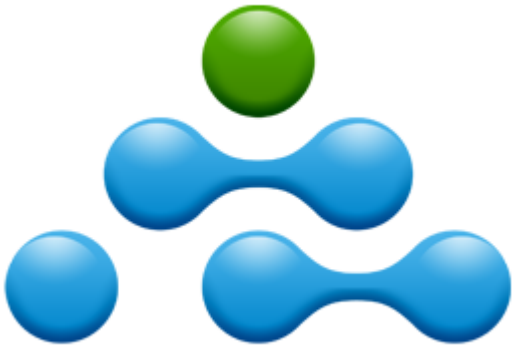

Avoiding overwhelming external systems by events coming from IEC 61499 control applications

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Agenda

INTELLIGENT SYSTEMS GROUP

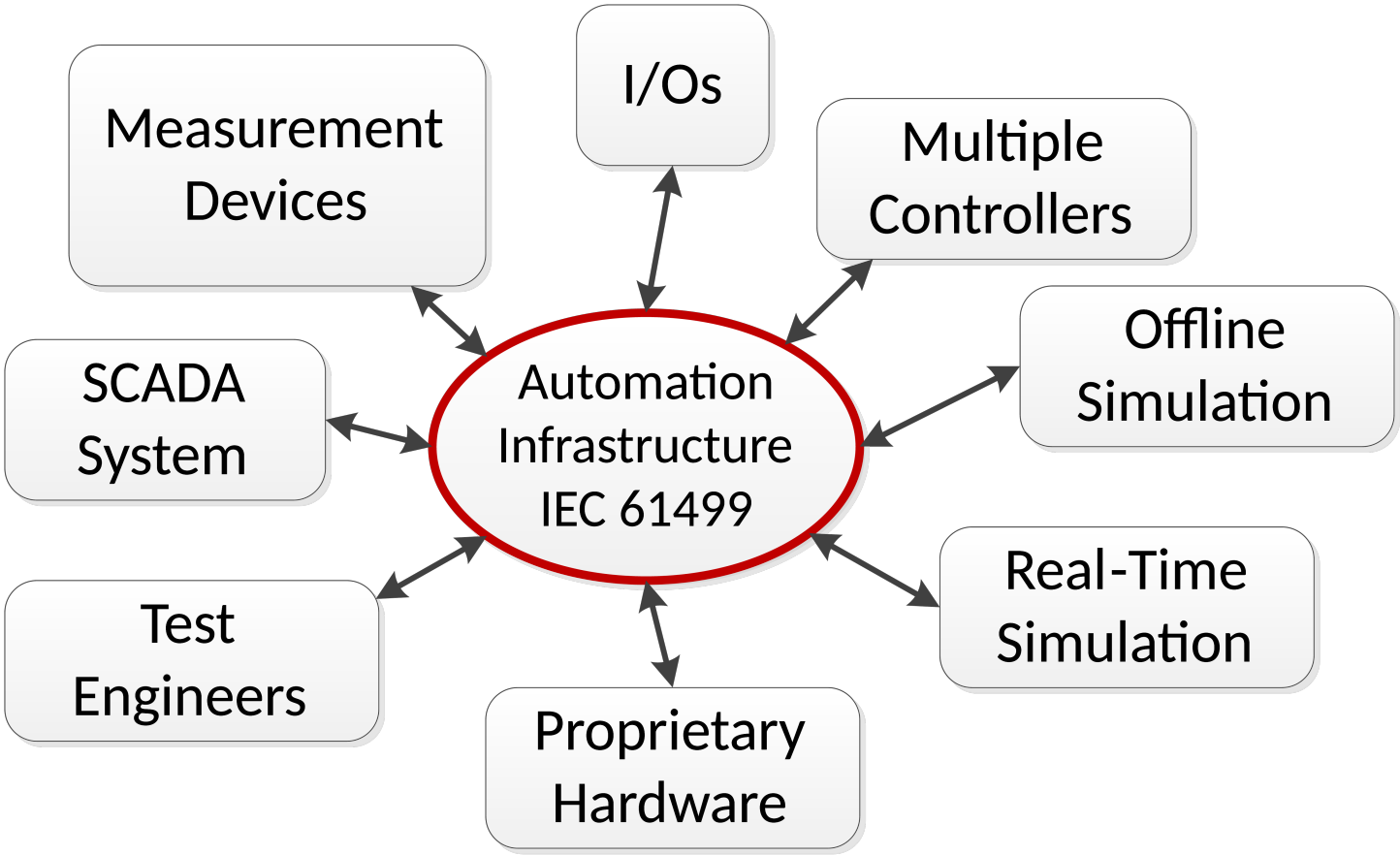
- SmartEST Lab at AIT
- Why IEC 61499?
- Experienced Problems
- Provided Solution
- How to face complex problems

