# Timing Throughput Analysis:

Timing Throughput Analysis is performed on HDU Communication Software and Display Software.

## 1.1 Communication Software (F4)

Timing throughput analysis is performed on Tasks of HDU Communication Software which are mentioned in HRTP section 9.3.1

Steps followed to perform Timing Throughput Analysis for each of the tasks HDU Communication Software is described in following sections.

**A429 Task:**

Steps followed to perform Timing Throughput Analysis for A429 task.

1. Test Result is accounted with a help of a counter “tick\_counter\_a429” using the gdb script and is logged in “TR\_HSIT\_HDU\_CB\_Timing\_Analysis\_nominal.txt” and “TR\_HSIT\_HDU\_CB\_Timing\_Analysis\_worst.txt”.
2. Log file contains value of counter variable “tick\_counter\_a429” that is the ticks required for completion of a429 task.
3. The maximum value of ticks obtained for “tick\_counter\_a429” is taken into consideration and converted into Milliseconds i.e. 10 ticks = 1ms.
4. The Time percentage obtained for A429 Task is calculated using the below method

Number of times A429 task should reschedule within 1000ms, I = 1000/a

Where,

a = Frequency of A429 task mentioned in SRS

HDU-SRS-CB-DRQ-285

Time taken by A429 task in % = ((I\*T)/S) \* 100

Where,

1. I = Number of times the A429 task should reschedule within the time slice 10000ms.
2. T = Average Time taken by the A429 task to complete execution in milliseconds.
3. S = Time Slice (10000ms)

Calculation

**Nominal:**

I = 1000/10 = 100

= ((100\*1.77)/10000) \*100

= 1.77%

**Worst Case:**

I = 1000/10 = 100

= ((100\*2.34)/10000) \*100

= 2.34%

**Application Task:**

Steps followed to perform Timing Throughput Analysis for Application task.

1. Test Result is accounted with a help of a counter “tick\_counter\_app” using the gdb script and is logged in “TR\_HSIT\_HDU\_CB\_Timing\_Analysis\_nominal.txt” and “TR\_HSIT\_HDU\_CB\_Timing\_Analysis\_worst.txt”.
2. Log file contains value of counter variable “tick\_counter\_app” that is the ticks required for completion of app task.
3. The maximum value of ticks obtained for “tick\_counter\_app” is taken into consideration and converted into Milliseconds i.e. 10 ticks = 1ms.
4. The Time percentage obtained for Application Task is calculated using the below method.

Number of times App task should reschedule within 1000ms, I = 1000/a

Where,

a = Frequency of App task mentioned in SRS

HDU-SRS-CB-DRQ-291

Time taken by Application task in % = ((I\*T)/S) \* 100

Where,

1. I = Number of times the Application task should reschedule within the time slice 10000ms.
2. T = Average Time taken by the Application task to complete execution in milliseconds.
3. S = Time Slice (10000ms)

Calculation:

**Nominal:**

I = 1000/1 = 1000

= ((1000\*0.81)/10000) \*100

= 8.11%

**Worst Case:**

I = 1000/1 = 1000

= ((1000\*1)/10000) \*100

= 10%

**Init Task:**

Steps followed to perform Timing Throughput Analysis for Init task.

1. Test Result is accounted with a help of a counter “tick\_counter\_init” using the gdb script and is logged in “TR\_HSIT\_HDU\_CB\_Timing\_Analysis\_nominal.txt” and “TR\_HSIT\_HDU\_CB\_Timing\_Analysis\_worst.txt”.
2. Log file contains value of counter variable “tick\_counter\_init” that is the ticks required for completion of Init task.
3. The maximum value of ticks obtained for “tick\_counter\_init” is taken into consideration and converted into Milliseconds i.e. 10 ticks = 1ms.
4. The Time percentage obtained for Init Task is calculated using the below method

Number of times Init task should reschedule within 1000ms, I = 1000/a

Where,

a = Frequency of Init task mentioned in SRS

HDU-SRS-CB-DRQ-288

Time taken by Init task in % = ((I\*T)/S) \* 100

Where,

1. I = Number of times the Init task should reschedule within the time slice 10000ms.
2. T = Average Time taken by the Init task to complete execution in milliseconds.
3. S = Time Slice (10000ms)

Calculation:

**Nominal:**

I = 1000/500 = 2

= ((2\*0)/10000) \*100

= 0%

**Worst Case:**

I = 1000/500 = 2

= ((2\*0)/10000) \*100

= 0%

**CBIT Task:**

Steps followed to perform Timing Throughput Analysis for CBIT task.

