ANOMALOUS BEHAVIOR OF IEEE 1588 NETWORKS

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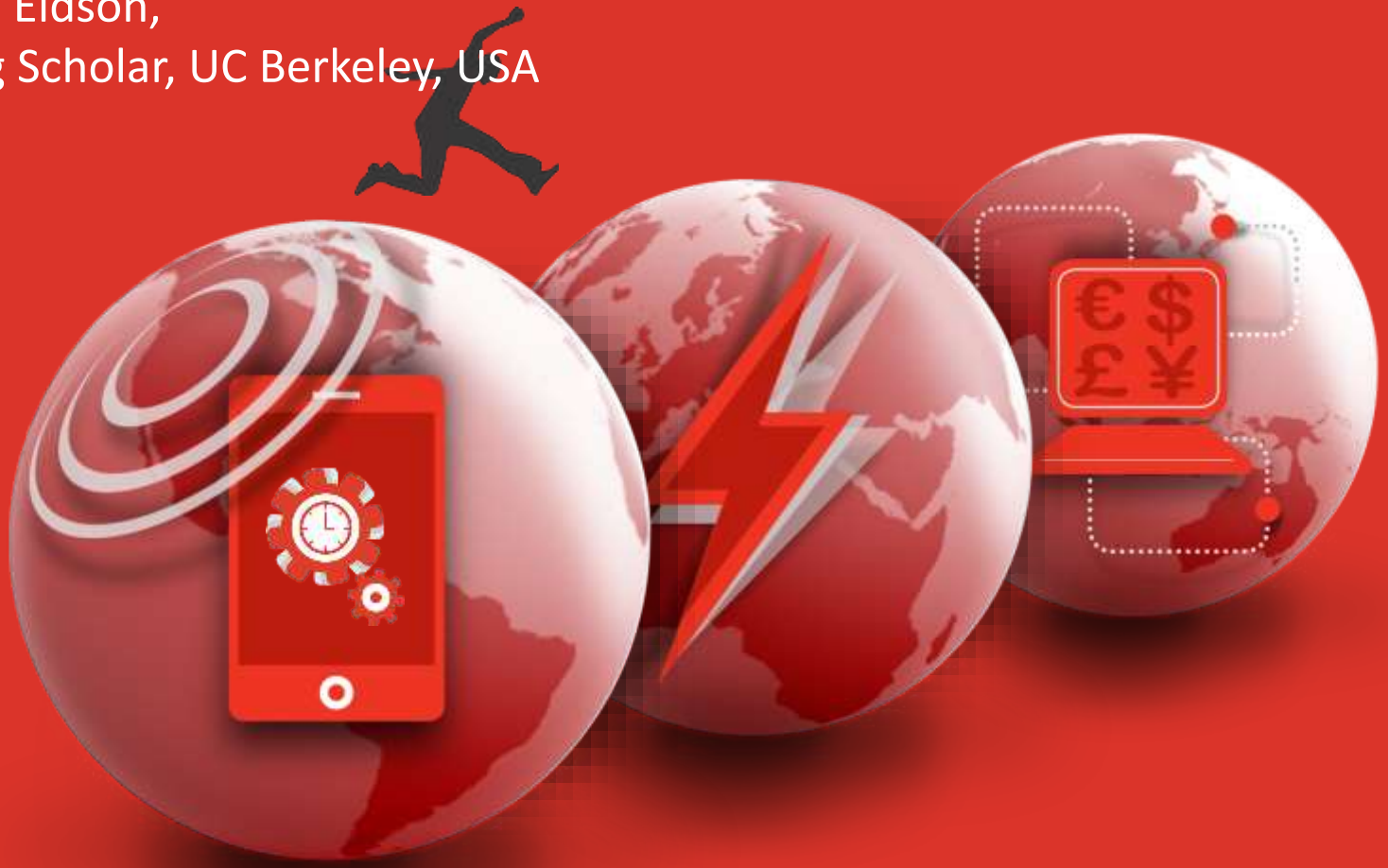

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Agenda

Background

Description of the model

Modelling results

Conclusions

Background

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In the P1588 discussions prior to 1588-2008 there were very heated arguments on the existence of “rogue frames’ and what to do about it. (Rogue frames being PTP messages endlessly circulating in a PTP system)

From IEEE 1588-2008:
“9.3.2.5 Qualification of Announce messages
d) If the stepsRemoved field of S is 255 or greater, S shall not be qualified.

NOTE—This provision ensures that rogue frames are extinguished. This is a mandatory backup to the use of the PATH_TRACE option for this purpose; see 16.2. This stepsRemoved-based mechanism may cause the failure of PTP if the size of the network is such that there are possible loops involving 255 boundary clocks. This is extremely unlikely in practical applications.”

Do G8275.1 systems face the same or possibly other issues?

Description of the model

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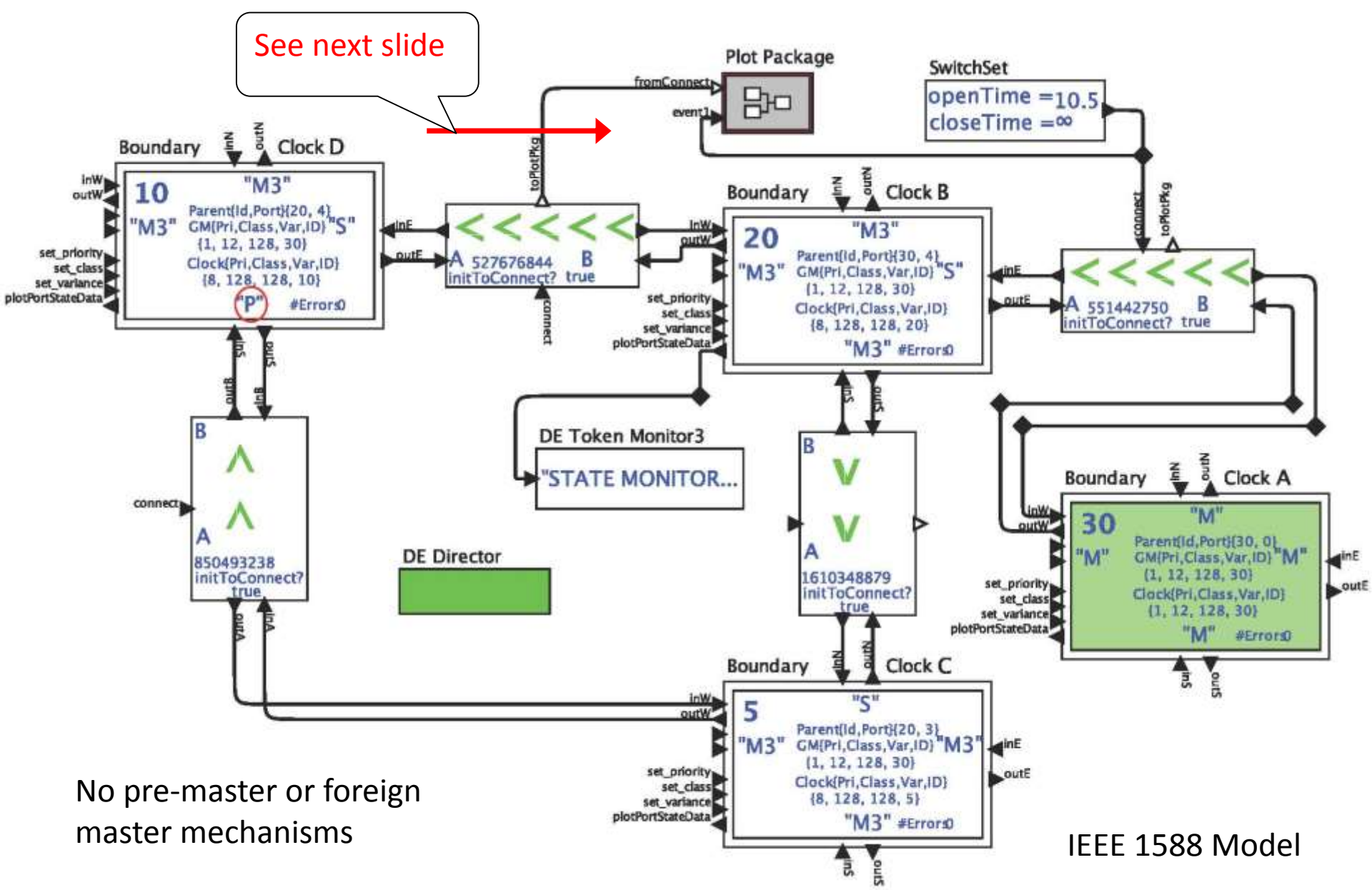
Goal of the project was to simulate a few PTP system designs to see whether rogue frames could exist and under what conditions.

We used a discrete event simulation using the Ptolemy II tool of UC Berkeley.

The model fully implements with deterministic execution the 2008 BMCA and in the case of G8275.1 the alternate BMCA and associated data.



No pre-master or foreign master mechanisms

IEEE 1588 Model

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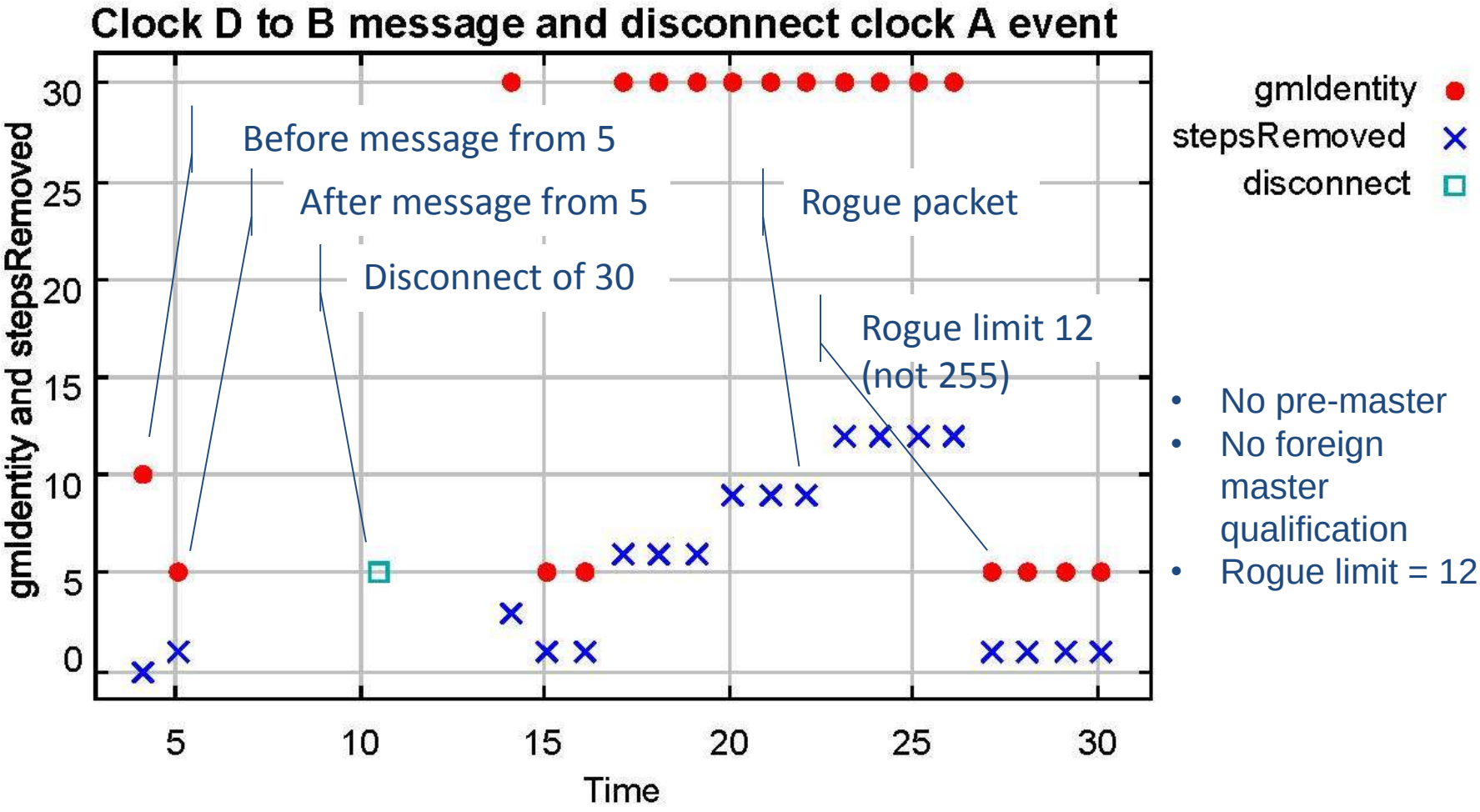
System at time 9s just prior to disconnect of clock A

Modelling results 1588-2008



- No pre-master
- No foreign master qualification
- Rogue limit = 12

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Modelling results 1588-2008

Announce Receipt Timeout Values (in units of announce interval timeouts)						
2	3	4	5	6	7	12
3 Clocks in the cycle: ratio and direction						
2:1CW	3:0CW	3:0CW	3:0CW	3:0CW	3:0CW	3:0CW
4 Clocks in the cycle No rogue messages generated						
5 Clocks in the cycle						
2:3CW	3:2CW	4:1CW	5:0CW	5:0CW	5:0CW	5:0CW
6 Clocks in the cycle No rogue messages generated						
7 Clocks in the cycle: ratio and direction						
2:5CW	3:4CW	4:3CW	5:2CW	6:1CW	7:0CW	7:0CW

