

# APP4RTA

For Analyzing Response Time & End-to-End Event-Chain Latency

The screenshot shows the APP4RTA Java application interface. It has two main tabs: 'AMALTHEA MODEL' and 'EVENT CHAIN MODEL'.

**AMALTHEA MODEL Tab:**

- Task Name:** OS\_Overhead, Lidar\_Grabber, DASM, CANbus\_polling, EKF, Planner, PRE\_SFm\_gpu, PRE\_Localizat..., PRE\_Lane\_det..., PRE\_Detection..., SFM, Localization, Lane\_detection, Detection.
- PU Num:** 4, 1, 1, 3, 4, 0, 3, 3, 0, 6, 2, 5, 6.
- Buttons:** Default IA, Enter IA, Synchronous (radio button), Asynchronous (radio button), Worst-Case (radio button), Average-Case (radio button), Best-Case (radio button), Calculate, Reset.
- Data Tables:**
  - 0: Denver Response Time: Planner PRE\_Detectio 13358534500 73565439500
  - 1: Denver Response Time: DASM Lidar\_Grabber 1302430000 p 18265272000
  - 2: A57 Response Time: Localization 392590097500
  - 3: A57 Response Time: CANbus\_polli PRE\_SFm\_gp PRE\_Lane\_de PRE\_Localiza 602880000 ps 26771995000 0 ps (GPU Task) 0 ps (GPU Task)
  - 4: A57 Response Time: EKF OS\_Overhead 4788430000 p 73942150000
  - 5: A57 Response Time: Lane\_detectio 56045200000
  - 6: GPU\_def Response Time: SFM Detection 20000000000 p 20000000000 p
- Metrics:** Cumulated Memory-Access Cost (5361668000 ps), Cumulated Contention (24795710000 ps), Computation (635075050500 ps), Response Time Sum (665232428500 ps).

**EVENT CHAIN MODEL Tab:**

- Communication Paradigm:** CA-EK-P-DA, Direct (radio button), Implicit (radio button).
- Direct & Implicit Communication Paradigm:**
  - WC Reaction: 81302942000 ps
  - BC Reaction: 16086298500 ps
- LET Communication Paradigm:**
  - WC Reaction: 800000000000 ps
  - BC Reaction: 450000000000 ps
- Task Chain Age (Direct & Implicit):**
  - WC Age: 52500000000 ps
  - BC Age: 47500000000 ps
- Task Chain >:**
  - 1: Core3 (A57) CANbus\_polling
  - 2: Core4 (A57) EKF
  - 3: Core0 (Denver) Planner
  - 4: Core1 (Denver) DASM
- Data Age:**

Contained Labels	Worst-case Age	Best-case Age
Occupancy_grid_host	17900000000 ps	12100000000 ps
Vehicle_status_host	10200000000 ps	9800000000 ps
x_car_host	15780000000 ps	12100000000 ps
y_car_host	15780000000 ps	12100000000 ps
yaw_car_host	15780000000 ps	12100000000 ps
vel_car	15780000000 ps	12100000000 ps
yaw_rate	15780000000 ps	12100000000 ps
steer_objective	5250000000 ps	4750000000 ps
steer_desire	5250000000 ps	4750000000 ps
steer_error	17900000000 ps	12100000000 ps

Before executing the code, please install the Java GUI software.

- To install Java GUI softwares:
  1. Eclipse > 'Help'
  2. 'Install New Software' > Work with: Eclipse Repository (<http://download.eclipse.org/releases/oxygen>)
  3. 'General Purpose Tools' > all click from 'Swing Designer' to 'WindowBuilder XML Core' (requires Eclipse WTP/WST)'
  4. 'Next' > 'Next' > 'accept' > 'Finish'

