” housekeeping packet will be sent every 30s. A “high priority” housekeeping packet will be sent every 5 seconds. Table 2 summarizes the data rate to the DPU

Table 2. Housekeeping data to DPU

	Number of items	Bits/item	Total bits	Total bytes	Time interval (s)	Bit rate (bits/s)
Normal Priority HK	40	16	640	80	30	21.33
High Priority HK	8	16	128	16	5	25.6

DPU PLASTIC Processor Tasks

DPU Control tasks

The DPU is responsible for the following tasks:

1) Receiving, decoding and routing commands to the instrument
2) Controlling sweep and deflector HV, including determining energy step to switch between entrance systems.
3) Emergency response.
4) Triggering the “Tracking Mode”, and controlling the stepping sequence for the tracking mode.

Receiving, decoding and routing commands to the instrument

The DPU is responsible for receiving, decoding and routing commands initiated on the ground. We will also define a number of standard configurations for the instrument (e.g. Standby, Maneuver-safe, Calibration). The DPU will store the parameters for these states, and execute them on command.

Controlling deflector voltages

The DPU is responsible for choosing the stepping tables for the ESA and deflectors. There may be more than one table (stepping mode), selectable by command. There will be two sets of deflection tables, one for using the proton/alpha channel and one for using the “Z>2” channel. At the start of a cycle, the Z>2 channel is used. In order to determine the energy step at which to switch to the proton/alpha channel the DPU will need to monitor the data from the previous cycle. Initially, there will be a default switching energy. From the SW proton distribution, the DPU will identify the energy step with the peak number of counts. The energy step at which it switches will then be a constant factor above this peak. That energy step is the switching point for the whole next energy/angle cycle. This will be repeated every cycle (~ 1 min). More details of this are described below, when the treatment of the SW protons and alphas data is discussed.

Emergency Response

The DPU will read critical housekeeping values and execute emergency procedures if the HK values fall out of range. Some examples are:

> If Current limits are exceeded, turn voltages down and instrument off.
> If HV discharges, step the HV back up to nominal value (like CLUSTER)

The DPU may also need to respond to spacecraft flags of critical events. For example it may need to automatically safe the instrument during thruster operations, and then automatically reconfigure the instrument at the end.

Triggering the Tracking Mode

There will be a special mode triggered by other IMPACT instruments, where we need to get high time-resolution proton data, at the expense of the heavy ion data. To do this, the DPU will need to find the peak in the SW proton/alpha distribution. The DPU will then indicate the step in the table where the sequence should start, and the number of steps it should take (e.g. 10 steps around the H+ peak). Our baseline is that we will still step through all 30 polar-angle deflection steps. In this scenario, the DPU still reads the data arrays every 420 ms, and we will get a proton distribution every 4.2 s. We could also reduce the number of angles that we cycle through, but then the DPU would have to read our board more frequently than every 420 ms. The tradeoffs of different implementations need to be discussed with the IMPACT team.

DPU Data Tasks:

There are five types of data that the DPU will process:

1) HK data
2) Monitor rate data
3) Matrix Rate Data (from Classification Board)
4) Raw Event data (PHA data)
5) Beacon Mode data

In all cases the DPU must format the data for telemetry, including adding header information for identifying product type and data collection time.

HK Data

A housekeeping packet containing a number of instrument voltages, currents and temperatures will be sent to the DPU, to be formatted for telemetry. As described above, a normal priority packet will be sent every 30 s and a high priority packet will be sent every 5 sections. The DPU will monitor these values, and check them against established limits. If the values go outside the limits are, a pre-defined procedure will take place. For if a current gets too high, the instrument may be shut off.

A subset of the housekeeping data will be put into telemetry. The telemetry will contain the 48 housekeeping values once/minute. The values will be a snapshot (one out of two of the low-priority, one out of 5 of the high priority).

Monitor Rate data

The monitor rates data consists of the raw rates from individual 16-bit counters and from checks for logical coincidences in the instrument. There will be about 32 rates (exact number TBD). The packet will contain the rate data, the E/Q step, and the deflection step information.