TABLE I

SUMMARY OF DISCONNECT MODEL BEHAVIORS

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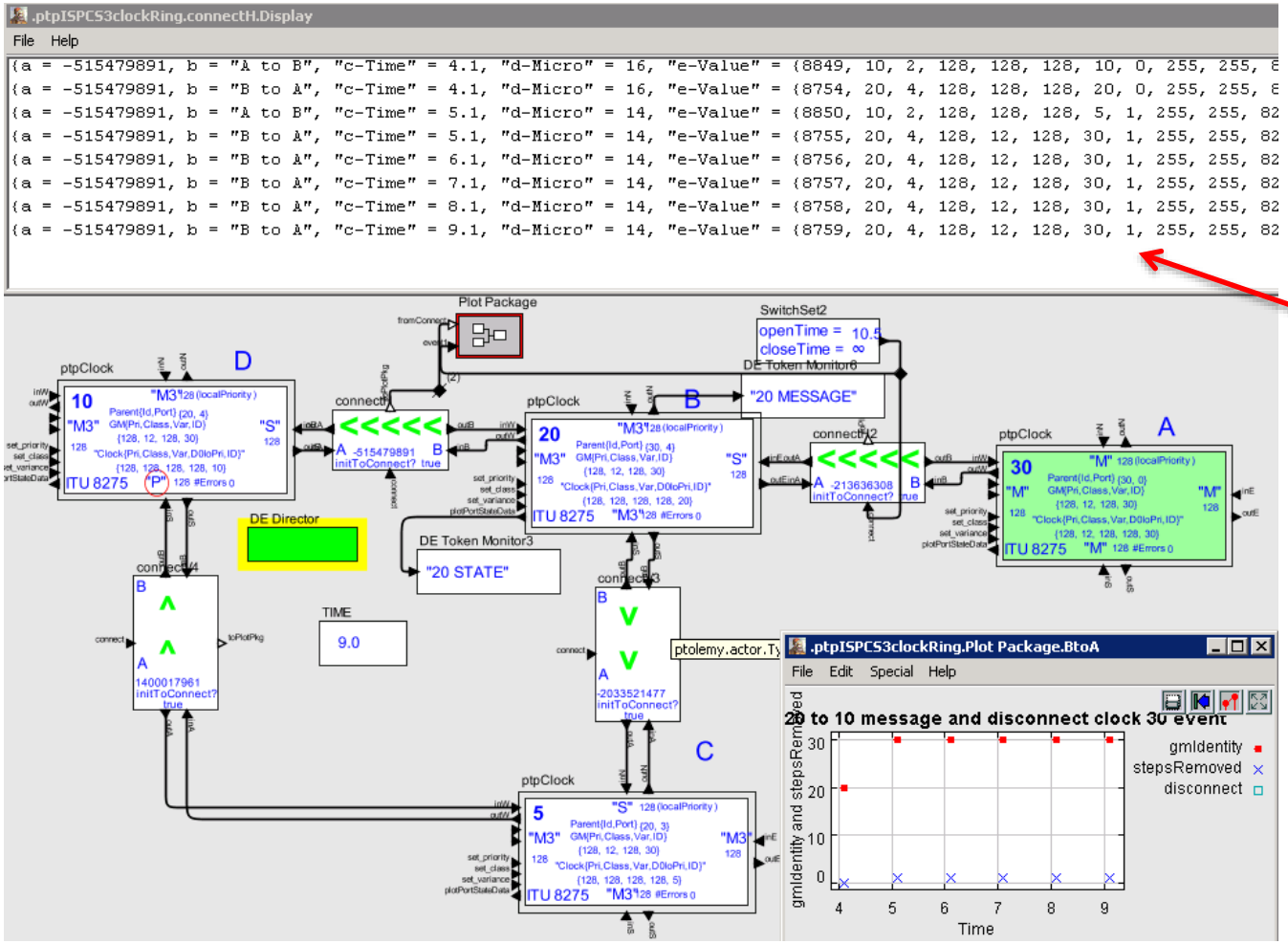
What about G8275.1?

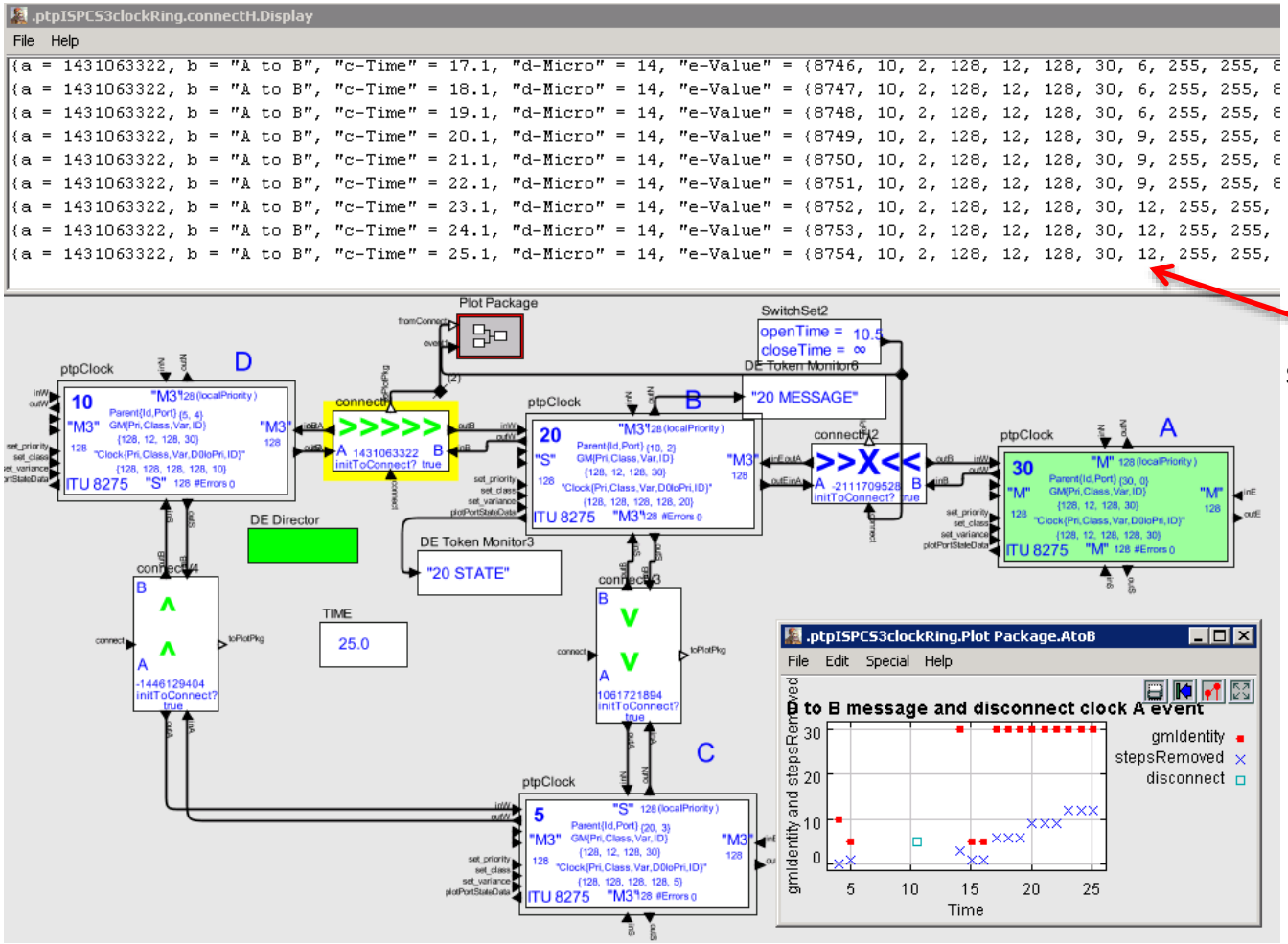
3 clock ring 8275.1, AI=1, ART=3, FMT=0, no-pre-master (stepsRemoved limit = 20)

(same conditions as for the 1588 model)



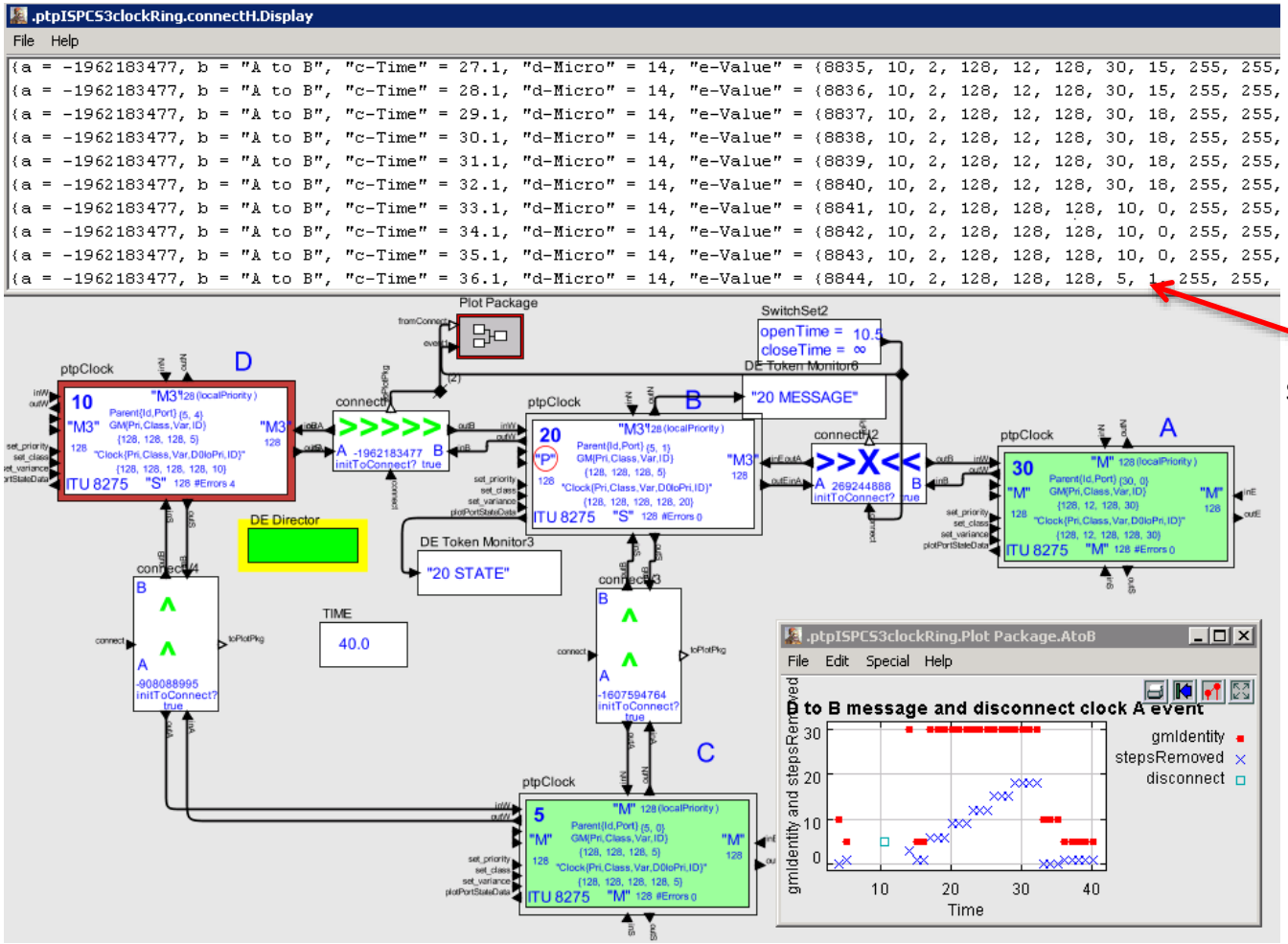
stepsRemoved

3 clock ring 8275.1, AI=1, ART=3, FMT=0, no-pre-master (stepsRemoved limit =20)



stepsRemoved

3 clock ring 8275.1, AI=1, ART=3, FMT=0, no-pre-master (stepsRemoved limit= 20)