Use Case - SmartEST lab at AIT

INTELLIGENT SYSTEMS GROUP

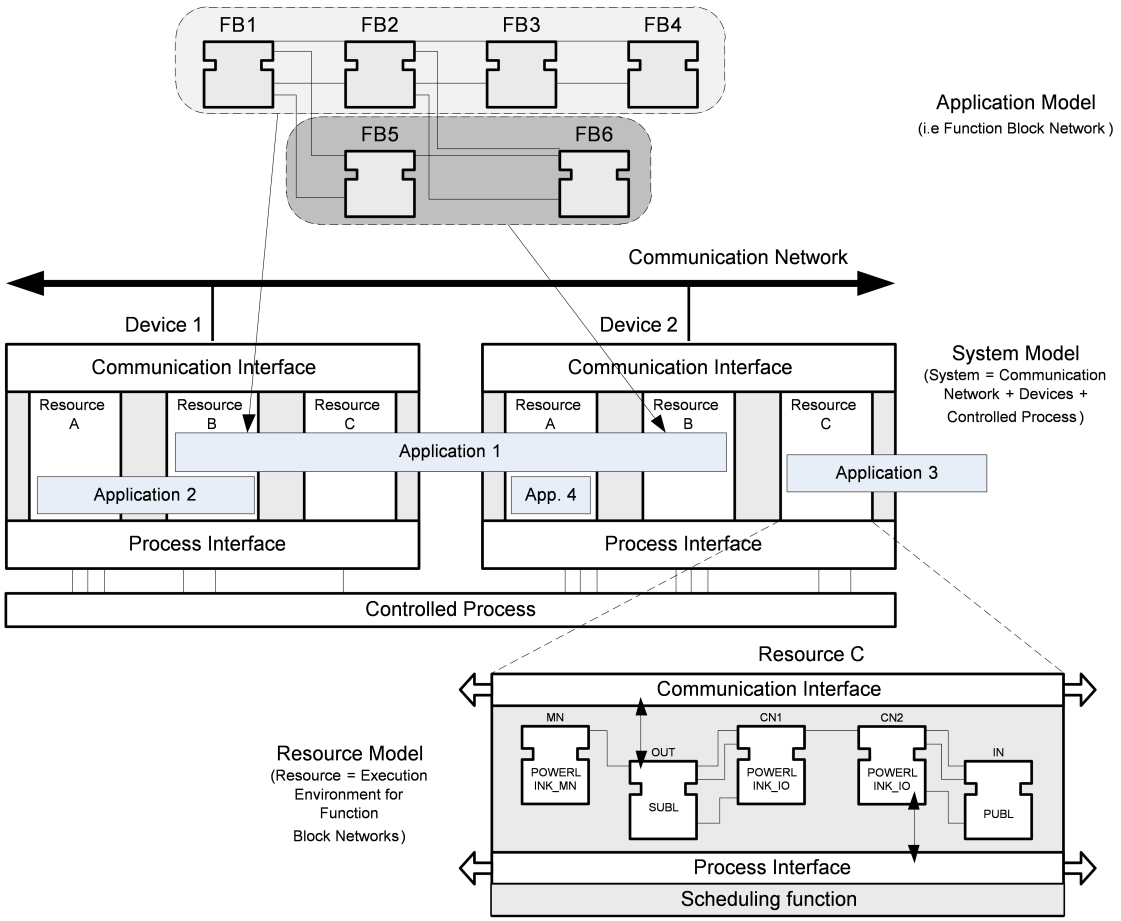
- **SmartEST lab**
  - Laboratory for Component Tests
  - Research, Design and Validation Environment

Hardware and Software Components



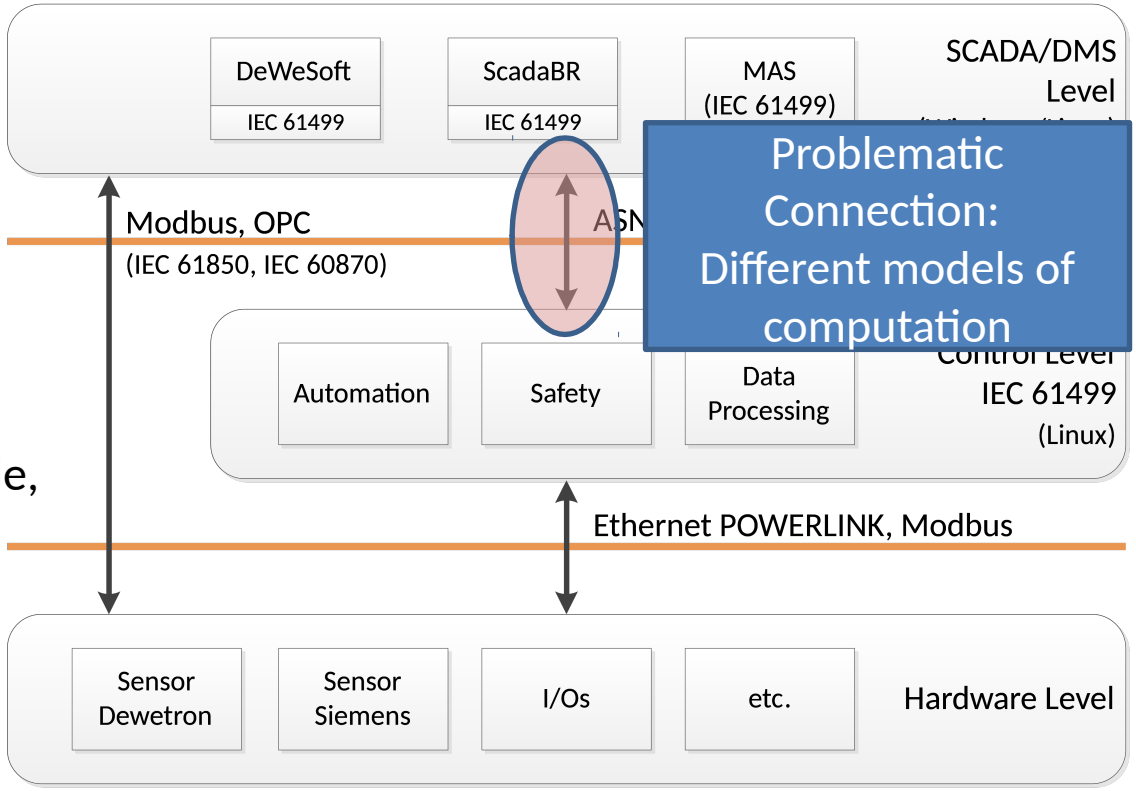
Why IEC 61499?

- **Engineering Process**
  - Applications and subapplications
  - Resources
  - Devices
- **Generic Interfaces**
  - Adapters
  - Communication
  - Process



System Layers

- **SCADA Layer**
  - Superior control functions
  - Alterations straightforward
- **Control Layer**
  - Basic control functionality
  - Software alterations possible, but not necessary
- **Hardware Layer**
  - Proprietary hardware
  - No access to software