1. Test Result is accounted with a help of a counter “tick\_counter\_cbit” using the gdb script and is logged in “TR\_HSIT\_HDU\_CB\_Timing\_Analysis\_nominal.txt” and “TR\_HSIT\_HDU\_CB\_Timing\_Analysis\_worst.txt”.
2. Log file contains value of counter variable “tick\_counter\_cbit” that is the ticks required for completion of CBIT task.
3. The maximum value of ticks obtained for “tick\_counter\_cbit” is taken into consideration and converted into Milliseconds i.e. 10 ticks = 1ms.
4. The Time percentage obtained for CBIT Task is calculated using the below method

Number of times CBIT task should reschedule within 1000ms, I = 1000/a

Where,

a = Frequency of CBIT task mentioned in SRS

HDU-SRS-CB-DRQ-341

Time taken by CBIT task in % = ((I\*T)/S) \* 100

Where,

1. I = Number of times the CBIT task should reschedule within the time slice 10000ms.
2. T = Average Time taken by the CBIT task to complete execution in milliseconds.
3. S = Time Slice (10000ms)

Calculation:

**Nominal:**

I = 1000/60 = 16.66

= ((16.66\*4)/10000) \*100

= 0.66%

**Worst Case:**

I = 1000/60 = 16.66

= ((16.66\*4)/10000) \*100

= 0.66%

**Log Task:**

Steps followed to perform Timing Throughput Analysis for Application task.

1. Test Result is accounted with a help of a counter “tick\_counter\_log” using the gdb script and is logged in “TR\_HSIT\_HDU\_CB\_Timing\_Analysis\_nominal.txt” and “TR\_HSIT\_HDU\_CB\_Timing\_Analysis\_worst.txt”.
2. Log file contains value of counter variable “tick\_counter\_log” that is the ticks required for completion of log task.
3. The maximum value of ticks obtained for “tick\_counter\_log” is taken into consideration and converted into Milliseconds i.e. 10 ticks = 1ms.
4. The Time percentage obtained for Log Task is calculated using the below method.

Number of times Log task should reschedule within 1000ms, I = 1000/a

Where,

a = Frequency of App task mentioned in SRS

HDU-SRS-CB-DRQ-521

Time taken by Log task in % = ((I\*T)/S) \* 100

Where,

1. I = Number of times the Log task should reschedule within the time slice 10000ms.
2. T = Average Time taken by the Log task to complete execution in milliseconds.
3. S = Time Slice (10000ms)

Calculation:

**Nominal:**

I = 1000/10 = 100

= ((100\*0.11)/10000) \*100

= 0.11%

**Worst Case:**

I = 1000/10 = 100

= ((100\*0.14)/10000) \*100

= 0.14%

**Idle Task:**

Steps followed to perform Timing Throughput Analysis for Idle task:

1. The Time percentage obtained for Idle Task is calculated using the below method

Time taken for Idle Task in % = 100 – B

Where,

B = Sum of all the tasks in %.

Formula:

Time taken for Idle Task: 100 – (A429 Task + App Task + Init Task + CBIT Task + Log Task)

Calculation:

**Nominal:**

= 100 - (1.77 + 8.11 + 0 + 0.66 + 0.11)

= 100 – 10.66

= 89.35%

**Worst Case:**

= 100 - (2.34 + 10 + 0 + 0.66 + 0.14)

= 100 – 13.17

= 86.83%

## 1.2 Display Software (F7)

Timing throughput analysis is performed on Tasks of HDU Display Software which are mentioned in HRTP section 9.3.2

Steps followed to perform Timing Throughput Analysis for each of the tasks HDU Display Software is described in following sections.

**Application Task:**

1. Test Result is accounted with a help of a counter “tick\_counter\_app” using the gdb script and is logged in “TR\_HSIT\_HDU\_DB\_Timing\_Analysis\_nominal.txt” and “TR\_HSIT\_HDU\_DB\_Timing\_Analysis\_worst.txt”.
2. Log file contains value of counter variable “tick\_counter\_app” that is the ticks required for completion of app task.
3. The maximum value of ticks obtained for “tick\_counter\_app” is taken into consideration and converted to Milliseconds i.e. 10 ticks = 1ms.
4. The Time percentage obtained for Application Task is calculated using the below method.