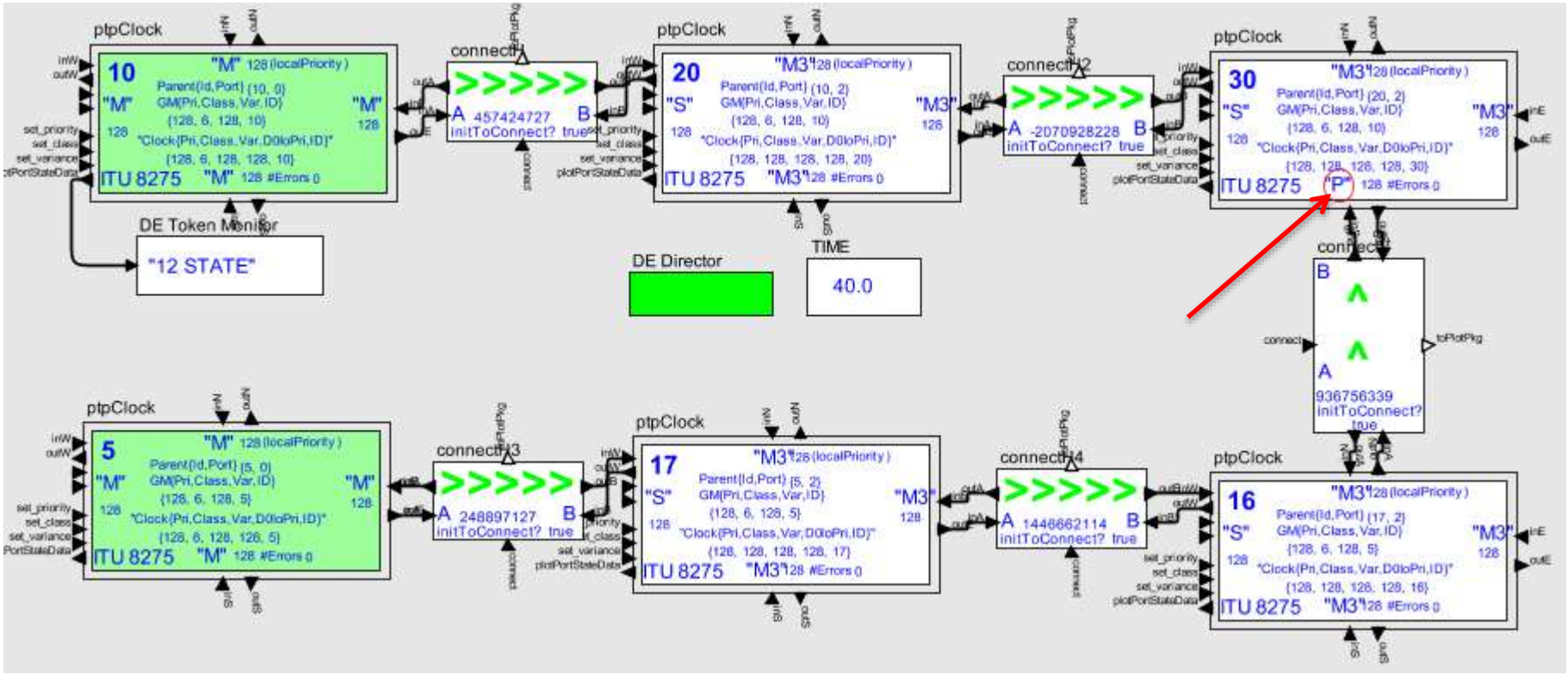


- Rogue frames can occur in G8275.1 systems!
- If the rogue frames are not squelched, there is no grandmaster for clocks to synchronize to.

What other quirks exist?

Linear systems with “notSlave” feature

linear 8275.1, AI=1, ART=3, FMT=1, pre-master state, no “notSlave” ports



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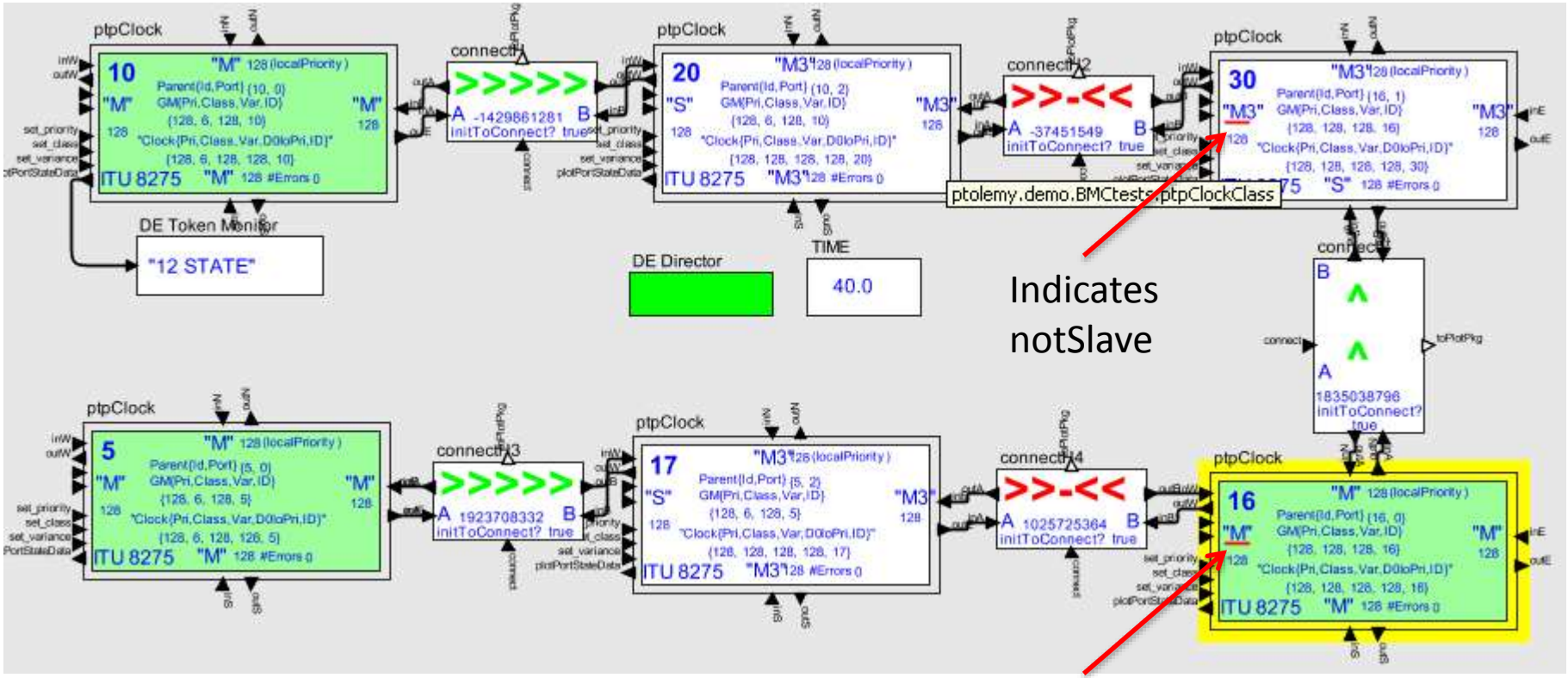
linear 8275.1, AI=1, ART=3, FMT=1, pre-master state, notSlave @30W, 16W



Not surprisingly the “notSlave” feature can lead to isolated regions

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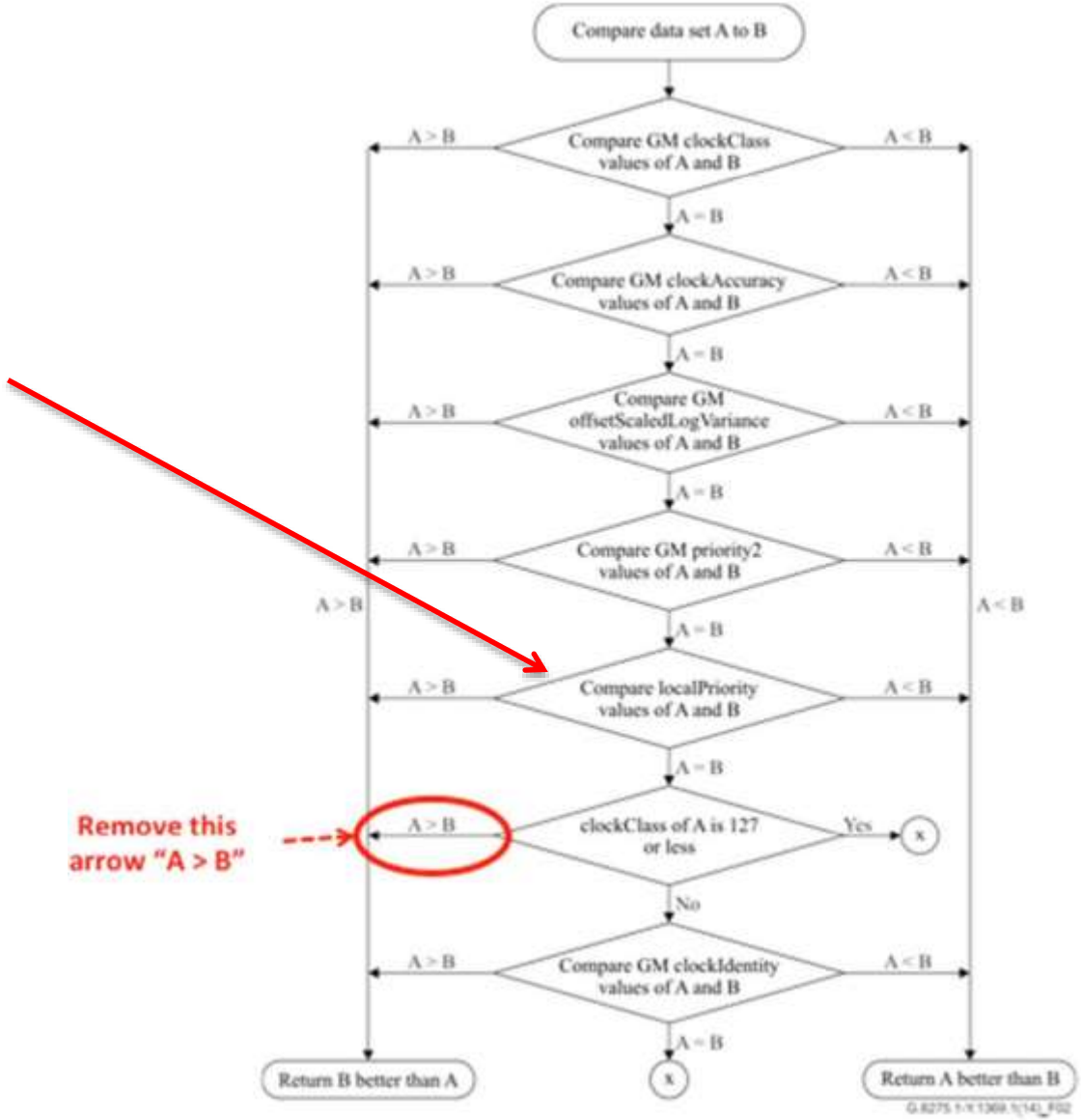
What about the “localPriority” field?



A warning from G8275.1

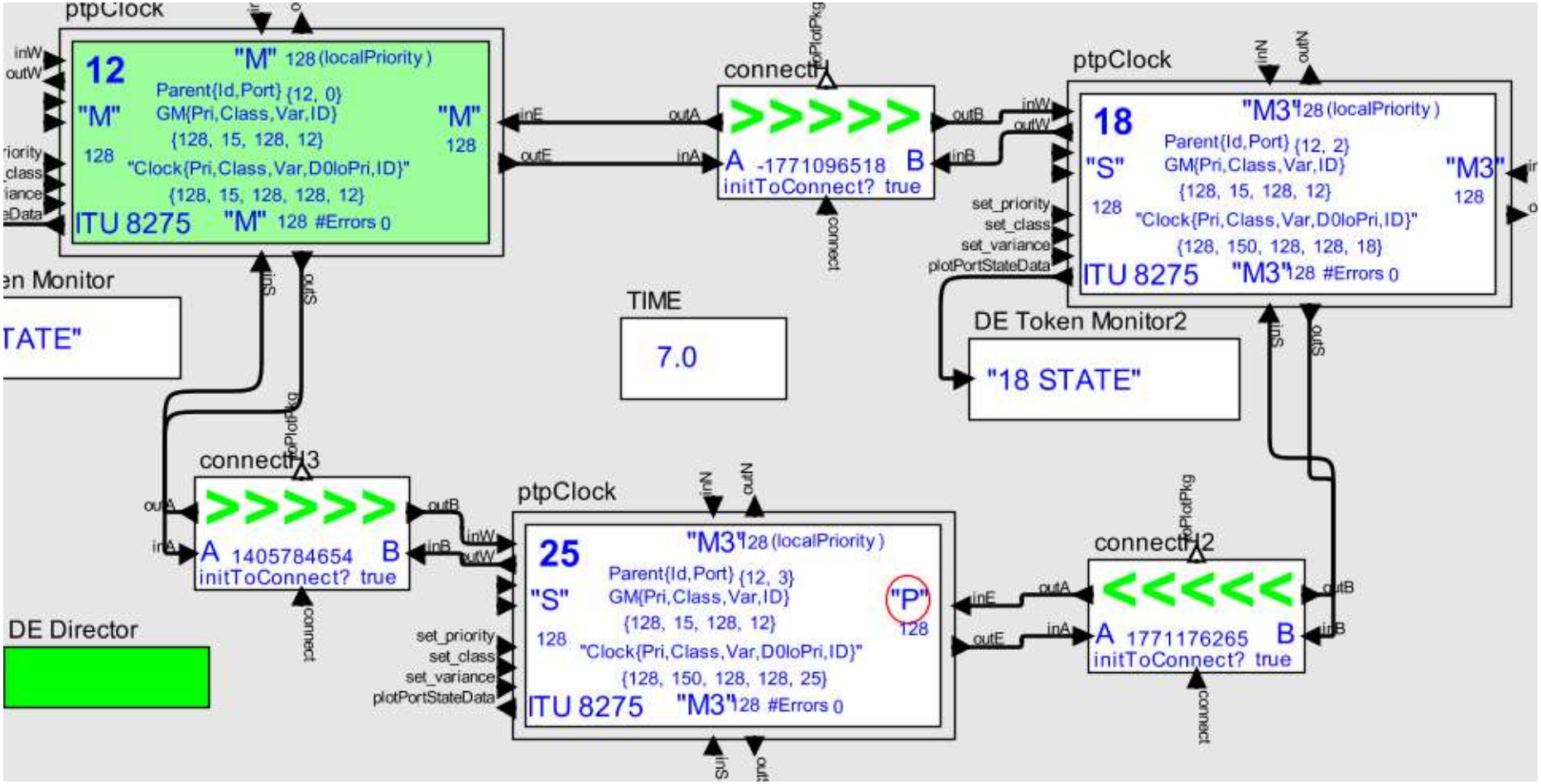
6.3.2 Considerations on the use of the localPriority attributes

The localPriority attributes provide a powerful tool in defining the synchronization network architecture.