Identified Problem

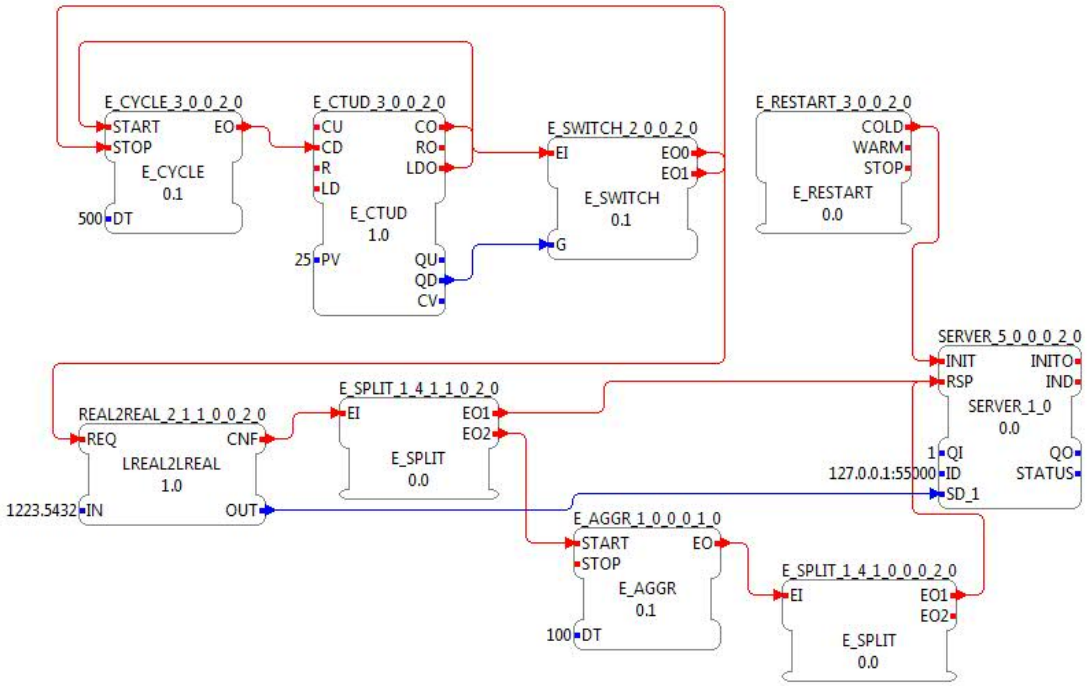
- **IEC 61499 – SCADA BR Connection**
  - IEC 61499 sends data
  - SCADA BR receives data
  - If (sending frequency > receiving frequency){

    Data Type Mismatch Error;

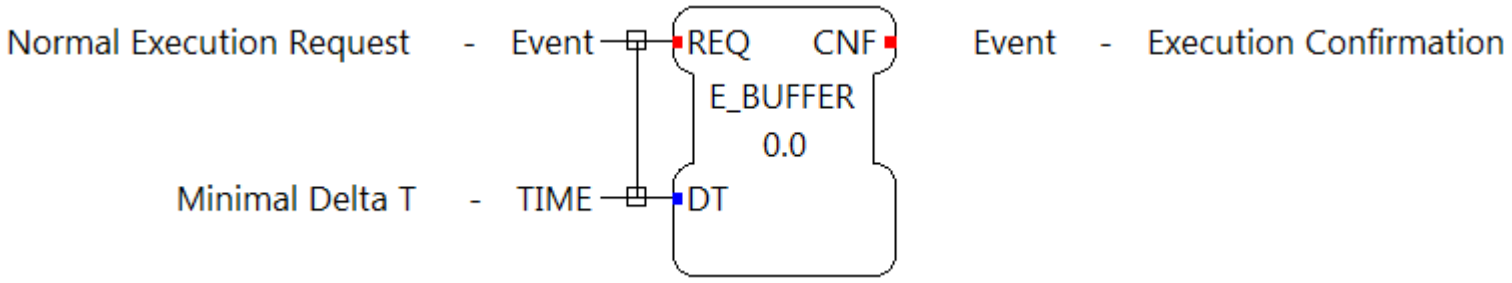
    }
  - Explanation
    - *SCADA BR input buffer is filled with new data before processed the previous ones*

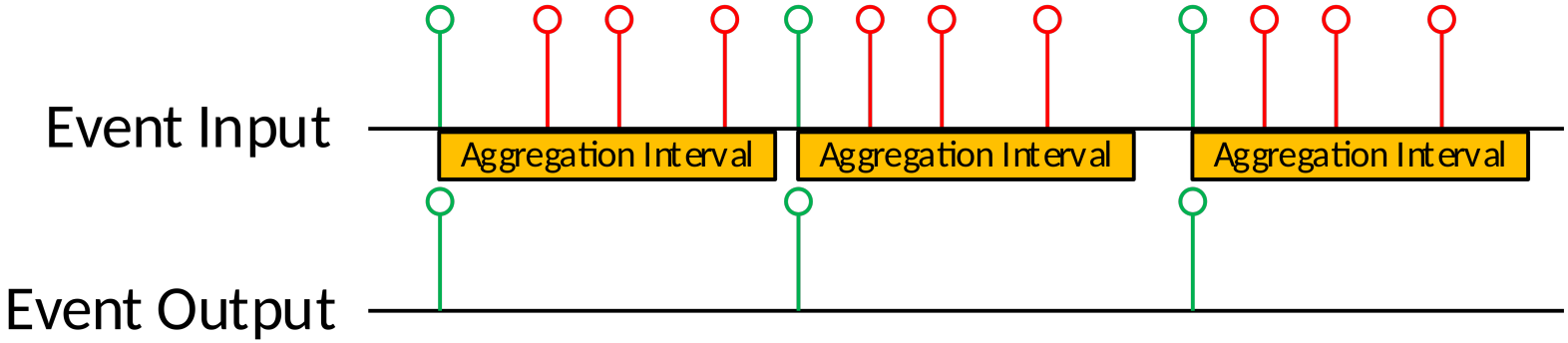
Solution

- **What is the necessary Delta T?**
  - Prerequisites
    - *High-precise scheduler*
    - *New function blocks: E_AGGR, E_BUFFER*