APP4RTA

**AMALTHEA MODEL**  **Search Amalthea**

Task Name PU Num

1. Select an Amalthea Model

Response Time & Mapping Analysis Part

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**EVENT CHAIN MODEL**

**Direct & Implicit Communication Paradigm**

WC Reaction   
BC Reaction

**LET Communication Paradigm**

WC Reaction   
BC Reaction

**Data Age**

Contained Labels   
Worst-case Age   
Best-case Age

Calculate Reset  Direct  Implicit Task Chain > WC Age   
BC Age

Early Reaction (Direct & Implicit)  
WC E-Rct   
BC E-Rct

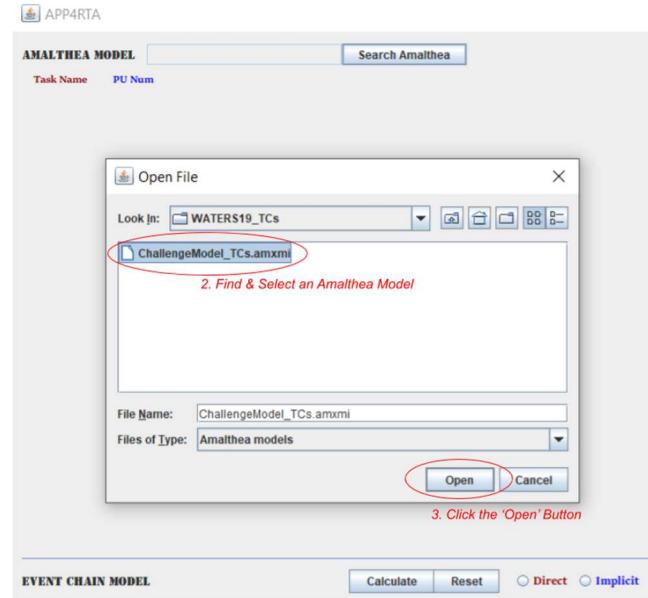
End-to-End Event-Chain Latency Part

Run `APP4RTA.java` in `org.eclipse.app4mc.gsoc\_rta.ui` package, then this window will show up.

Based on the horizontal line on the middle, the upper part is for response time & mapping analysis, and the lower part is for end-to-end event-chain latency analysis.

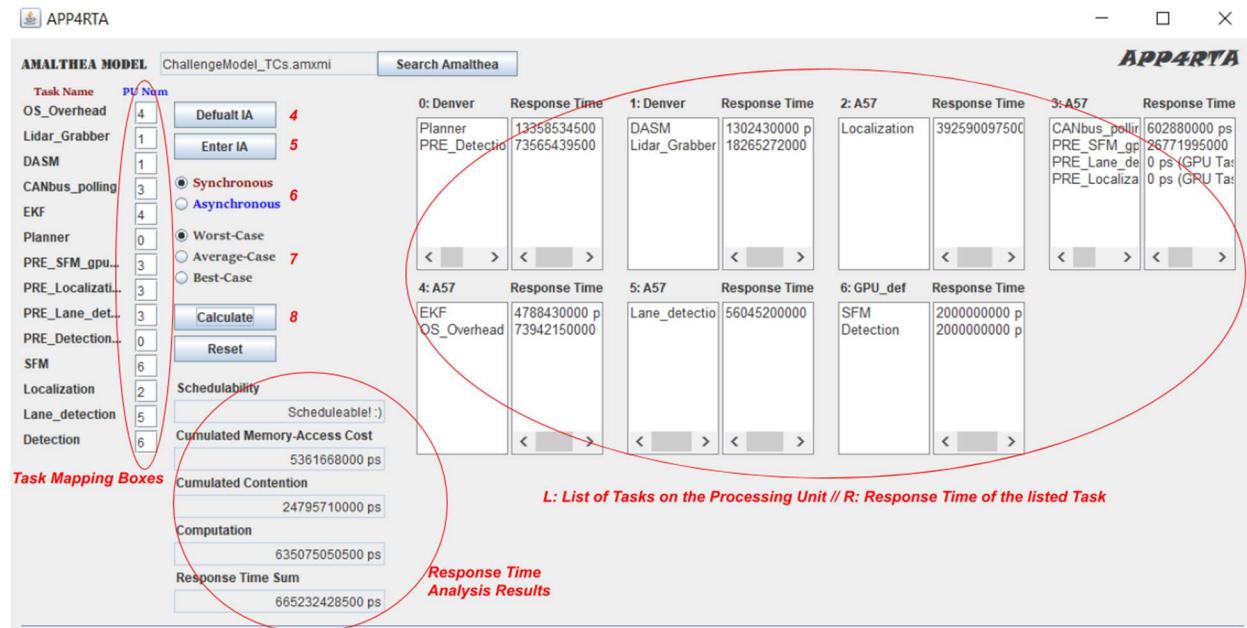
The first thing to do is deciding a target Amalthea model.