The use of the default values for these attributes as defined by the Alternate BMCA results in a timing-loop free synchronization network.

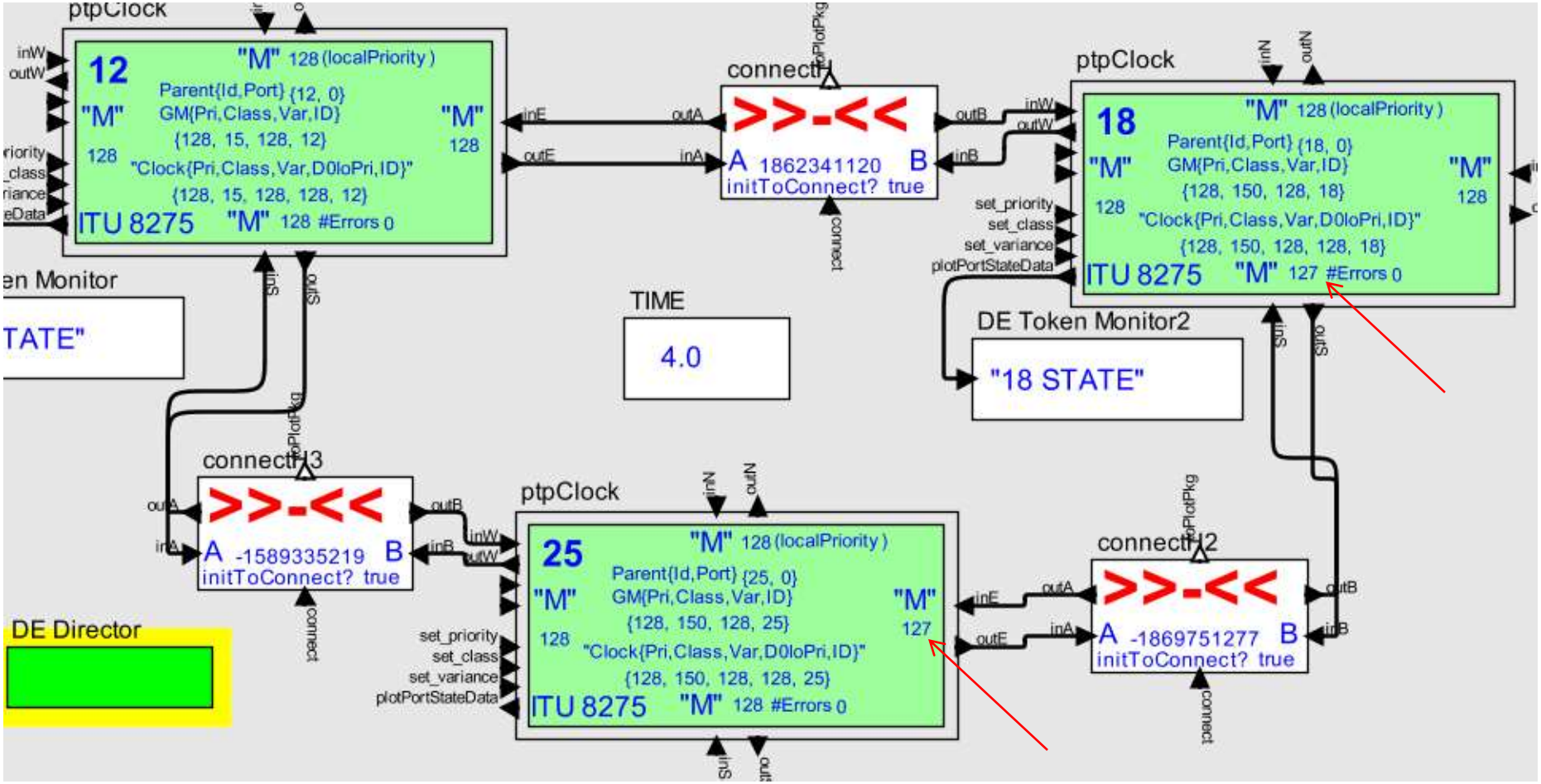
Proper planning will be mandatory to avoid timing-loops when configuring values different from the default ones.

3 clock ring, AI=1, ART=3FMT=1, pre-master state, localPriority 128

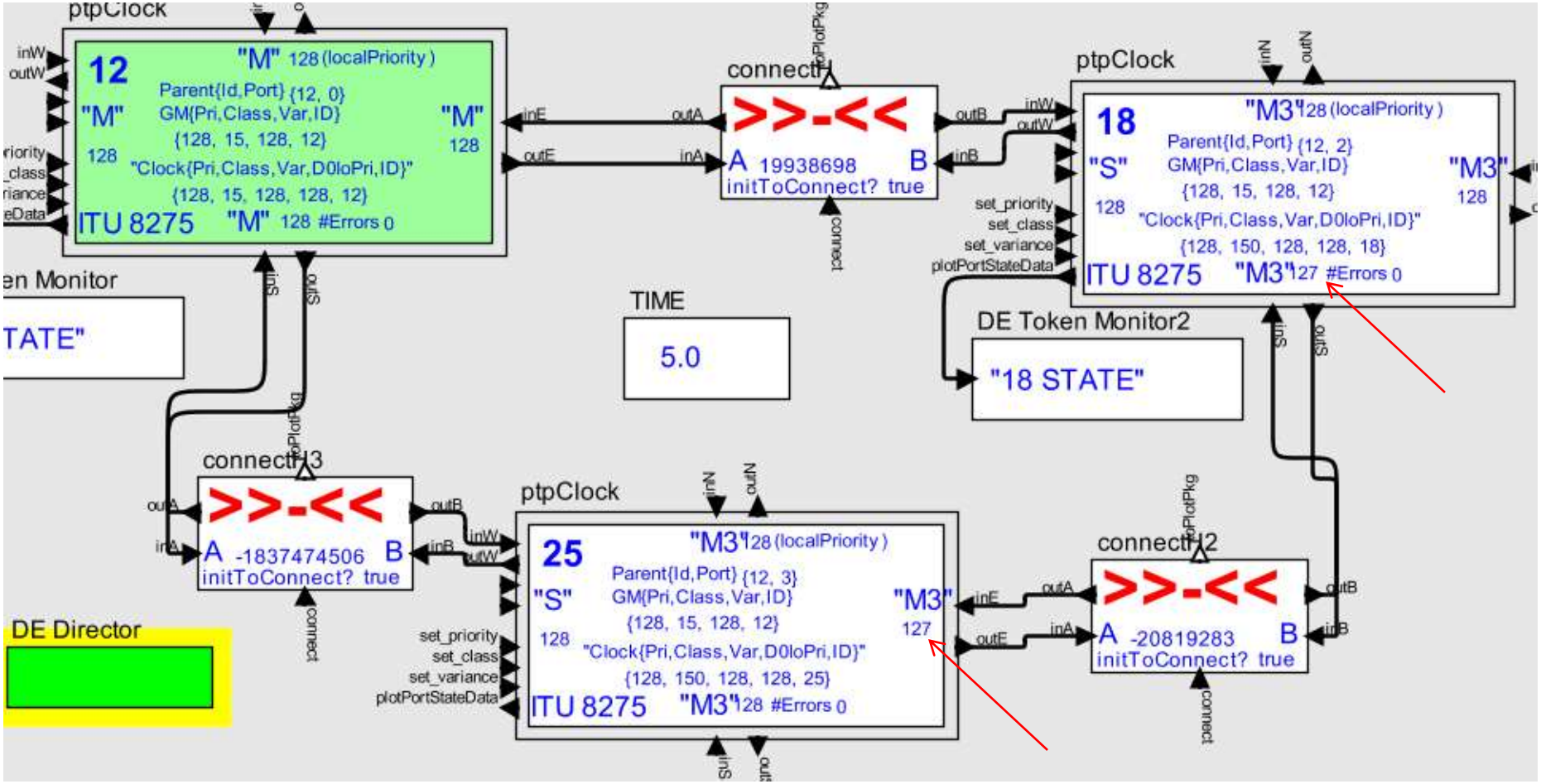


This is a stable configuration

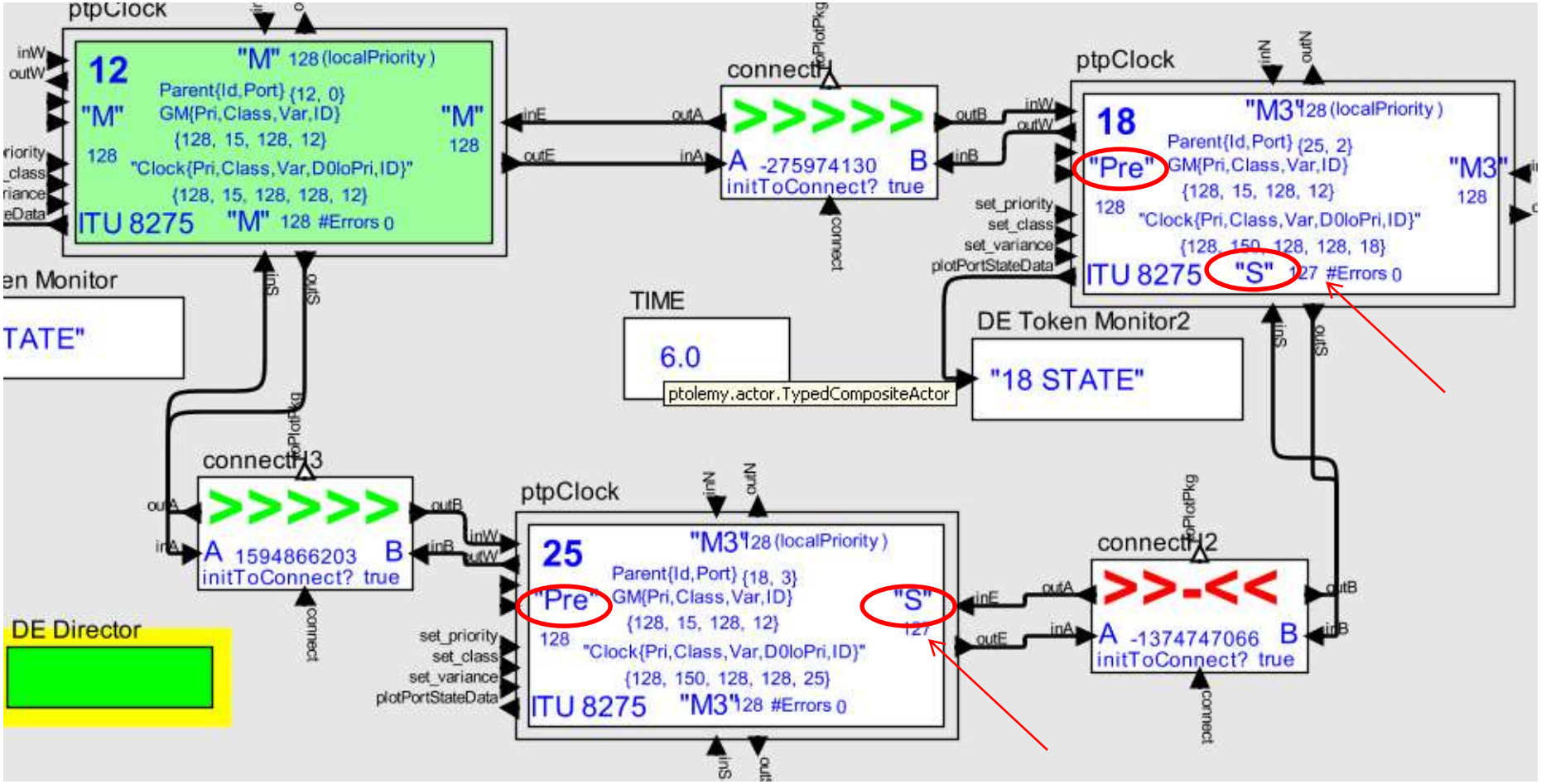
3 clock ring, AI=1, ART=3FMT=1, pre-master state, localPriority 127 on 18S,25E