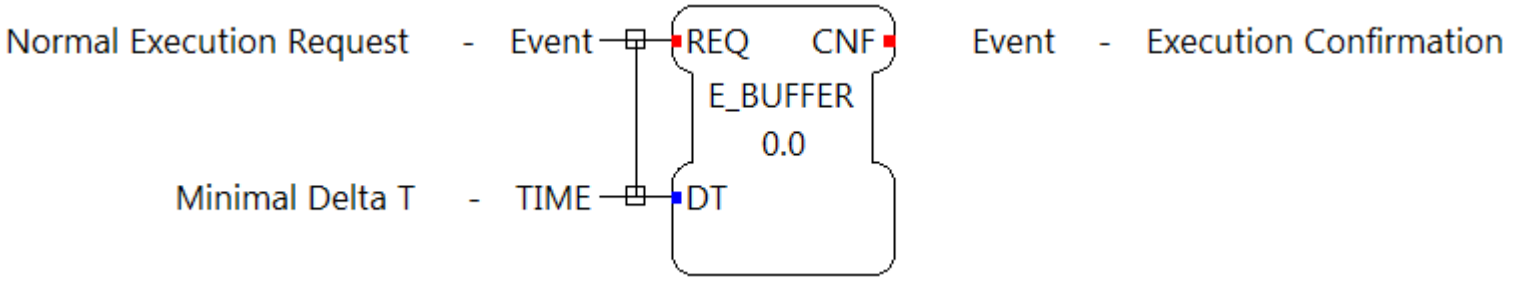


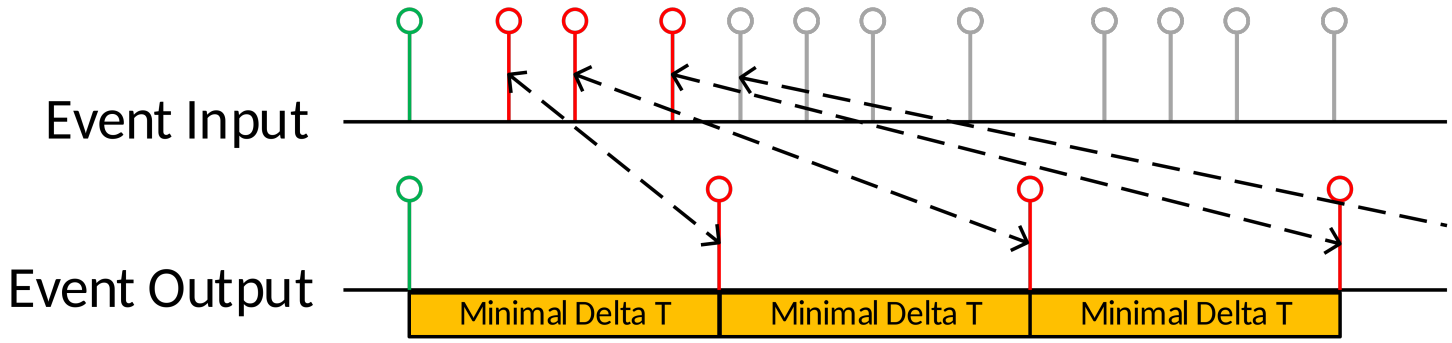
Event Aggregator



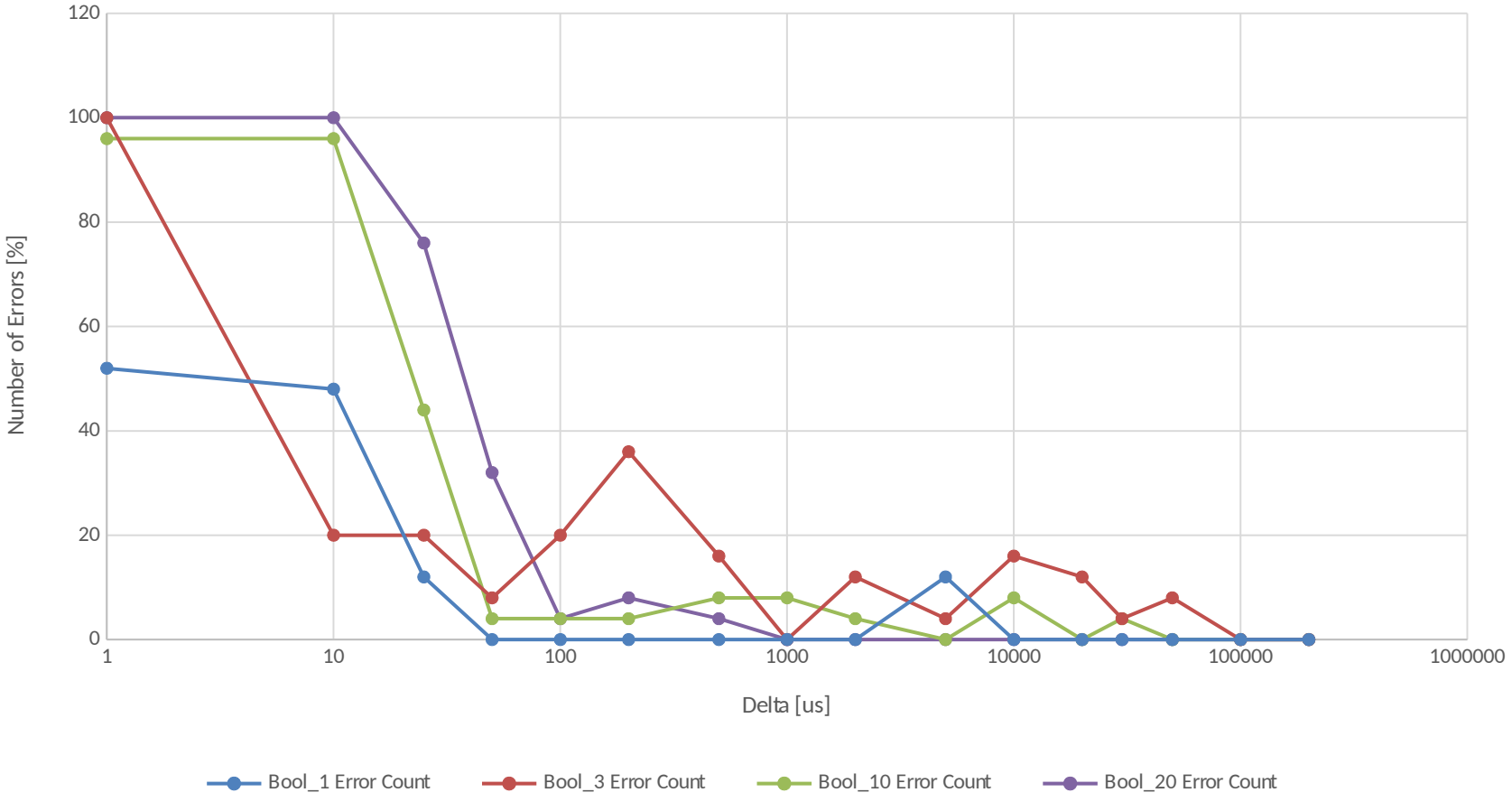


Event Buffer

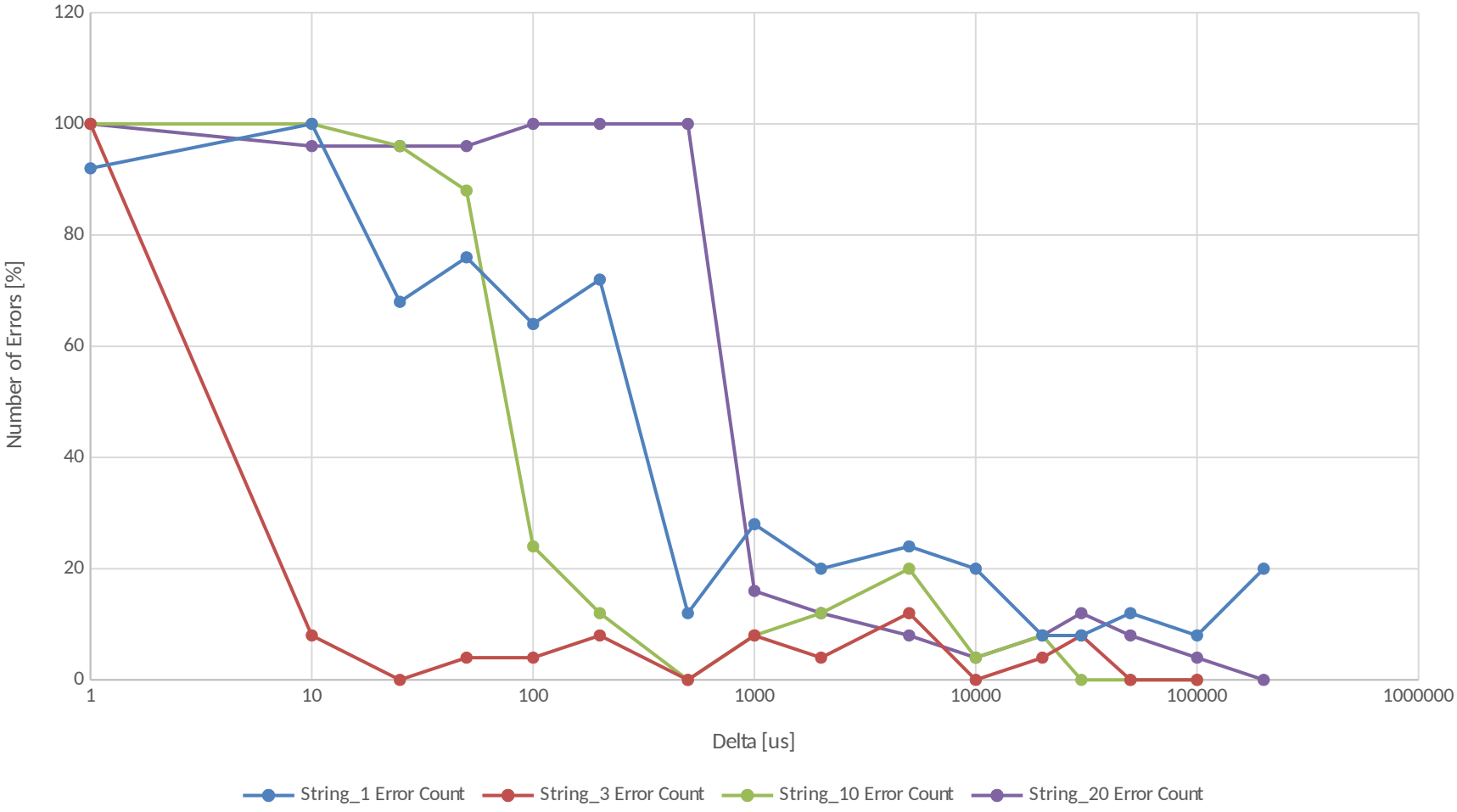