These will be sent in a packet to the DPU every deflection step (every 12.8 ms). From this, two types of data products will be formed. For two rates (selectable, but default would be start rate and start-stop coincidence rate) we would keep full angle/energy/time resolution. For the full set of rates we will create a data product which sums the rates in energy, angle and time to get a smaller set. [Do we want the rates from one cycle, or the summed rates from 5 cycles? This summed product would sent out once every 5 cycles. Each set of 4 adjacent energies, and 4 adjacent deflector angles would be summed.

Table 3. Monitor Rates data products formed by DPU.

	N Rates	N Energies	N Polar	total items	bits/item	total bits	Total bits Compressed	Time res	bits/s
Normal	32	32	8	8192	16	131072	65536	300	218.4
High-res	2	128	32	8192	16	131072	65536	60	1092.2

Matrix Rate Data

The 16-bit accumulators will be sent to the DPU after every deflection cycle (455.4 ms). The contents of the accumulators are listed in table 4. The accumulated data must then be further summed and processed as listed below.

Table 4. Accumulated products on Classification board.

Name	Class bins	Position bins	Deflection bins	Energy steps	# of sections	SECTION*	Total bins	bits/item	Total Bytes
SW-all	1	32	32	1	1	0	1024	16	2048
SW-H/alpha-Doubles	2	32	32	1	1	0	2048	16	4096
SW_alpha_Triples	1	32	32	1	1	0	1024	16	2048
SW Z>2	15	16	8	1	1	0	1920	16	3840
Wide-angle, Triples	15	8	1	1	1	1	120	16	240
Wide-angle, Double	7	8	1	1	2	1,2	112	16	224
SW_PHA_Priority_rates	4	1	32	1	1	0	128	16	256
WAP_PHA_Priority_rates	4	1	1	1	2	1,2	8	16	16
PHA Data							512	48	3072
Total									15840
						* 0-SW, 1-WAPwSSD ,2=WAP_no_SSD			

SW Proton and Alpha data

From the instrument, there are three arrays which contain the solar wind proton and alpha data. The first array contains the proton/alpha data together, with only angular binning. The second contains data classified using the time-of flight: there is a 30-azimuthal bin x 30-polar bin array for each of the two species. The third contains the alpha data classified using the both time-of-flight and energy measurement. By command, we will be able to choose the array used for calculating proton moments, and the array used for calculating alpha moments. A reduced distribution function from all arrays will be telemetered to the ground. If the first array is used for moments, only one set of moments (assumed protons) will be calculated.

So that the DPU does not have to store a whole array of data, the telemetered reduced distribution functions will be based on the peak from the previous cycle. The moments will be calculated over a fixed (commandable) energy range which does not depend on the previous measurements.

The following processing must be done

1) calculate moments for protons, using the commanded array and commanded Emin, Emax
2) calculate moments for alphas, using the commanded array and commanded Emin and Emax
3) Form reduced distribution functions, for protons and alphas. There will be four distribution functions total, from the 4 SW proton/alpha arrays. If the proton peaks are EP (peak energy step), PP(peak position bin) DP(peak deflection bin) and the alpha peaks are EA (peak energy step) PA(peak position bin) DA (peak deflection peak), then the min and max energies and angles to use are given in the following table 5. Note that the energy step counts from high energy to low energy (ie. higher step numbers are lower energies)

Table 5. Bins to use to form the reduced proton and alpha distributions.

Source Array	Reduced Array	Class bin	E min	E max	Esteps	POS min	POS max	Pos bins	DEF min	DEF max	Def bins
SW-all	H_alpha	0	EP+4	EP-15	20	PP-3	PP+4	8	DP-3	DP+4	8
SW-H/alpha-Doubles	H+ Peak	0	EP+4	EP-5	10	PP-3	PP+4	8	DP-3	DP+4	8
SW-H/alpha-Doubles	He++ Peak	1	EA+4	EA-5	10	PA-3	PA+4	8	DA-3	DA+4	8
SW_alpha_Triples	He++ TCR	0	EA+4	EA-5	10	PA-3	PA+4	8	DA-3	DA+4	8

4) determine the energy, deflection angle, and position angle of the peak from the selected proton array. This info is used both to set up the energy step to change entrance systems, and is used to generate the reduced distribution function. [This can be done in real time – for each new packet that comes, check the peak counts against the current peak – if it is higher, replace the EP, PP and DP values.
5) Determine the energy, deflection angle, and position angle of the peak from the alpha-array. Again, this can be done on a packet by packet basis. As each new packet comes in, check the values against the previous peak. If it is higher, replace the EA, PA, and DA values. This will be used to generate the next alpha distribution.