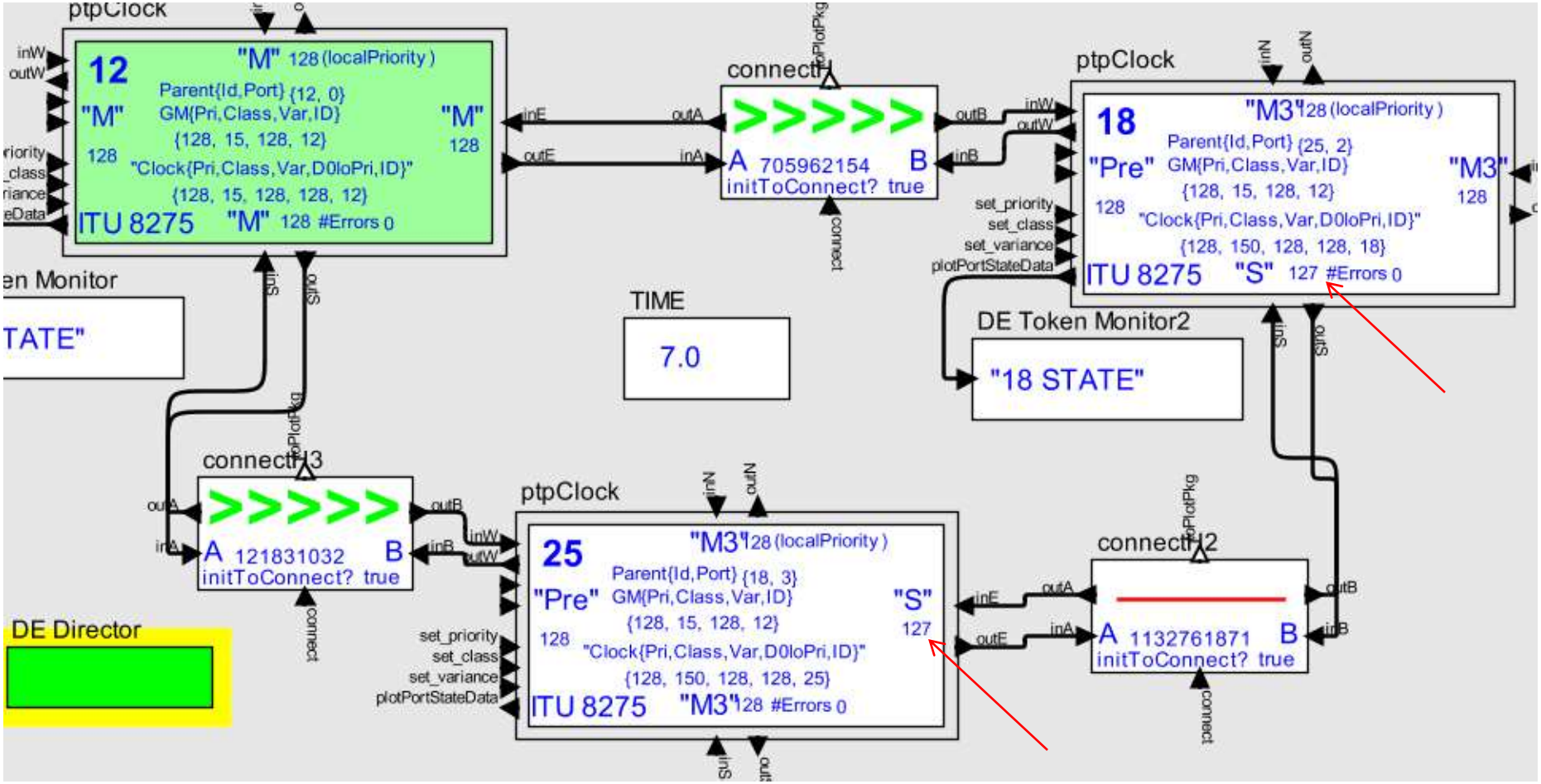
3 clock ring, AI=1, ART=3FMT=1, pre-master state, localPriority 127 on 18S,25E



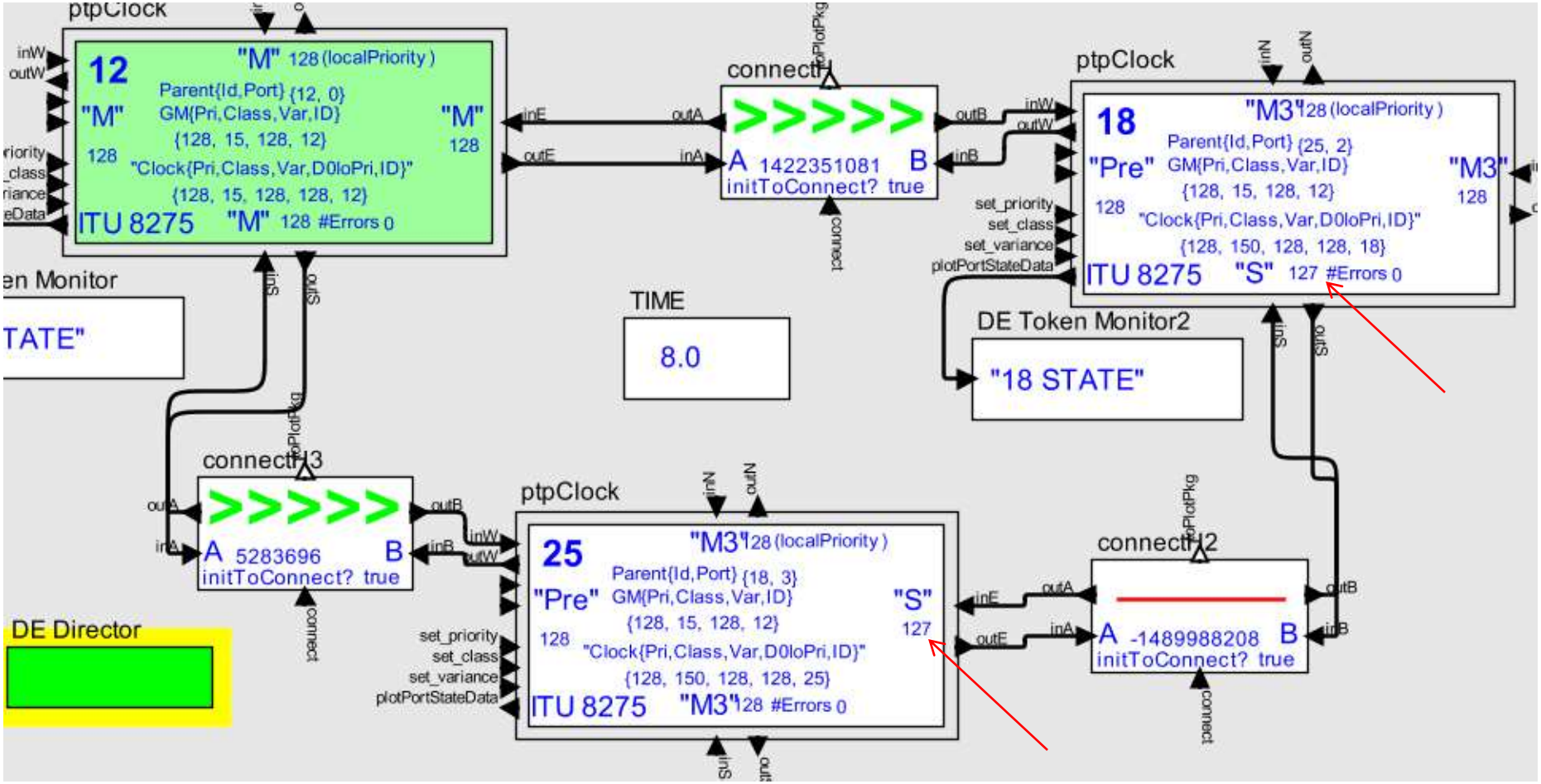
3 clock ring, AI=1, ART=3FMT=1, pre-master state, localPriority 127 on 18S,25E



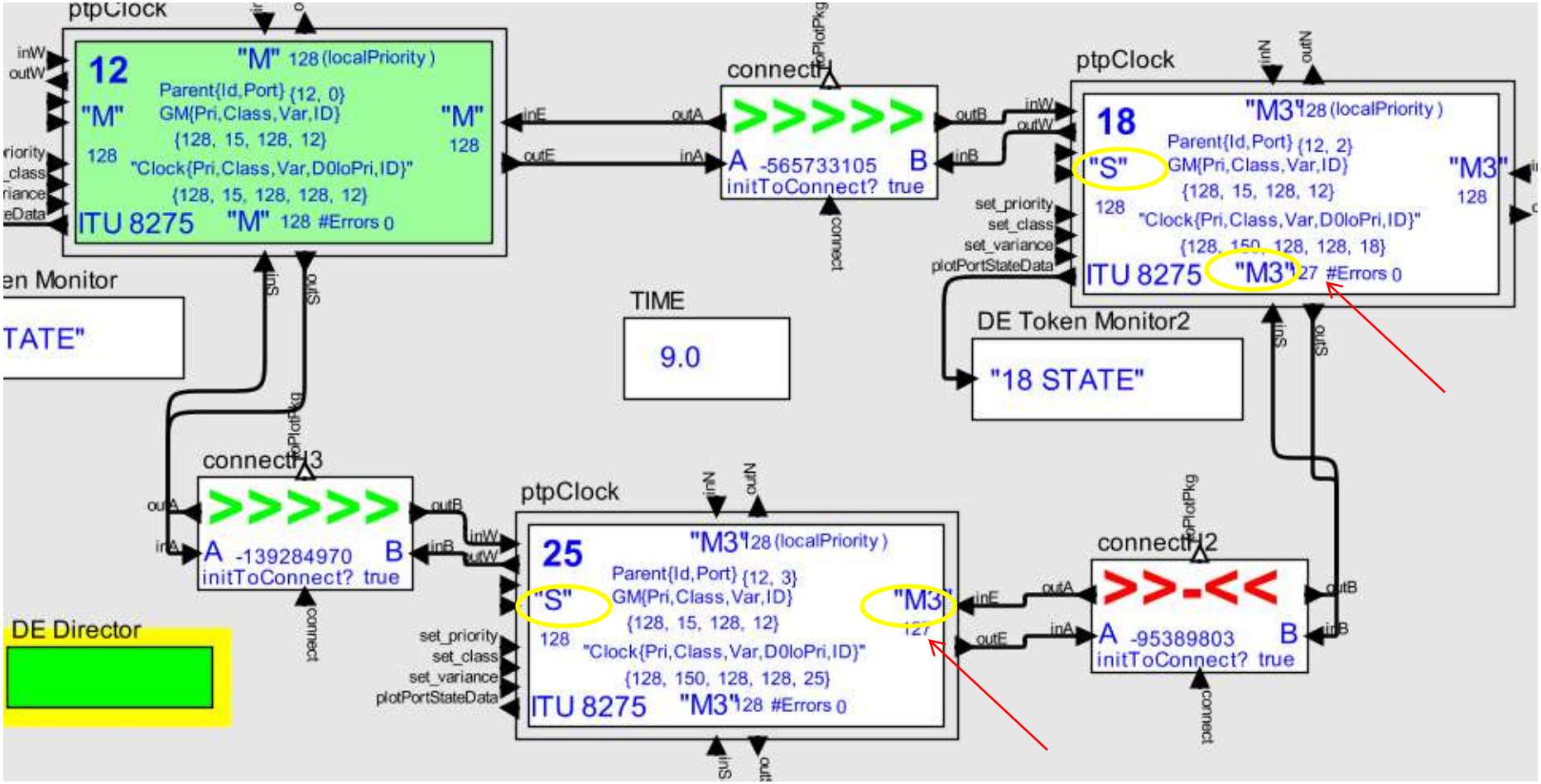
3 clock ring, AI=1, ART=3FMT=1, pre-master state, localPriority 127 on 18S,25E



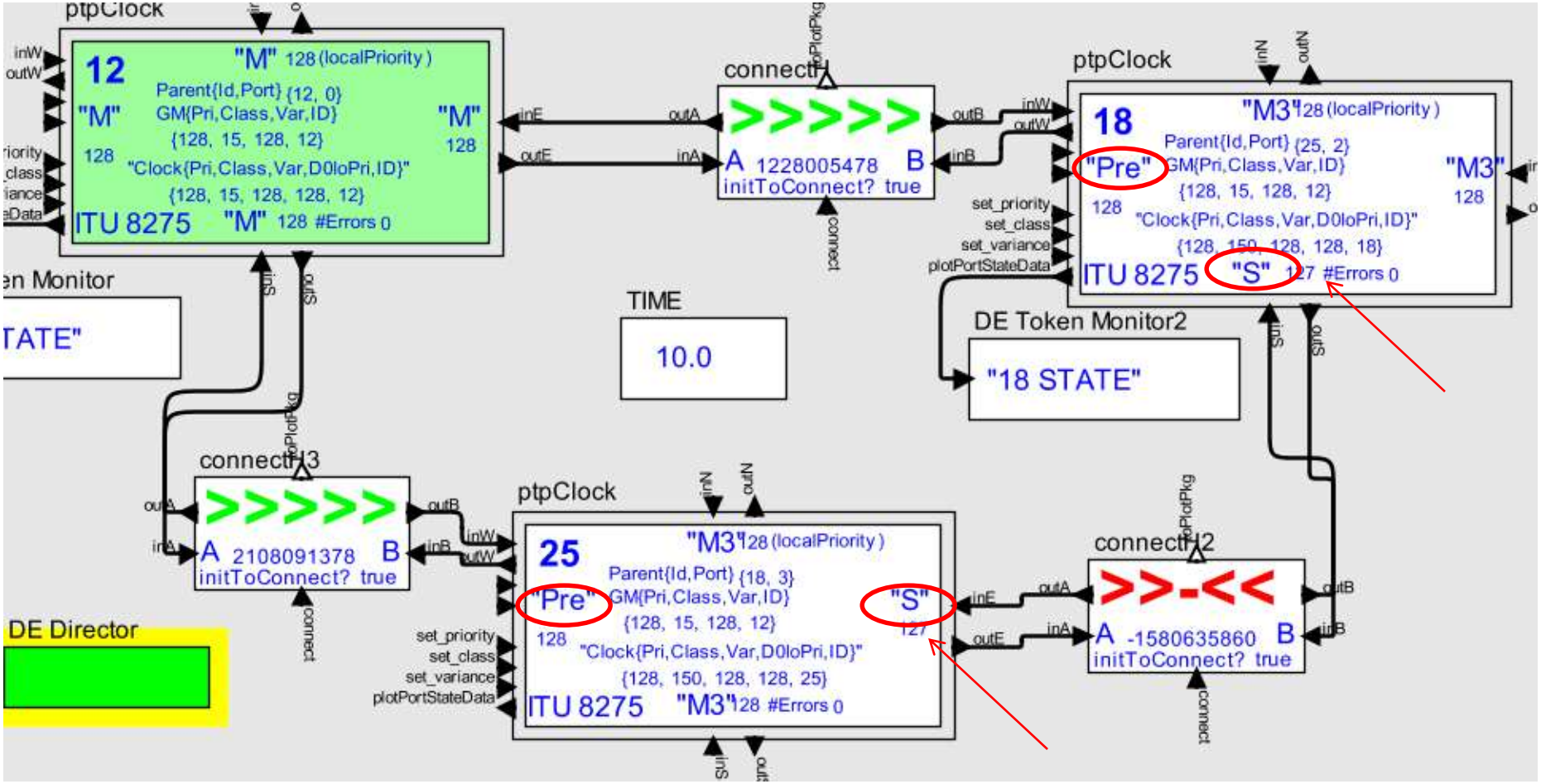
3 clock ring, AI=1, ART=3FMT=1, pre-master state, localPriority 127 on 18S,25E



3 clock ring, AI=1, ART=3FMT=1, pre-master state, localPriority 127 on 18S,25E



3 clock ring, AI=1, ART=3FMT=1, pre-master state, localPriority 127 on 18S,25E



Starting the cycle over!