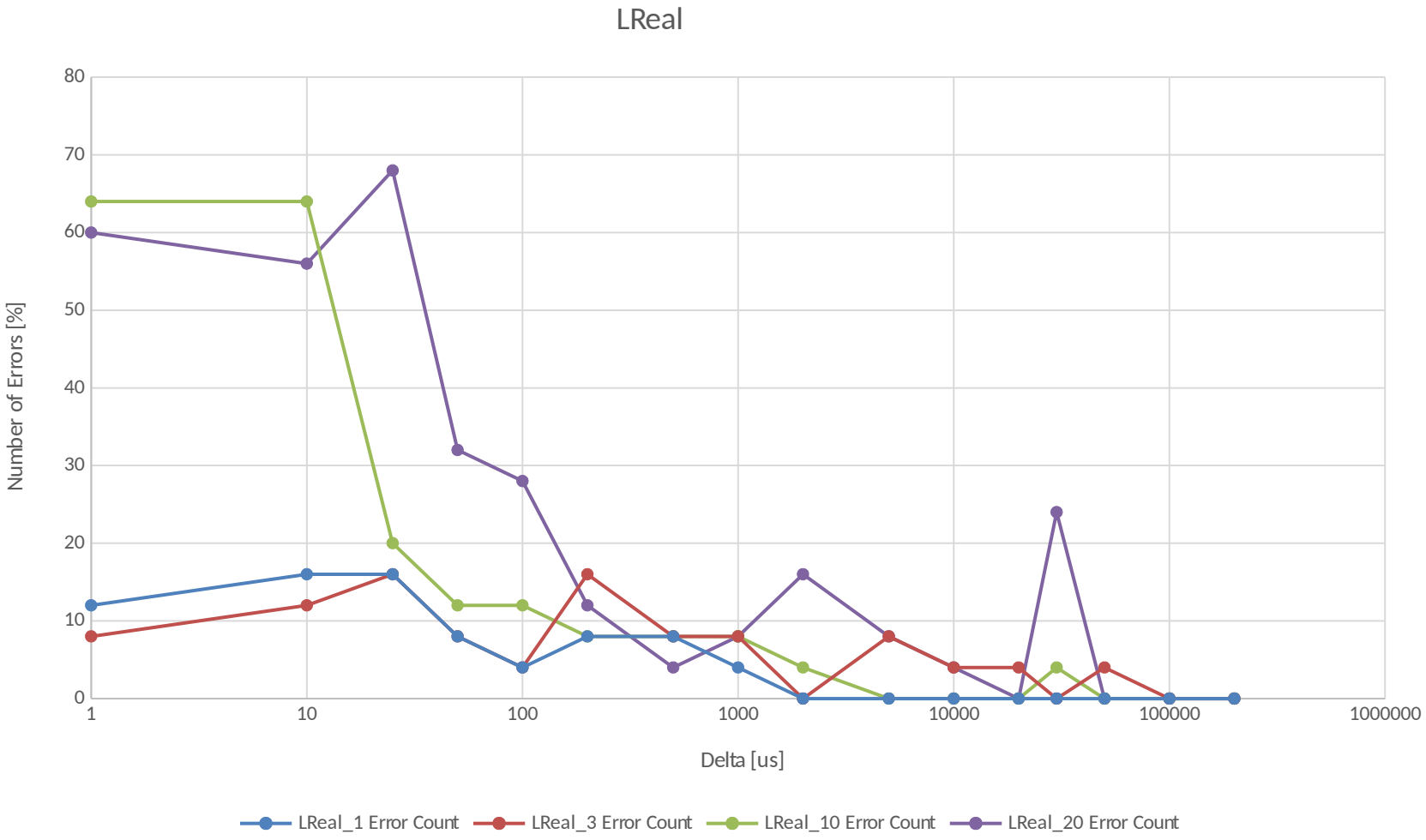
Bool


120
100
80
60
40
20
0
Number of Errors [%]
1
10
100
1000
10000
100000
1000000
Delta [us]
Bool_1 Error Count
Bool_3 Error Count
Bool_10 Error Count
Bool_20 Error Count