The four distributions will be telemetered every cycle. The header in formation in the packet needs to include the Peak (or first) energy, position, and deflection used in for the array. The moments will be calculated to 16 bits (and not compressed).

Commandable parameters:

Minimum and maximum energy step to use for calculating proton moments
Minimum and maximum energy step to use for calculating alpha moments
Array for proton moments
Array for alpha moments

Heavy Ion Data

The other "matrix rate" products must be accumulated in time, and angle to create "data products" that can be telemetered at our available telemetry rate. The following gives the source arrays, and the summing that needs to be done to generate the final array.

Table 6. Bins to be summed to form the heavy ion distributions.

Source Array	Reduced Array	Sec.	Total Class bins	Summed Energy bins	Total Energy bins	Summed Pos. Bins	Total Pos. bins	Summed Def. Bins	Total Def. Bins	Summed Cycles	total bins	Bits /item	total bits
SW Z>2	SW_Z>2 - H	0	2	1	128	2	8	1	8	5	16384	16	262144
SW Z>2	SW_Z>2 - L	0	13	1	128	2	8	8	1	5	13312	16	212992
Wide-angle, Triples	WAP-SSD_TCR	1	15	1	128	2	4	1	1	5	7680	16	122880
Wide-angle, Double	WAP-SSD_DCR	1	7	1	128	2	4	1	1	5	3584	16	57344
Wide-angle, Double	WAP-noSSD-DCR	2	7	1	128	1	8	1	1	5	7168	16	114688
SW_PHA_ Priority_ rates	SW_Priority_ rates	0	4	1	128	1	1	2	16	5	8192	16	131072
WAP_PHA_ Priority_ rates	WAP_Priority_ SSD	1	4	1	128	1	1	1	1	5	512	16	8192
WAP_PHA_ Priority_ rates	WAP_Priority_ noSSD	2	4	1	128	1	1	1	1	5	512	16	8192
Total storage needed													917504

Raw Event data

We need to collect a sample of raw events, which are used for high resolution science analysis, as well as instrument diagnostics. We want to maximize the number of minor ions collected, and also collect a selection of ions from the different sections of the instrument. Thus we need to have a prioritizing scheme for selecting the ions. The ions need to be tagged with their priority classification. This comes from the classification board. Then, a selection of these events needs to be put into the telemetry.

On the classifier board, the data have already been sorted by section (only one section sent at a time) and by priority. The DPU is responsible for down-selecting the data, but making sure we still emphasize the heavy ions in a full packet. The process would be something like this:

There will be a programmable number of events from each priority, where the total number adds up to 6. For example, the default would be N0 = 1, N1=1, N2=2, N3=2. Then the DPU divides its PHA buffer into an area for prioirty 0 which would equal 128*N0*Event_size. Similarly, it sets up a buffer for the other priorities: 128*N1, 128*N2, 128*N3.

In the default case, the DPU would have a buffer that has room for 768 events, which are divided into 4 segments: 128 P0 events, 128 P1 events, 256 P2 and 256 P3 events

These buffers would be filled in the following way:
1) When the DPU receives a PHA packet it begins to fill the buffers, filling the P0 buffer with priority 0 events, P1 buffer with priority 1 events, etc. As the DPU gets more packets, it continues to fill the buffers.
2) Once a buffer is full, the DPU then begins to overwrite the buffer, starting at the end, and working backward (or starting at the beginning, but pushing events out the end). If the P0 buffer is full, the DPU writes up to N0 events into the buffer from each packet. The DPU needs to keep track of where it is writing, and keep moving backwards through the buffer. (Note this is equivalent to writing at the beginning of the buffer, and pushing events out the back. [Maybe this is an easier way to do it?] Similary, if the P1 buffer is full, it starts overwriting events, putting in up to N1 events per packet.

The required memory in the DPU for this product is 768*48bits = 36864 bits, and it would be sent out once per cycle (every minute).

Beacon Mode Data

The Beacon Mode data will be a subset of the normal data stream, with some small additional processing. Table 7 lists the data products for beacon mode, and the source of the data. There will also be a data quality flag associated with each parameter.