1. The window browser for searching Amalthea models shows up when the `Search Amalthea` button clicked.



2. When the search browser shows up, direct to the path where the target Amalthea model file is located and select the model file.

3. Click the `Open` button.



Then the empty space will be filled with the the tasks and processing units of the selected model.

On the left-hand side, tasks' names with empty boxes can be found.

On the right-hand side, seven pairs of lists are seen (It means the selected model has seven processing units).

The list on the left side of each pair is for listing names of the tasks which are mapped to the corresponding processing unit while one on the right side is for listing response times of the corresponding tasks.

Basically, we can map the tasks with these boxes by entering the number of each processing unit which is stated on the top of the lists on the left-side.

4. The user can either manually type numbers for every box or simply click the 'Default IA' button which would automatically fill up every box with the pre-defined integer array values.
5. Once every 'PU Num' box is filled, click 'Enter IA' button to assign tasks to processing units according to each integer value. Once this is done, the mapped tasks would appear on the left-side lists.
6. Choose the offloading mode between 'Synchronous' case and 'Asynchronous' case.
7. Choose the execution case between 'Worst' case and 'Average' case and 'Best' case.
8. By clicking the 'Calculate' button, all calculation results will be printed out on the text-fields ('Schedulability', 'Cumulated Memory-Access Cost', 'Cumulated Contention', 'Computation').

The screenshot shows the APP4RTA tool interface with two main sections: Amalthea Model and APPARTA.

**Amalthea Model:**

- Task Name:** OS\_Overhead, Lidar\_Grabber, DASM, CANbus\_polling, EKF, Planner, PRE\_SFM\_gpu, PRE\_Localizati..., PRE\_Lane\_det..., PRE\_Detection..., SFM, Localization, Lane\_detection, Detection.
- PU Num:** 4, 1, 1, 3, 4, 0, 3, 3, 0, 6, 2, 5, 6.
- Buttons:** Default IA, Enter IA, Calculate, Reset.
- Execution Case:** Synchronous (radio button selected), Asynchronous, Worst-Case, Average-Case, Best-Case.
- Text Fields:** Cumulated Memory-Access Cost (5361668000 ps), Cumulated Contention (24795710000 ps), Computation (635075050500 ps), Response Time Sum (665232498500 ps).

**APPARTA:**

Processor	Task	Response Time
0: Denver	Planner PRE_Detectio...	13358534500 73565439500
1: Denver	DASM Lidar_Grabber	1302430000 p 18265272000
2: A57	Localization	392590097500
3: A57	CANbus_pollir PRE_SFM_gp...	602880000 ps 26771995000 ps
4: A57	EKF OS_Overhead	4788430000 p 73942150000
5: A57	Lane_detectio...	56045200000
6: GPU_def	SFM Detection	2000000000 p 2000000000 p