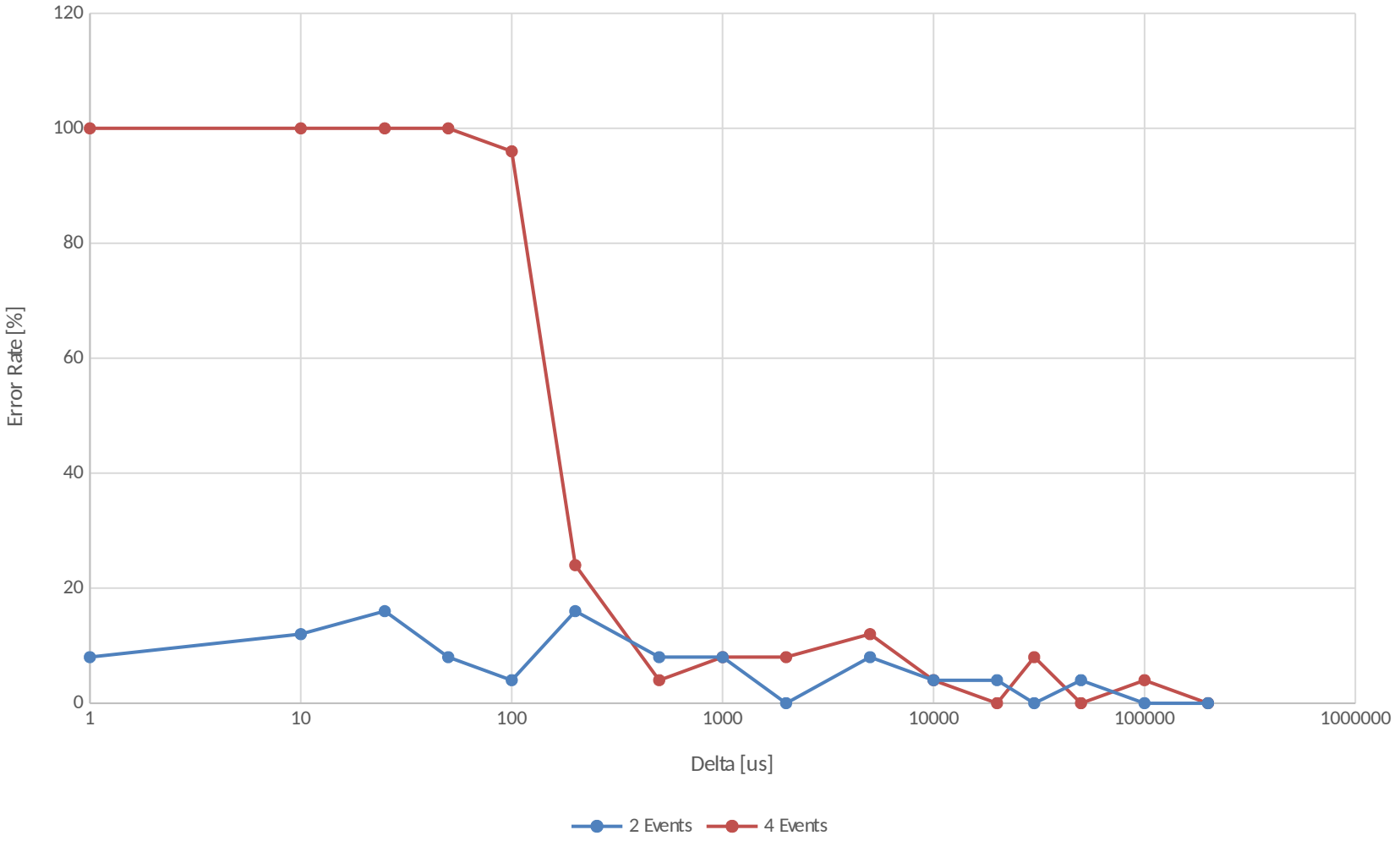
String


120
100
80
60
40
20
0
Number of Errors [%]
1
10
100
1000
10000
100000
1000000
Delta [us]
String_1 Error Count
String_3 Error Count
String_10 Error Count
String_20 Error Count