Table 7. Beacon Mode Data

Parameter	Resolution (min)	Bits	Source	Additional Processing
SW H density	1	16	Moments	None
SW He++ density	1	16	Moments	None
SW bulk H velocity (vx,vy,vz)	1	16*3	Moments	None
SW thermal temperature	1	16	Moments	Average Components of temperature tensor
Representative SW Charge states	5	8*5	SW Z>2	Summing selected bins from SWZ>2 matrix rates
Suprathermal rates	5	30*8	WAP_SSD_TCR WAP_SSD_DCR	Summing selected bins from Suprathermal matrix rates

(This is only 50 bytes so far – we could have 263 bytes/minute. We could easily send down all of our moments, for example. Total H+ and alpha moments = 7 bps.)

Summary of Requirements

Tables 8 and 9 give the total data rate to the DPU from PLASTIC, and the total storage requirements for the DPU to accumulate our data products.

Table 8. Total data rate from PLASTIC to the DPU

	Bytes	Time interval (ms)	Data rate (kbps)	Time to read at 1 Mhz (ms)
Classifier Board	15840	455.4	278.26	126.72
Monitor Rates	64	12.8	40.00	0.512
Normal Priority HK	80	30000	0.0213	0.64
High Priority HK	16	5000	0.0256	0.128
Total			318.31	

Table 9. Total data product storage required for DPU

	Size (bits)	Size(bytes)
Matrix Rates	968704	121088
PHA	36864	4608
Moments	416	52
Monitor Rates	262144	32768
HK	768	96
Total	1268896	158612

Tables 10-14 give telemetry tables for the Matrix Rates, moments, PHA, and Monitor Rates and Housekeeping that show the size and time resolution of each data product.

Table 10. Matrix Rate telemetry

	M vs M/Q bins	Energy steps	Pos steps	Def. steps	Number of items	Bits/item	Total Bits	Bits/item	Total bits	Time res (sec)	bits/s
H_alpha	1	20	8	8	1280	16	20480	8	10240	60	170.67
H+ Peak	1	10	8	8	640	16	10240	8	5120	60	85.33
He++ Peak	1	10	8	8	640	16	10240	8	5120	60	85.33
He++ TCR	1	10	8	8	640	16	10240	8	5120	60	85.33
SW_Z>2 - H	2	128	8	8	16384	16	262144	8	131072	300	436.91
SW_Z>2 - L	13	128	8	1	13312	16	212992	8	106496	300	354.99
WAP-SSD_TCR	15	128	4	1	7680	16	122880	8	61440	300	204.80
WAP-SSD_DCR	7	128	4	1	3584	16	57344	8	28672	300	95.57
WAP-noSSD-DCR	7	128	8	1	7168	16	114688	8	57344	300	191.15
SW_Priority_rates	4	128	1	16	8192	16	131072	8	65536	300	218.45
WAP_Priority_SSD	4	128	1	1	512	16	8192	8	4096	300	13.65
WAP_Priority_noSSD	4	128	1	1	512	16	8192	8	4096	300	13.65
Total							968704				1955.84

Table 11. Moments telemetry

Moments	Number	bits/moment	Total bits	Time res(secs)	minutes	bits/s
H-moments	13	16	208	60	1	3.47
alpha-moments	13	16	208	60	1	3.47
Total			416			6.93

Table 12. Monitor rates telemetry

	Rates	Esteps	Deflection Steps	Number of items	Bits/item	total bits	Compressebits/item	Comp. Total bits	Time res (sec)	bits/s
Normal Rates	32	32	8	8192	16	131072	8	65536	300	218.45
High-res rate	2	128	32	8192	16	131072	8	65536	60	1092.27
total						262144				1310.72

Table 13. PHA telemetry

	N_events	bits/event	total bits	Time res(secs)	bits/s
PHA	768	48	36864	60	614.4

Table 14. Total telemetry

	size (bits)	Time res	bits/s
SW proton/alpha Rates	25600	60	426.67
Other Matrix Rates	458752	300	1529.17
Moments	416	60	6.93
Mon_Rates_normal	65536	300	218.45
Mon_Rates_high	65536	60	1092.27
PHA	36864	60	614.40
Housekeeping	768	60	12.80
Total			3900.69

Total does not include packet headers, and other overhead.