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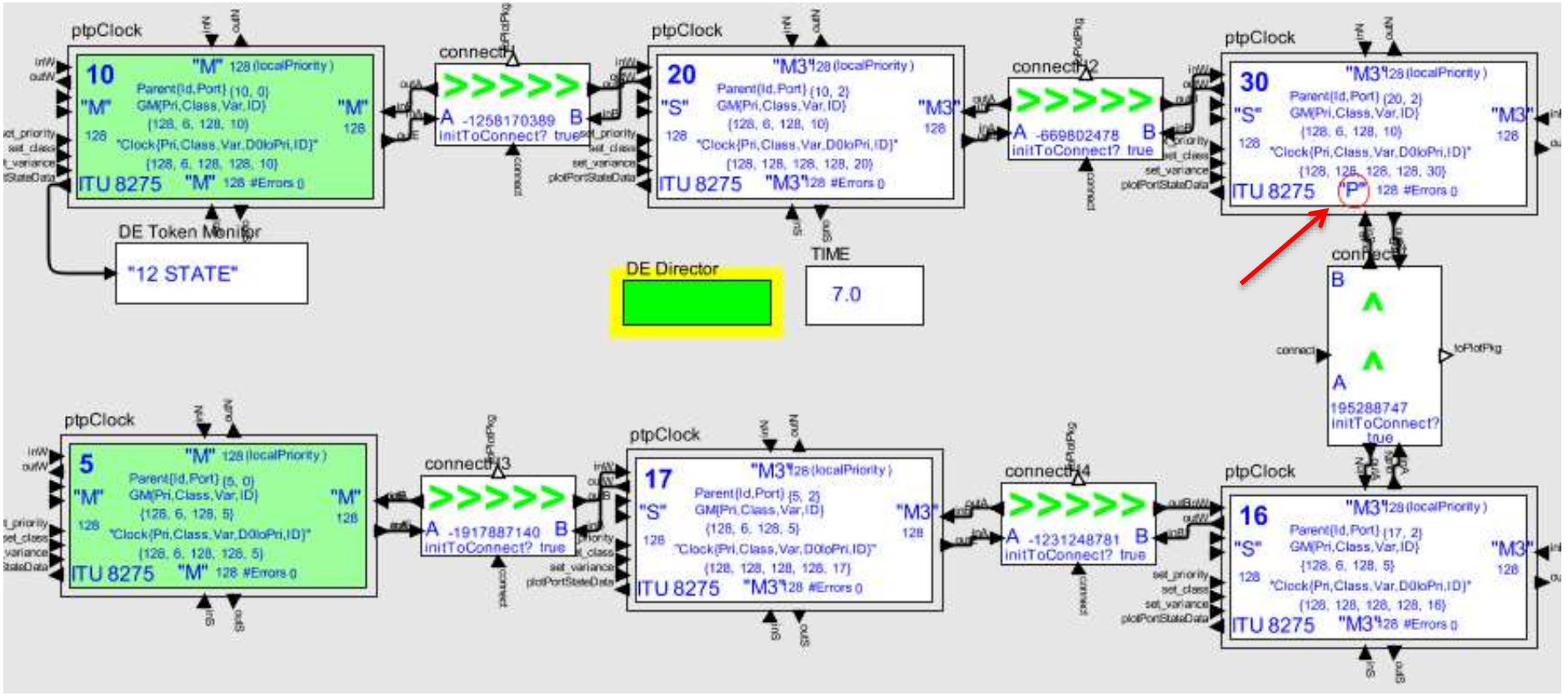
Same behavior but in a linear system!

6 clock linear, AI=1, ART=3,FMT=1, pre-master state, localPriority =128



This is a stable configuration

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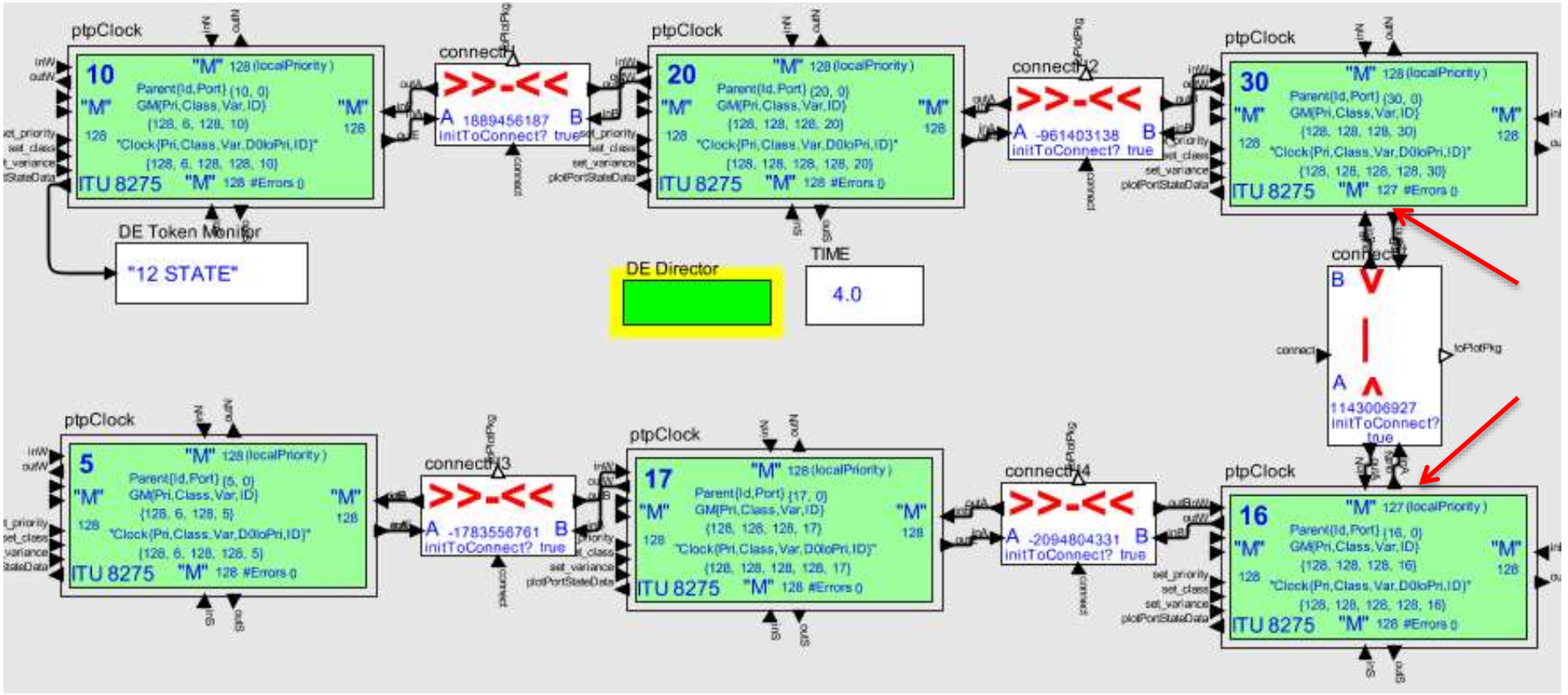
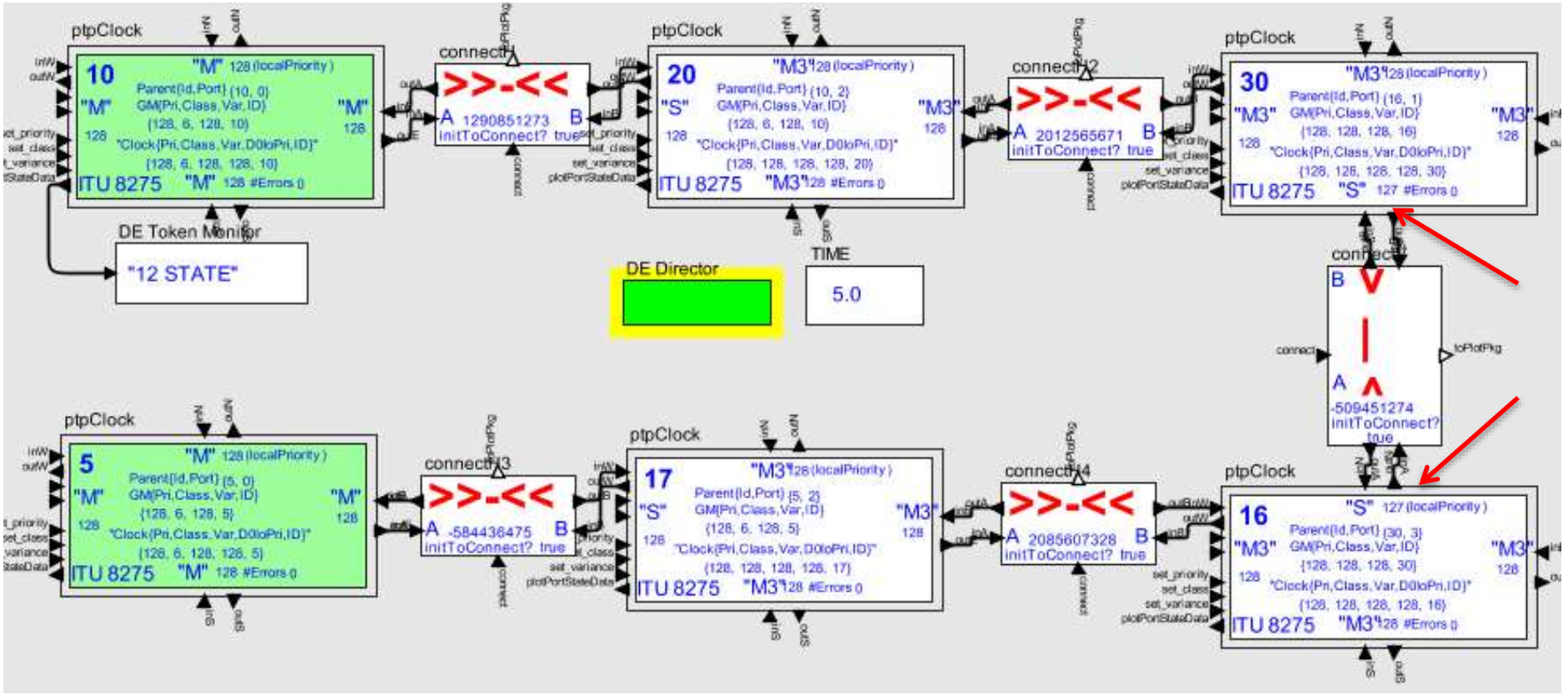
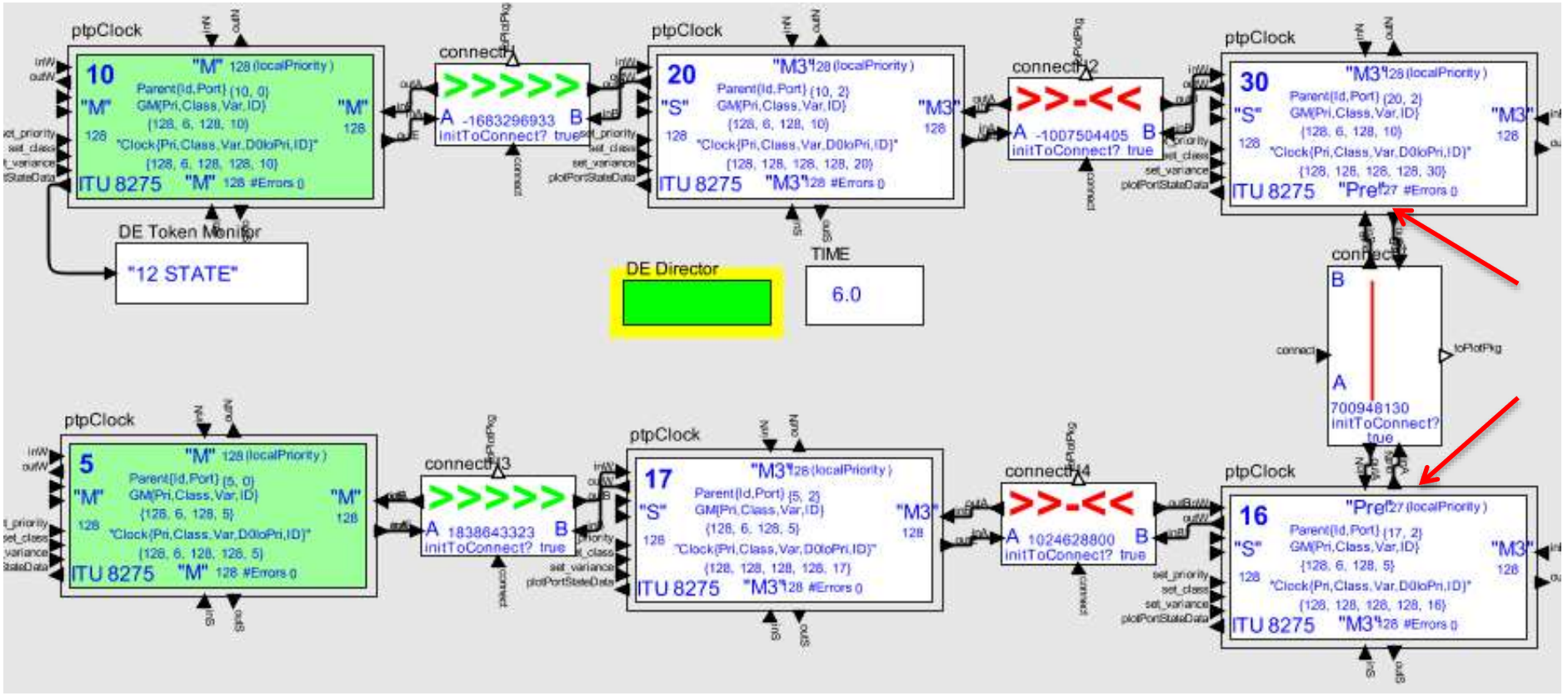
6 clock linear, AI=1, ART=3FMT=1, pre-master state, localPriority =127@30S,16N