Long Real

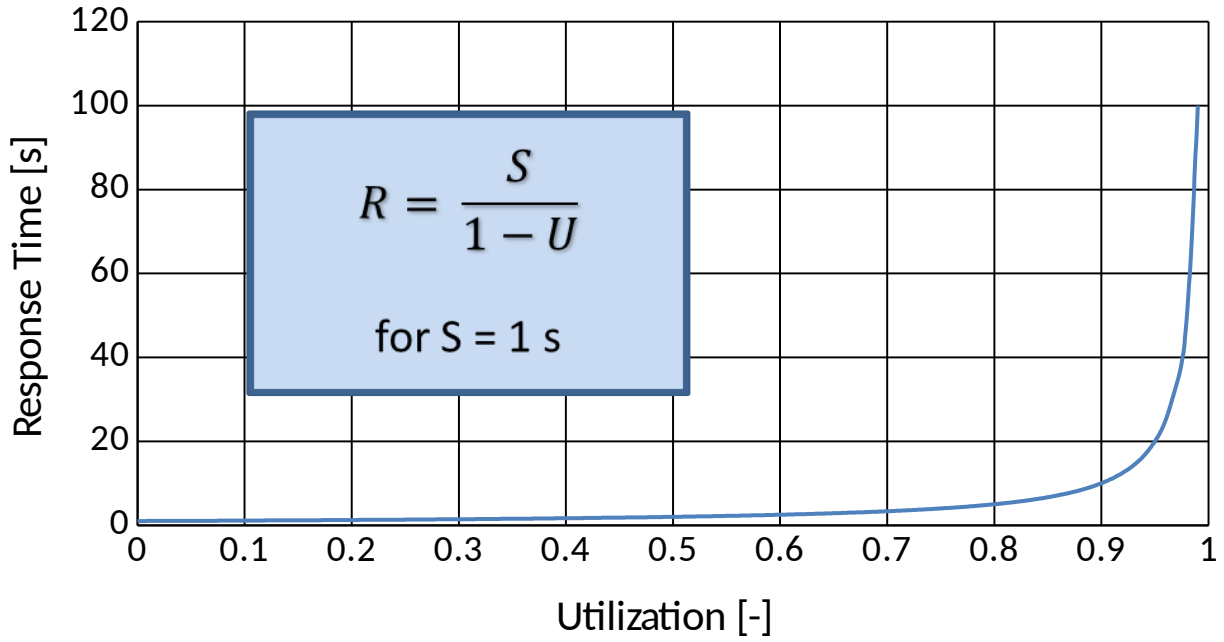

LReal
Number of Errors [%]
80
70
60
50
40
30
20
10
0
1
10
100
1000
10000
100000
1000000
Delta [us]
LReal_1 Error Count
LReal_3 Error Count
LReal_10 Error Count
LReal_20 Error Count

Long Real – Burst of 4 Events



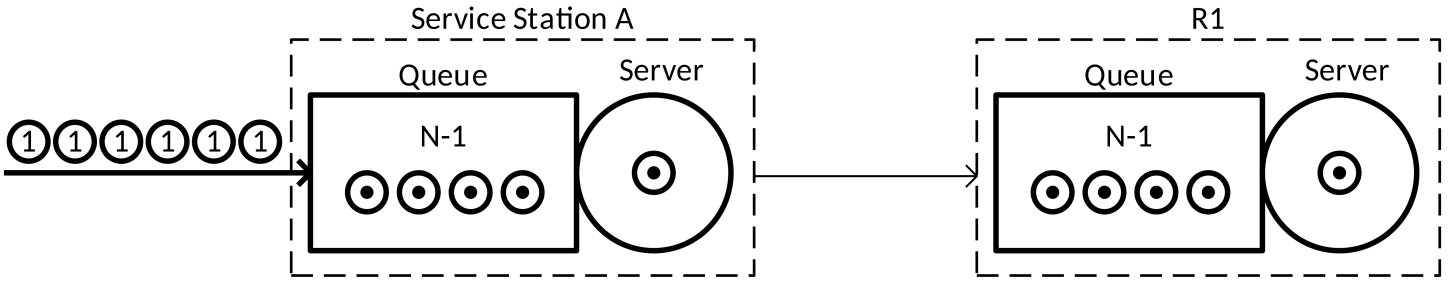
How to face a complex scenario?

- **Be aware how the response time depends on utilization**
- **Identify the possible bottlenecks**
- **Manage the flow of events as close to their sources as possible**