Number of times App task should reschedule within 10000ms, I = 10000/a

Where,

a = Frequency of App task mentioned in SRS

HDU-SRS-DB-DRQ-385

Time taken by Application task in % = ((I\*T)/S) \* 100

Where,

1. I = Number of times the task should reschedule within the time slice 10000ms.
2. T = Average Time taken by the task to complete execution in milliseconds.
3. S = Time Slice (10000ms)

Calculation:

**Nominal:**

I = 10000/20 = 500

= ((500\*2.65)/10000)\*100

= 13.29%

**Worst Case:**

I = 10000/20 = 500

= ((500\*1.66)/10000)\*100

= 8.32%

**Init Task:**

1. Test Result is accounted with a help of a counter “tick\_counter\_init” using the gdb script and is logged in “TR\_HSIT\_HDU\_DB\_Timing\_Analysis\_nominal.txt” and “TR\_HSIT\_HDU\_DB\_Timing\_Analysis\_worst.txt”.
2. Log file contains value of counter variable “tick\_counter\_init” that is the ticks required for completion of app task.
3. The maximum value of ticks obtained for “tick\_counter\_init” is taken into consideration and converted to Milliseconds i.e. 10 ticks = 1ms.
4. The Time percentage obtained for Init Task is calculated using the below method

.

Number of times Init task should reschedule within 10000ms, I = 10000/a

Where,

a = Frequency of Init task mentioned in SRS

HDU-SRS-DB-DRQ-388

Time taken by Init task in % = ((I\*T)/S) \* 100

Where,

1. I = Number of times the task should reschedule within the time slice 10000ms.
2. T = Average Time taken by the task to complete execution in milliseconds.
3. S = Time Slice (10000ms)

Calculation:

**Nominal:**

I = 10000/500 = 20

= ((20\*0)/10000)\*100

= 0%

**Worst Case:**

I = 10000/500 = 20

= ((20\*0)/10000)\*100

= 0%

**CBIT Task:**

1. Test Result is accounted with a help of a counter “tick\_counter\_cbit” using the gdb script and is logged in “TR\_HSIT\_HDU\_DB\_Timing\_Analysis\_nominal.txt” and “TR\_HSIT\_HDU\_DB\_Timing\_Analysis\_worst.txt”.
2. Log file contains value of counter variable “tick\_counter\_ cbit” that is the ticks required for completion of app task.
3. The maximum value of ticks obtained for “tick\_counter\_ cbit” is taken into consideration and converted to Milliseconds i.e. 10 ticks = 1ms.
4. The Time percentage obtained for CBIT Task is calculated using the below method

Number of times Cbit task should reschedule within 10000ms, I = 10000/a

Where,

a = Frequency of Cbit task mentioned in SRS

HDU-SRS-DB-DRQ-443

Time taken by Cbit task in % = ((I\*T)/S) \* 100

Where,

1. I = Number of times the task should reschedule within the time slice 10000ms.
2. T = Average Time taken by the task to complete execution in milliseconds.
3. S = Time Slice (10000ms)

Calculation:

**Nominal:**

I = 10000/600 = 16.66

= ((16.66\*0.02)/10000)\*100

= 0%

**Worst Case:**

I = 10000/600 = 16.66

= ((16.66\*0)/10000)\*100

= 0%

**A825 Communication#1 Task:**

1. Test Result is accounted with a help of a counter “tick\_counter\_a825\_1” using the gdb script and is logged in “TR\_HSIT\_HDU\_DB\_Timing\_Analysis\_nominal.txt” and “TR\_HSIT\_HDU\_DB\_Timing\_Analysis\_worst.txt”.
2. Log file contains value of counter variable “tick\_counter\_a825\_1” that is the ticks required for completion of app task.
3. The maximum value of ticks obtained for “tick\_counter\_a825\_1” is taken into consideration and converted to Milliseconds i.e. 10 ticks = 1ms
4. The Time percentage obtained for A8251 Task is calculated using the below method

Number of times A825 Communication Task#1 task should reschedule within 10000ms, I = 10000/a