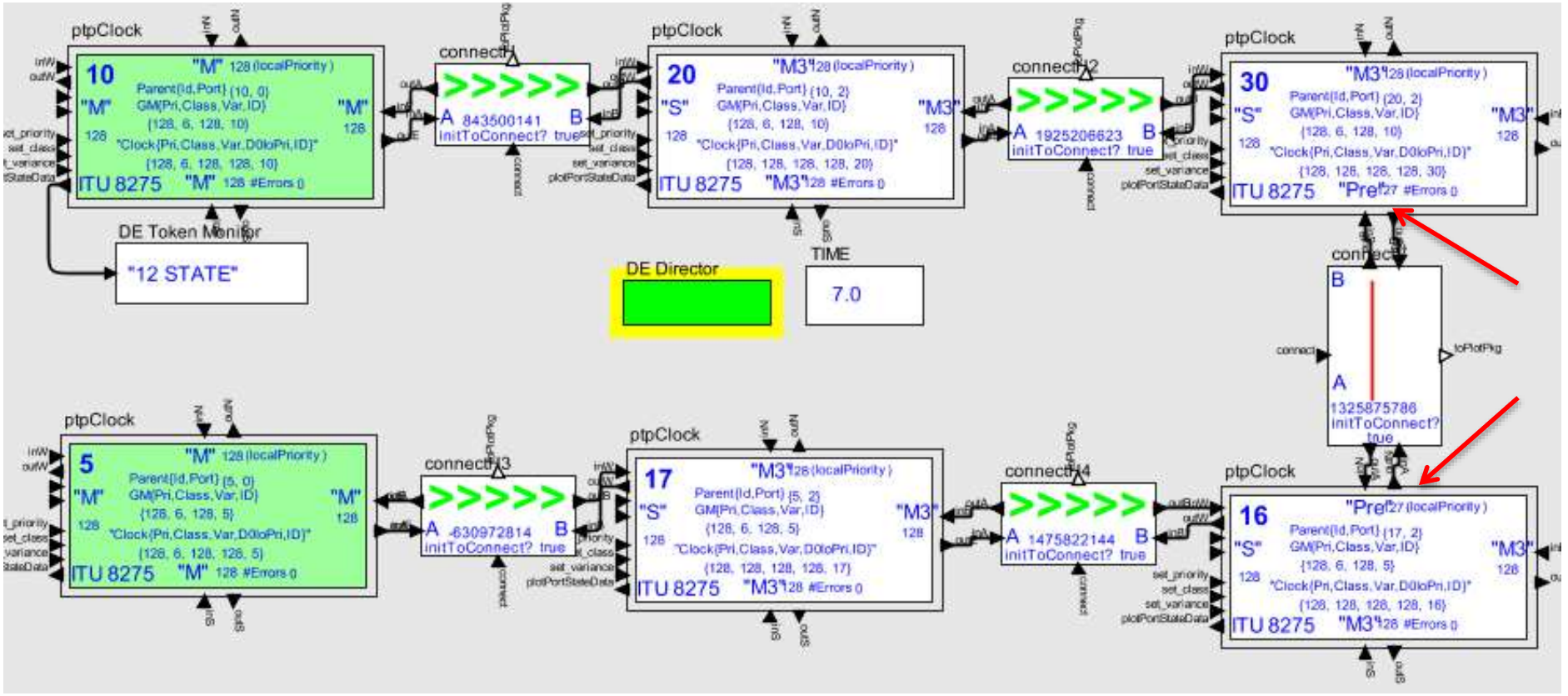
6 clock linear, AI=1, ART=3FMT=1, pre-master state, localPriority =127@30S,16N



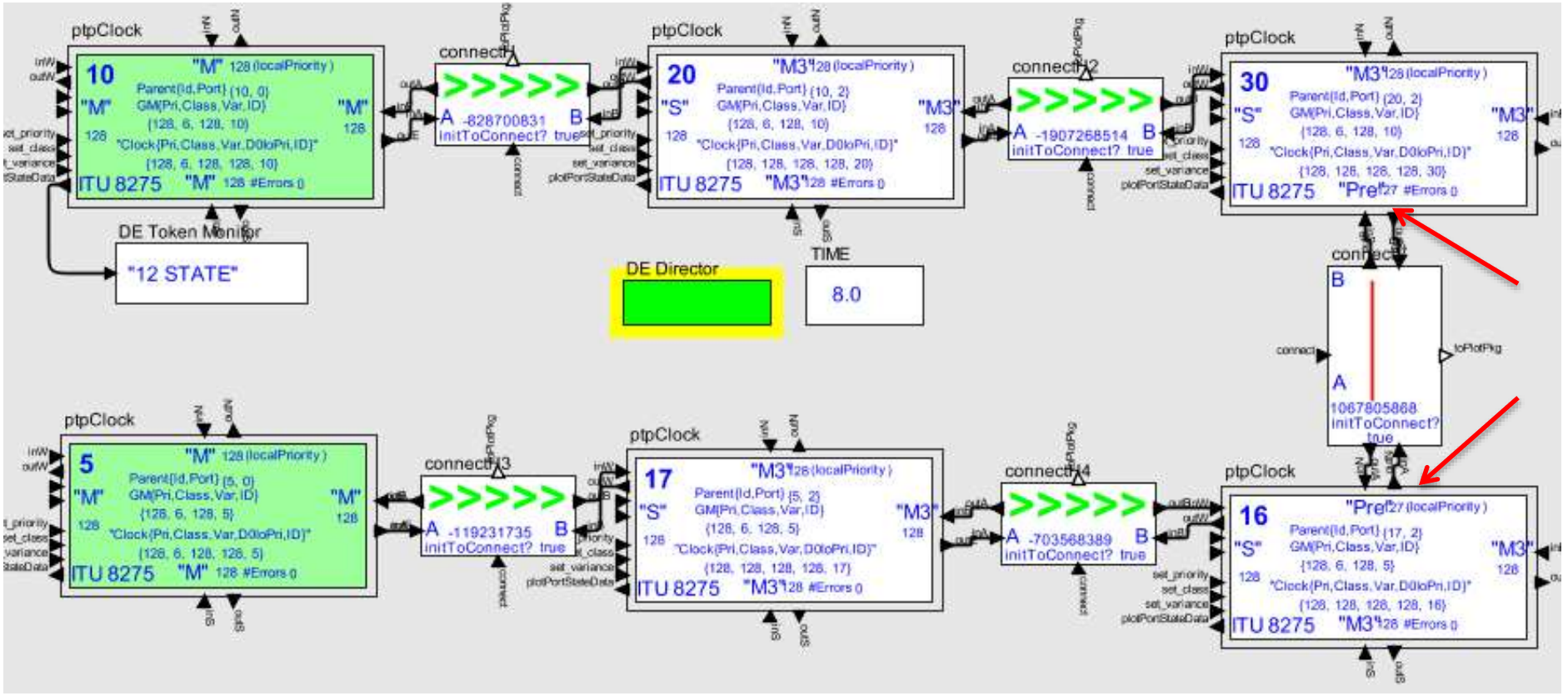
6 clock linear, AI=1, ART=3FMT=1, pre-master state, localPriority =127@30S,16N



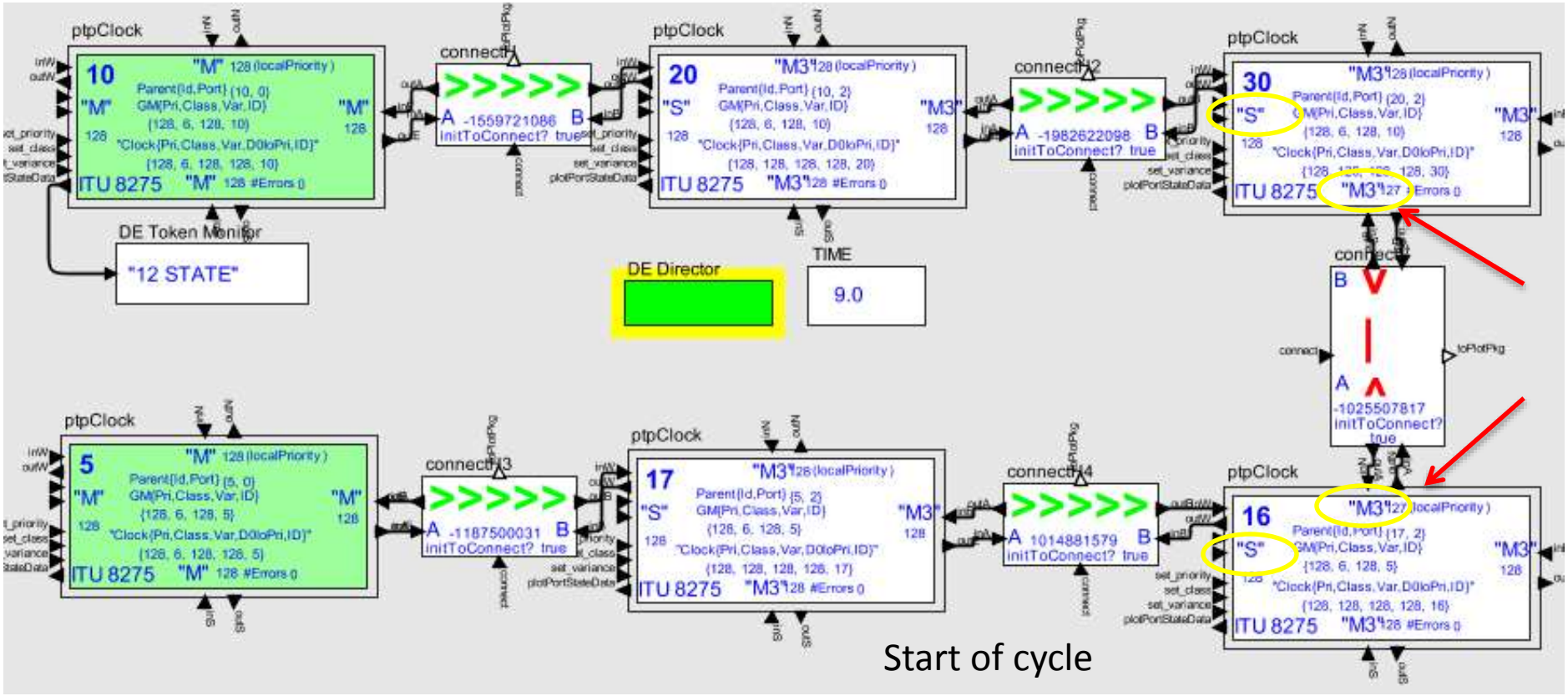
6 clock linear, AI=1, ART=3FMT=1, pre-master state, localPriority =127@30S,16N