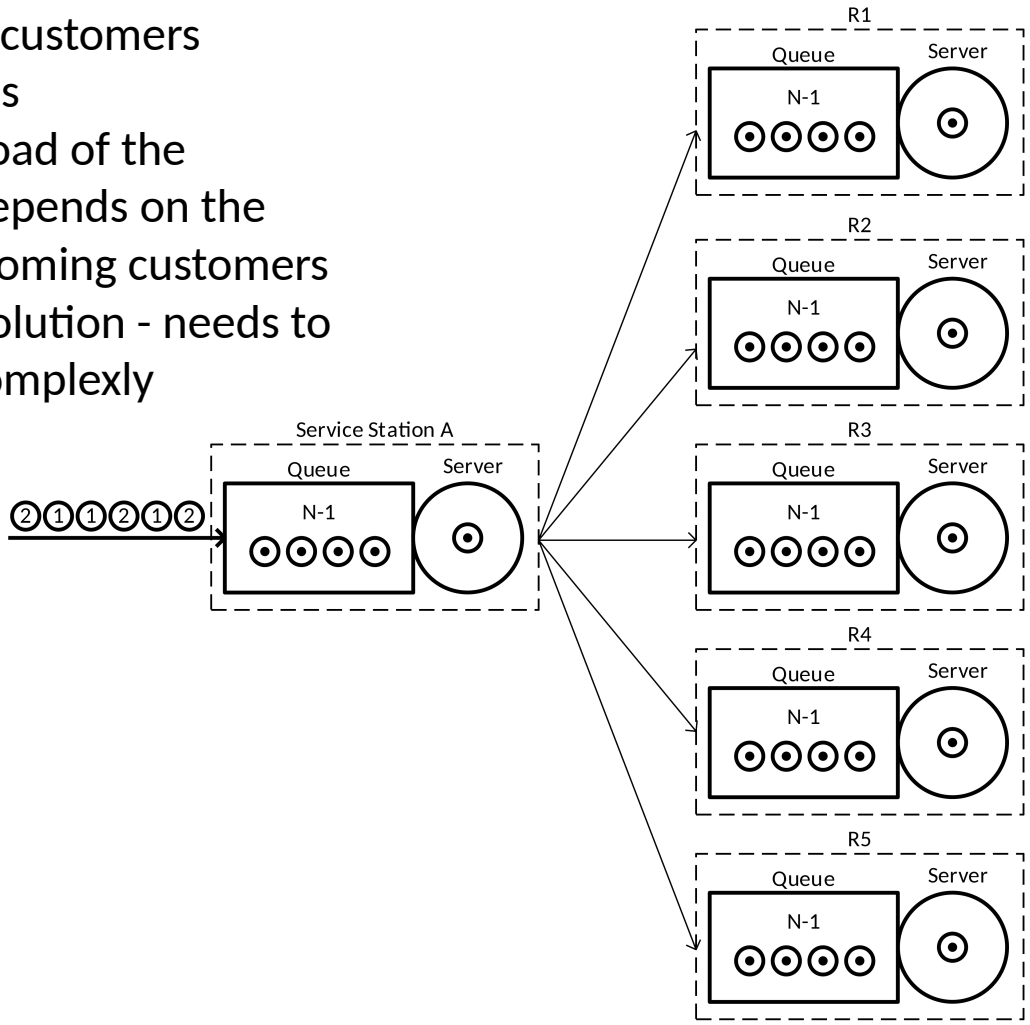
Simple Use Case

- Only one type of customers
- Only one resource
- Equivalent with the SmartEST Use Case
- Possible to solve locally as proposed above



Complex Use Case

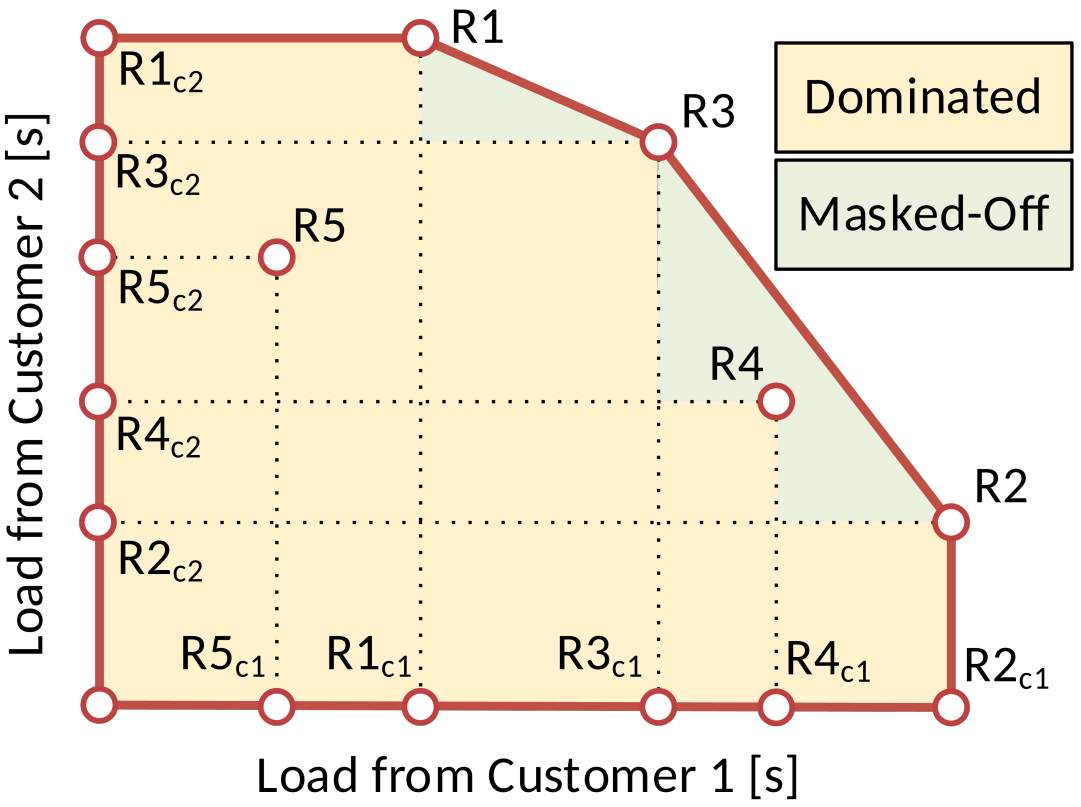
- > 1 types of customers
- > 1 resources
- The actual load of the resources depends on the mixture of coming customers
- No simple solution - needs to be solved complexly



Loading Matrix and Convex Hull

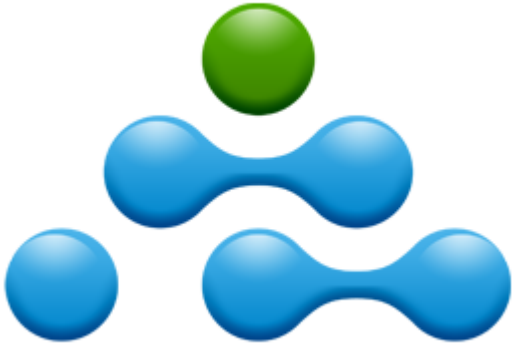
Resource	R1	R2	R3	R4	R5
Customer 1 [s]	$R1_{C1}$	$R2_{C1}$	$R3_{C1}$	$R4_{C1}$	$R5_{C1}$
Customer 2 [s]	$R1_{C2}$	$R2_{C2}$	$R3_{C2}$	$R4_{C2}$	$R5_{C2}$

- Possible bottlenecks lie on the Convex Hull (R1, R2, R3)
- Masked-Off (R4) and Dominated (R5) resource cannot become a bottleneck



Conclusion

- **Be aware of the model of computation when interacting with external systems**
- **Identify non-functional characteristics of these systems**
- **Decide whether your problem can be solved locally or you need a complex management of the arriving tasks**



Thank you.