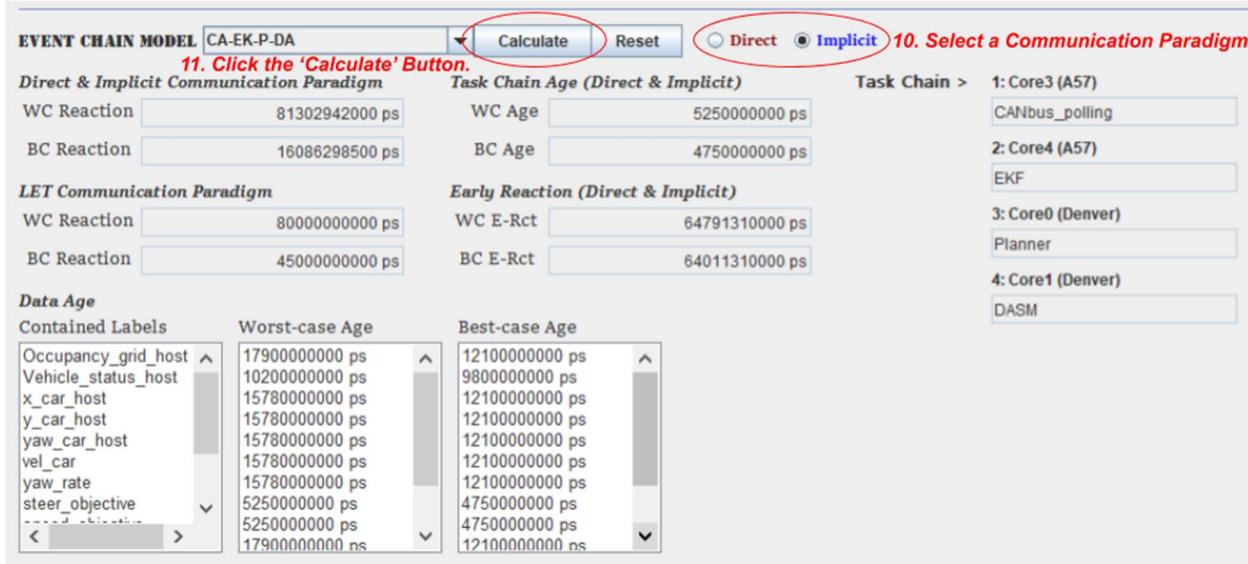
**Event Chain Model:**

- Direct & Implicit Communication:** LD-P-DA, SF-P-DA, CA-P-DA, CA-EK-P-DA, CA-Lo-EK-P-DA, Li-Lo-EK-P-DA, Li-P-DA, D-P-DA.
- Task Chain:** Task Chain Age (Direct & Implicit), WC Age, BC Age.
- Reactions:** Direct Reaction (Direct & Implicit), Indirect Reaction (Direct & Implicit), C-E-Rct, BC E-Rct.
- Data Age:** Contained Labels, Worst-case Age, Best-case Age.

A red circle highlights the 'Direct & Implicit Communication' section of the Event Chain Model.

The event-chain combo-box becomes visible once the user clicks 'Enter IA' to assign tasks to processing units according to each integer value in the boxes.

9. To analyze end-to-end event-chain latency, an event-chain in the combo-box should be selected first.



**EVENT CHAIN MODEL** CA-EK-P-DA    **11. Click the 'Calculate' Button.**

**Direct & Implicit Communication Paradigm**

WC Reaction	81302942000 ps	WC Age	5250000000 ps
BC Reaction	16086298500 ps	BC Age	4750000000 ps

**LET Communication Paradigm**

WC Reaction	80000000000 ps	WC E-Rct	64791310000 ps
BC Reaction	45000000000 ps	BC E-Rct	64011310000 ps

**Task Chain Age (Direct & Implicit)**

**Task Chain >**

- 1: Core3 (A57)
- CANbus\_polling
- 2: Core4 (A57)
- EKF
- 3: Core0 (Denver)
- Planner
- 4: Core1 (Denver)
- DASM

**Data Age**

Contained Labels	Worst-case Age	Best-case Age
Occupancy_grid_host	17900000000 ps	12100000000 ps
Vehicle_status_host	10200000000 ps	9800000000 ps
x_car_host	15780000000 ps	12100000000 ps
y_car_host	15780000000 ps	12100000000 ps
yaw_car_host	15780000000 ps	12100000000 ps
vel_car	15780000000 ps	12100000000 ps
yaw_rate	15780000000 ps	12100000000 ps
steer_objective	5250000000 ps	4750000000 ps
	5250000000 ps	4750000000 ps
	17900000000 ps	12100000000 ps

10. Select the communication paradigm between direct Communication and implicit communication.

11. Finally, click the 'Calculate' button.

Then all calculation results regarding reaction, age of data, task-chain in the worst and best cases will be printed out to the corresponding text fields or lists.