Where,

a = Frequency of A825 Communication Task#1 mentioned in SRS

HDU-SRS-DB-DRQ-394

Time taken by A825 Communication Task#1 in % = ((I\*T)/S) \* 100

Where,

1. I = Number of times the task should reschedule within the time slice 10000ms.
2. T = Average Time taken by the task to complete execution in milliseconds.
3. S = Time Slice (10000ms)

Calculation:

**Nominal:**

I = 10000/25 = 400

= ((400\*0.05)/10000)\*100

= 0.22%

**Worst Case:**

I = 10000/25 = 400

= ((400\*0.09)/10000)\*100

= 0.38%

**A825 Communication#2 Task:**

1. Test Result is accounted with a help of a counter “tick\_counter\_a825\_2” using the gdb script and is logged in “TR\_HSIT\_HDU\_DB\_Timing\_Analysis\_nominal.txt” and “TR\_HSIT\_HDU\_DB\_Timing\_Analysis\_worst.txt”.
2. Log file contains value of counter variable “tick\_counter\_a825\_2” that is the ticks required for completion of app task.
3. The maximum value of ticks obtained for “tick\_counter\_a825\_2” is taken into consideration and converted to Milliseconds i.e. 10 ticks = 1ms
4. The Time percentage obtained for A8252 Task is calculated using the below method

Number of times A825 Communication Task#2 task should reschedule within 10000ms, I = 10000/a

Where,

a = Frequency of A825 Communication Task#2 mentioned in SRS

HDU-SRS-DB-DRQ-397

Time taken by A825 Communication Task#2 in % = ((I\*T)/S) \* 100

Where,

1. I = Number of times the task should reschedule within the time slice 10000ms.
2. T = Average Time taken by the task to complete execution in milliseconds.
3. S = Time Slice (10000ms)

Calculation:

**Nominal:**

I = 10000/1000 = 10

= ((10\*0)/10000)\*100

= 0%

**Worst Case:**

I = 10000/1000 = 10

= ((10\*0)/10000)\*100

= 0%

**Poller Task:**

1. Test Result is accounted with a help of a counter “tick\_counter\_poller” using the gdb script and is logged in “TR\_HSIT\_HDU\_DB\_Timing\_Analysis\_nominal.txt” and “TR\_HSIT\_HDU\_DB\_Timing\_Analysis\_worst.txt”.
2. Log file contains value of counter variable “tick\_counter\_poller” that is the ticks required for completion of app task.
3. The maximum value of ticks obtained for “tick\_counter\_poller” is taken into consideration and converted to Milliseconds i.e. 10 ticks = 1ms
4. The Time percentage obtained for Poller Task is calculated using the below method

Number of times Poller task should reschedule within 10000ms, I = 10000/a

Where,

a = Frequency of Poller task mentioned in SRS

HDU-SRS-DB-DRQ-391

Time taken by Poller task in % = ((I\*T)/S) \* 100

Where,

1. I = Number of times the task should reschedule within the time slice 10000ms.
2. T = Average Time taken by the task to complete execution in milliseconds.
3. S = Time Slice (10000ms)

Calculation:

**Nominal:**

I = 10000/1 = 10000

= ((10000\*0)/10000)\*100

= 0%

**Worst Case:**

I = 10000/1 = 10000

= ((10000\*0)/10000)\*100

= 0%

**Demo Task:**

1. Test Result is accounted with a help of a counter “tick\_counter\_demo” using the gdb script and is logged in “TR\_HSIT\_HDU\_DB\_Timing\_Analysis\_nominal.txt” and “TR\_HSIT\_HDU\_DB\_Timing\_Analysis\_worst.txt”.
2. Log file contains value of counter variable “tick\_counter\_demo” that is the ticks required for completion of app task.
3. The maximum value of ticks obtained for “tick\_counter\_demo” is taken into consideration and converted to Milliseconds i.e. 10 ticks = 1ms
4. The Time percentage obtained for Demo Task is calculated using the below method

Number of times Demo task should reschedule within 10000ms, I = 10000/a

Where,

a = Frequency of Demo task mentioned in SRS

HDU-SRS-DB-DRQ-516

Time taken by Demo task in % = ((I\*T)/S) \* 100

Where,

1. I = Number of times the task should reschedule within the time slice 10000ms.
2. T = Average Time taken by the task to complete execution in milliseconds.
3. S = Time Slice (10000ms)

**Nominal:**

I = 10000/1 = 10000

= ((10000\*0.01)/10000)\*100

= 1.03%

**Worst Case:**

I = 10000/1 = 10000

= ((10000\*0.019)/10000)\*100

= 1.93%

**Idle Task:**

Steps followed to perform Timing Throughput Analysis for Idle task:

1. The Time percentage obtained for Idle Task is calculated using the below method

Time taken for Idle Task in % = 100 – B

Where,

B = Sum of all the tasks %.