6 clock linear, AI=1, ART=3FMT=1, pre-master state, localPriority =127@30S,16N



6 clock linear, AI=1, ART=3FMT=1, pre-master state, localPriority =127@30S,16N



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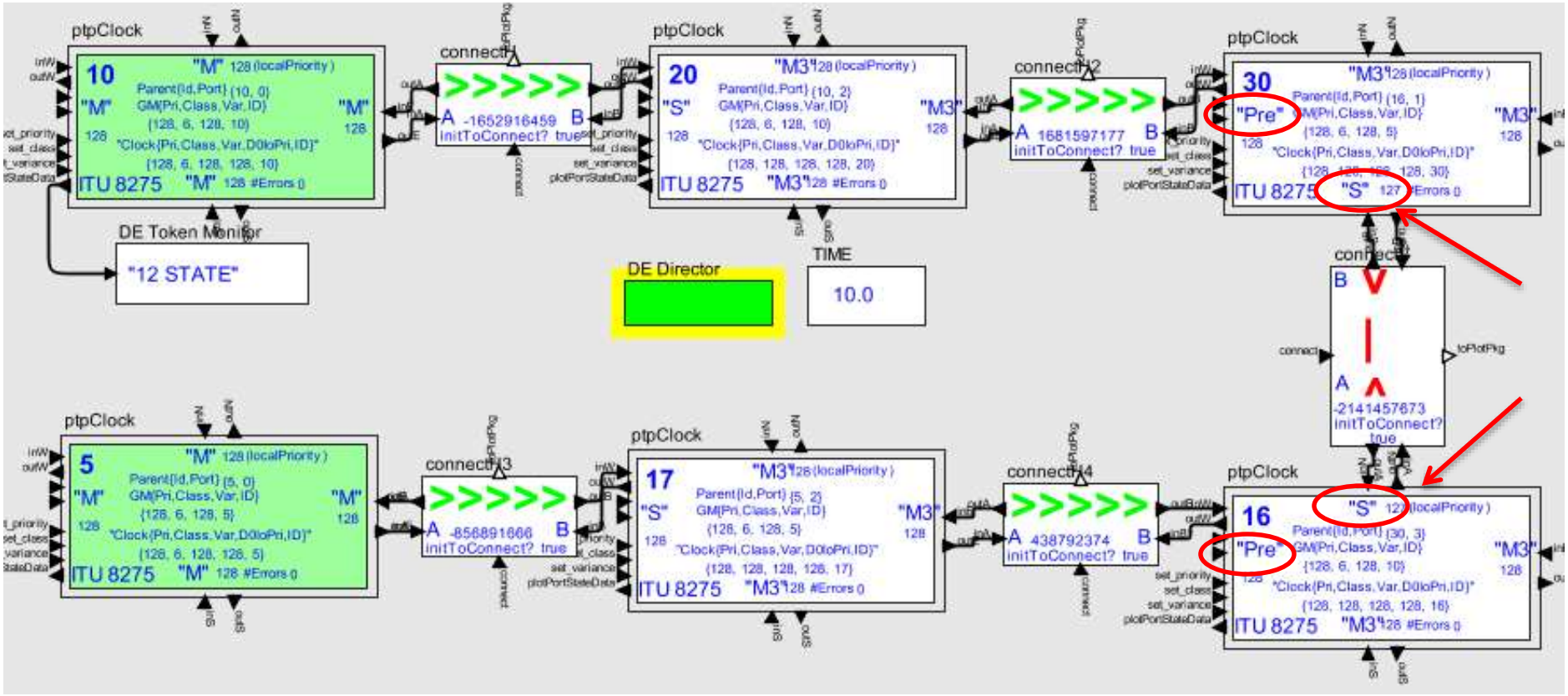
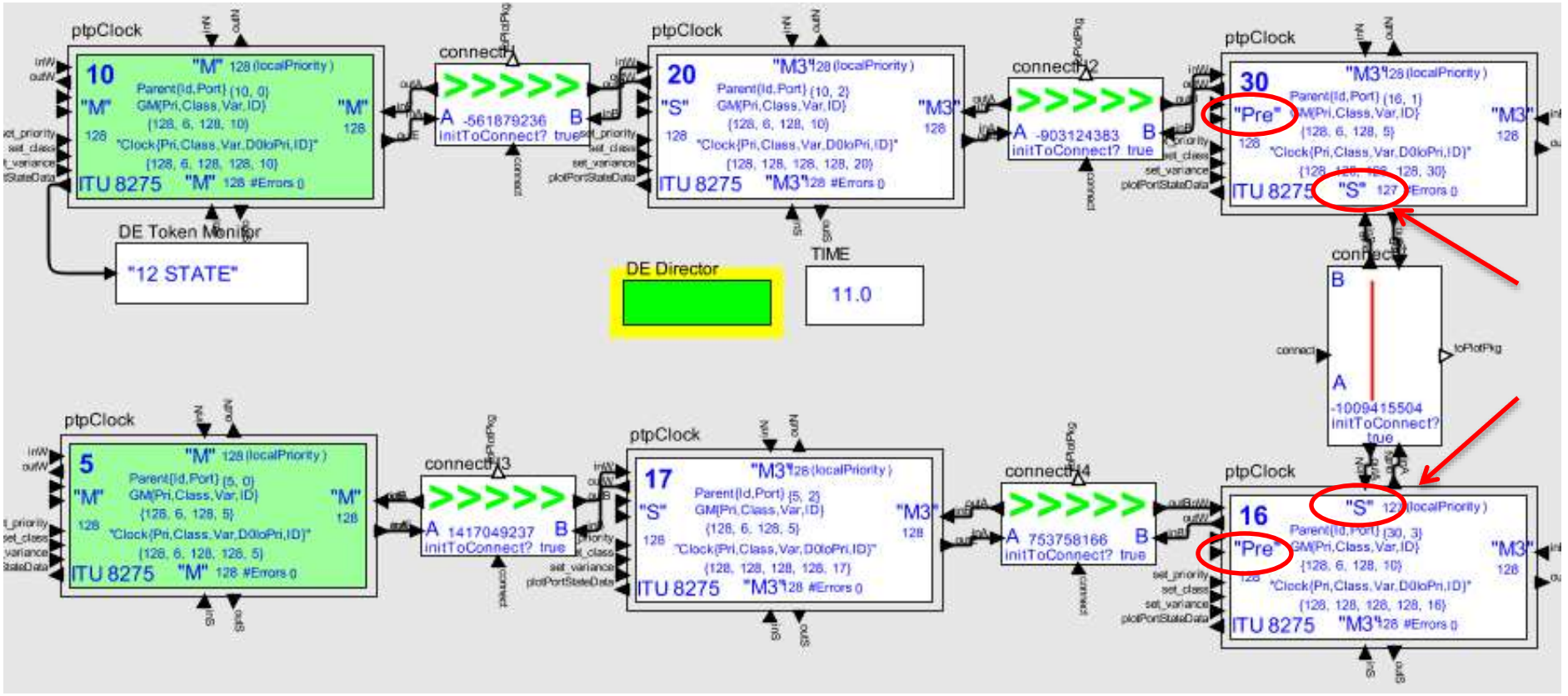
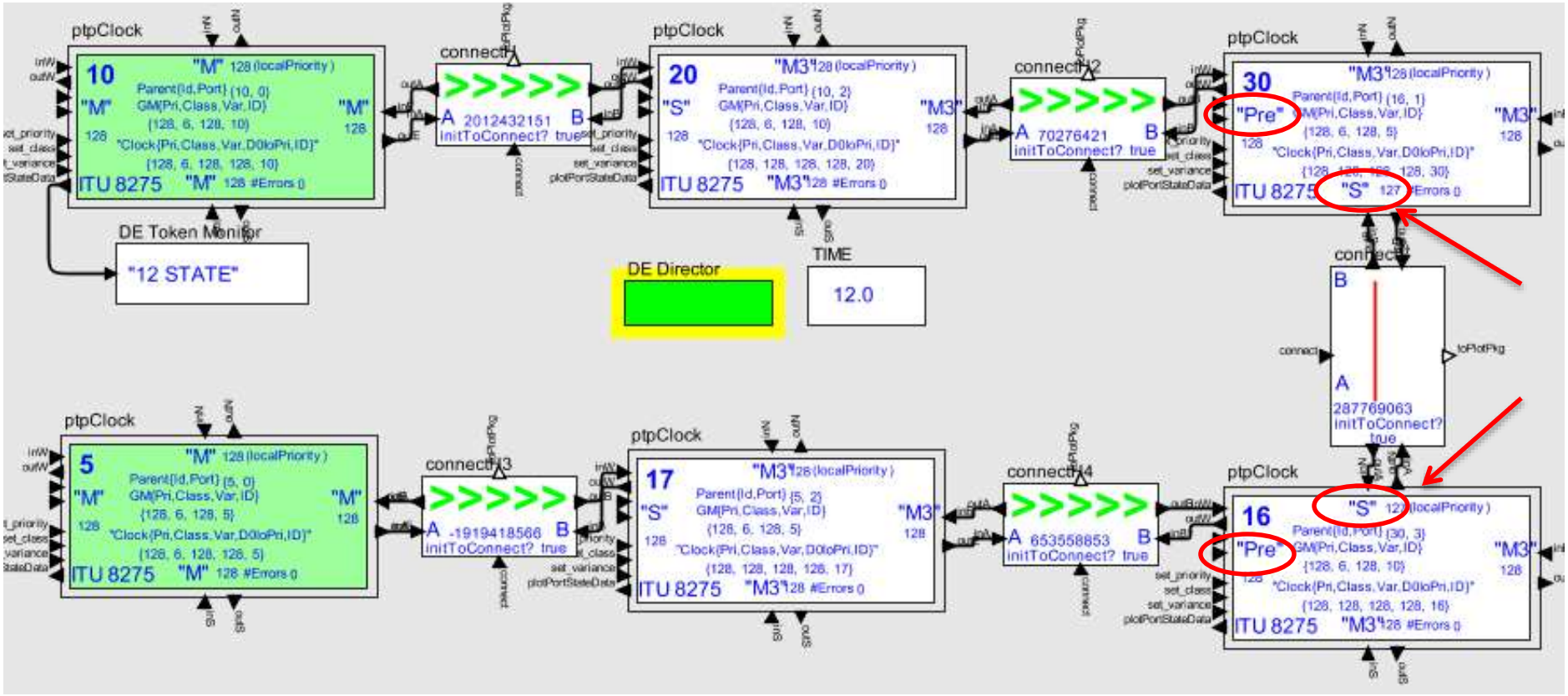
6 clock linear, AI=1, ART=3FMT=1, pre-master state, localPriority =127@30S,16N



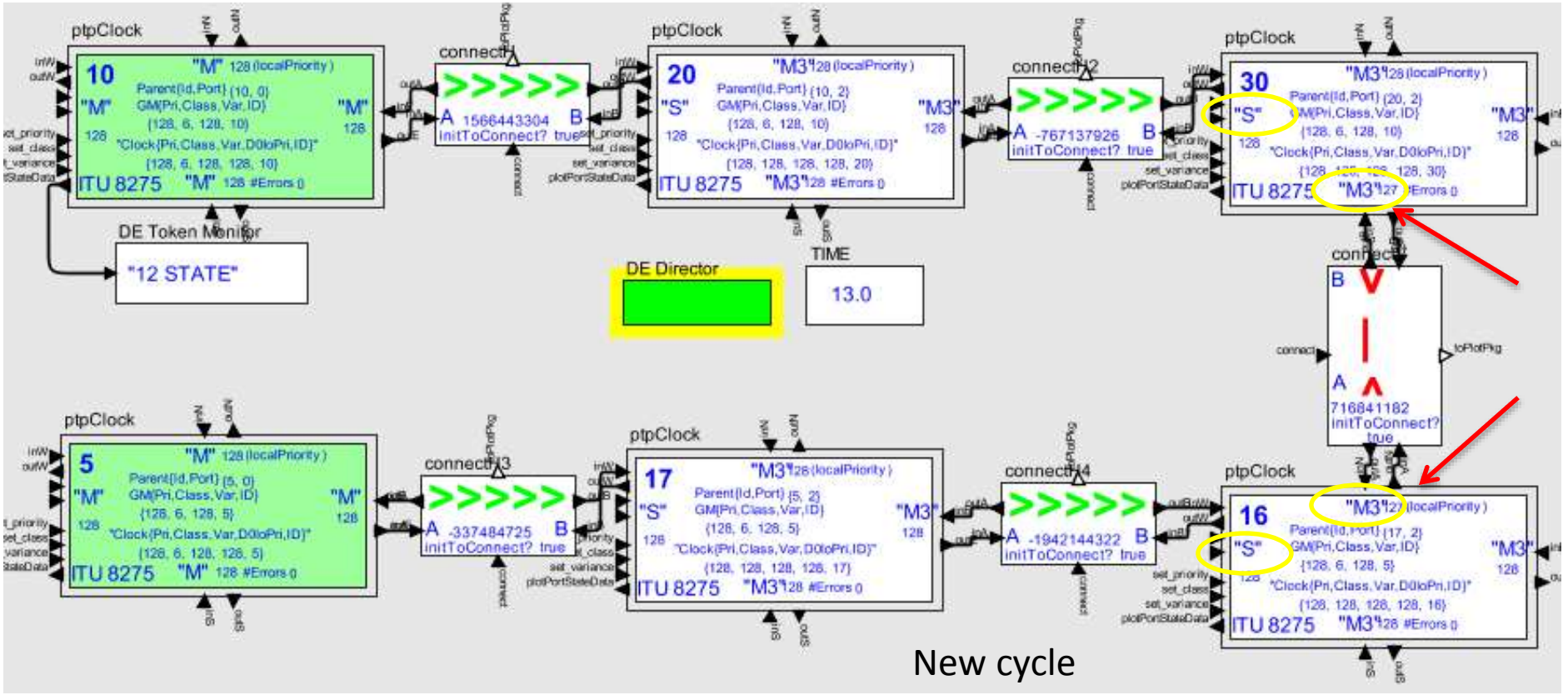
6 clock linear, AI=1, ART=3FMT=1, pre-master state, localPriority =127@30S,16N



6 clock linear, AI=1, ART=3FMT=1, pre-master state, localPriority =127@30S,16N



6 clock linear, AI=1, ART=3FMT=1, pre-master state, localPriority =127@30S,16N



Conclusions

- G8275.1 exhibits the same endlessly circulating frames behavior as IEEE 1588-2008 for the topologies tested
- The same mechanisms, e.g. pre-master, foreign master, steps removed limit, also squelch these frames in G8275.1
- G8275.1 exhibits understandable but potentially damaging behavior due to careless application of the notSlave and localPriority features.

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Thank you for your attention