Formula:

Time taken for Idle Task: 100 – (App Task + Init Task + CBIT Task + A825 Communication Task#1 +

A825 Communication Task#2 + Poller Task+ Demo Task)

Calculation:

**Nominal**

= 100 - (13.29 + 0 + 0 + 0.22 + 0 + 0 + 1.03)

= 85.46%

**Worst Case**

= 100 - (8.32 + 0 + 0 + 0.38 + 0 + 0 + 1.93)

= 89.37%

# 2. Timing Throughput Analysis Result

## 2.1 Communication Software (F4)

Summary of Timing Throughput Analysis Results for each task of HDU Communication Software

| **SL No** | **Task** | **Task Percentage Nominal** | **Task Percentage Worst Case** |
| --- | --- | --- | --- |
| 1 | A429 Task | 1.77% | 2.34% |
| 2 | Application Task | 8.11% | 10% |
| 3 | Init Task | 0% | 0% |
| 4 | CBIT Task | 0.66% | 0.66% |
|  |
| 5 | Log Task | 0.11% | 0.14% |  |
|  | Total Task Time in percentage | 10.66% | 13.17% |  |
|  |
| Total Idle Time in percentage | 89.34% | 86.83% |  |

**Conclusion**:

**Nominal:**

A) The total time taken by the processor to complete the entire task’s execution is: 10.66%

B) The total idle time of the processor is: 89.35%

**Worst Case:**

A) The total time taken by the processor to complete the entire task’s execution is: 13.17%

B) The total idle time of the processor is: 86.83%

Note:

1. Maximum Time (T) taken by the each task to complete execution is calculated by taking average of all the ticks of that particular task.

## 2.1 Display Software (F7)

Summary of Timing Throughput Analysis Results for each task of HDU Display Software

| **SL No** | **Task** | **Task Percentage** | **Task Percentage** |
| --- | --- | --- | --- |
| **Nominal** | **Worst Case** |
| 1 | Application Task | 13.29% | 8.32% |
| 2 | Init Task | 0% | 0% |
| 3 | CBIT Task | 0% | 0% |
| 4 | A825 Communication#1 | 0.22% | 0.38% |
| 5 | A825 Communication#2 | 0% | 0% |
| 6 | Poller Task | 0% | 0% |
| 7 | Demo Task | 1.03% | 1.93% |
|  | Total Task Time in percentage | 14.54% | 10.63% |
|  |
|  | Total Idle Time in percentage | 85.46% | 89.37% |  |

**Conclusion**:

**Nominal**

A) The total time taken by the processor to complete the entire task’s execution is: 14.54%

B) The total idle time of the processor is: 85.46%

**Worst Case**

A) The total time taken by the processor to complete the entire task’s execution is: 10.63%

B) The total idle time of the processor is: 89.37%

Note:

1. Maximum Time (T) taken by the each task to complete execution is calculated by taking average of all the ticks of that particular task.
2. Obtained value of time taken(%) by Init task is zero but, the time taken(%) by Init task is estimated to be 0.001% as it does initialization and toggling of the LED which will not consume much of the processor time.
3. A825 Communication#1 task is about the messages transmitted between Communication board and Display board. The rate at which the messages are sent and received between Communication board and Display Board is 50ms, since there are two arinc channels the frequency of A825 Communication#1 task is taken as 25ms.
4. A825 Communication#2 task is about the communication between DUs. The rate at which the messages are processed by DUs is 1Hz, hence the frequency of A825 Communication#2 task is taken as 1000ms.
5. Obtained value of time taken(%) by A825 Communication#2 task is zero but, the time taken(%) by A825 Communication#2 task is estimated to be 0.001% as it processes messages received on A825 channel#2 and the time taken by the task to do so is less.
6. Frequency of Poller task is 1ms.Observed value of Poller task is zero as Time taken by the task to complete execution in milliseconds is very less.