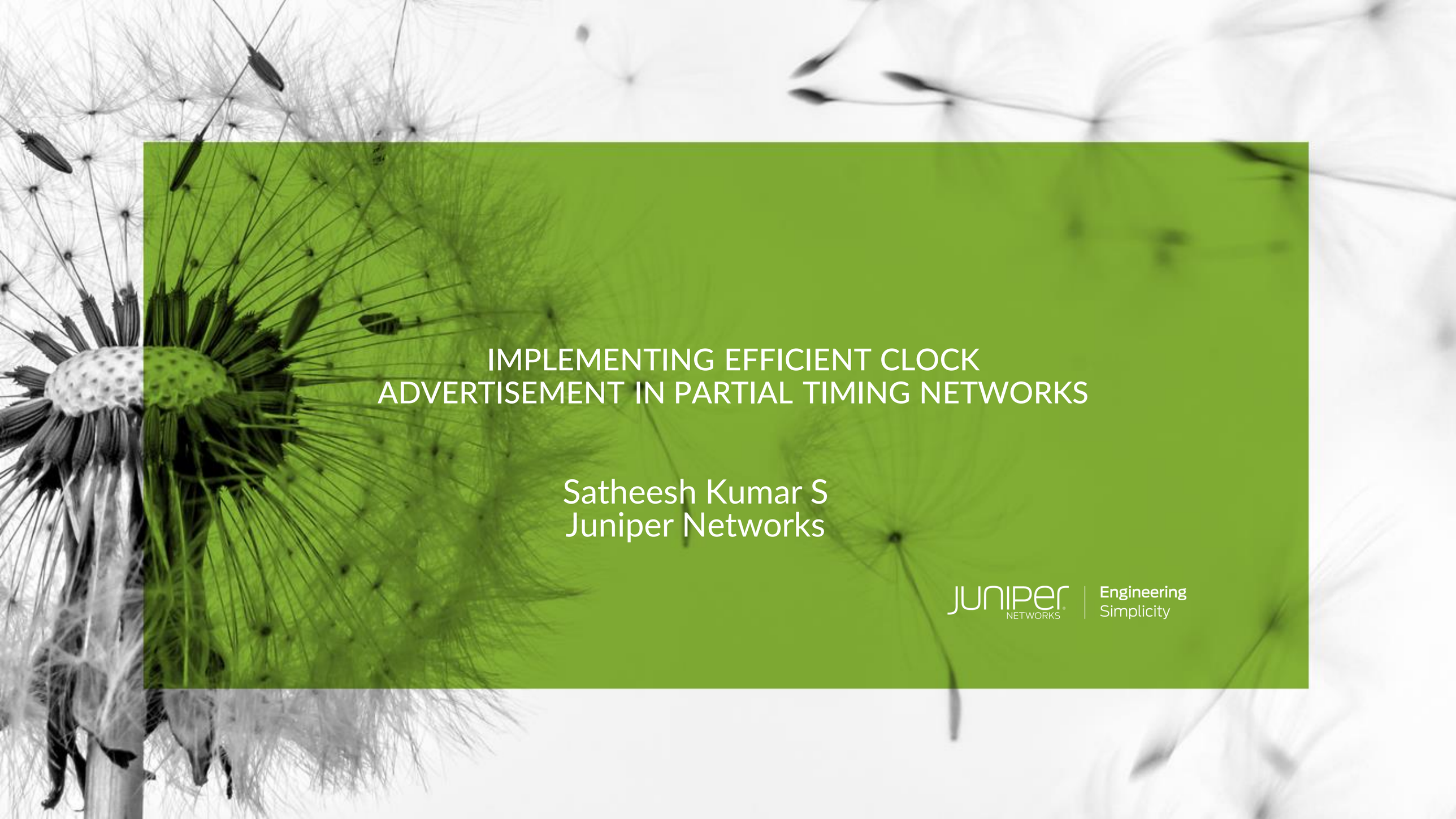

IMPLEMENTING EFFICIENT CLOCK ADVERTISEMENT IN PARTIAL TIMING NETWORKS

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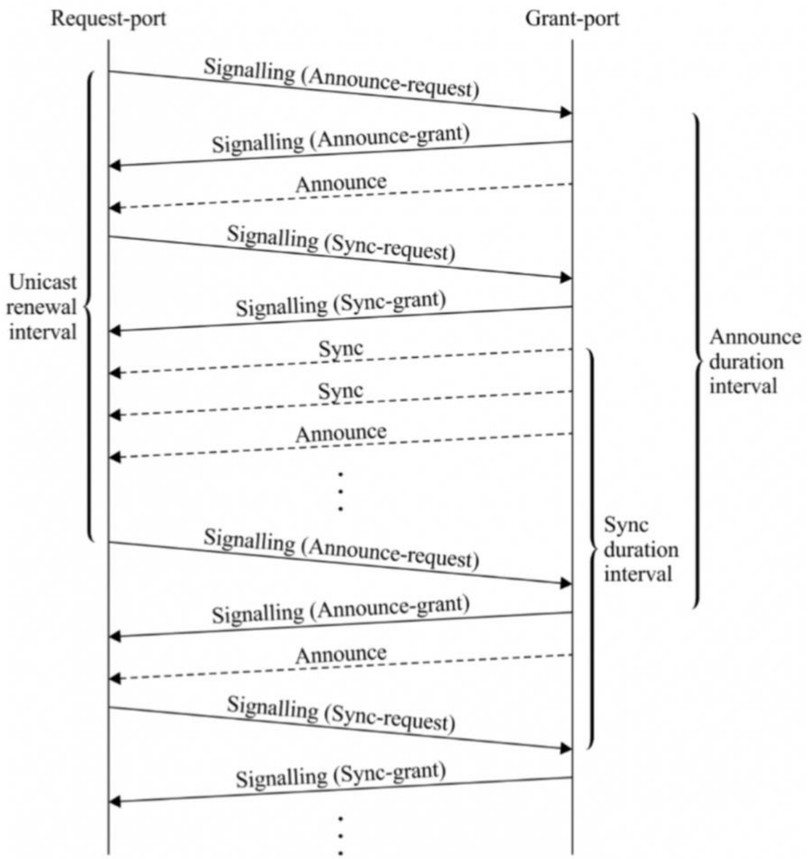
ABSTRACT

In Partial Timing Network, IP layer ensures PTP message delivery via the IGP such as OSPF, ISIS. These dynamic routing protocol can take any path through the IP transport network for delivering the PTP. When delivering PTP messaging over mix of PTP aware and Layer-3 routing PTP unaware devices, the operator might experience certain challenges on network convergence. It is quite possible that the path taken by the IP transport layer may not be the optimum path 'expected' by the operator who design the synchronization. So, with the current approach, one may need to apply certain restrictions in the IP layer. *This is likely to be the case in ring topologies with master on the Loopback and slave on the WAN port. This paper addresses a possible solution to overcome the issue dynamically so that any part of the network fails, PTP converges to the most desired path with best performance.*

INTRODUCTION

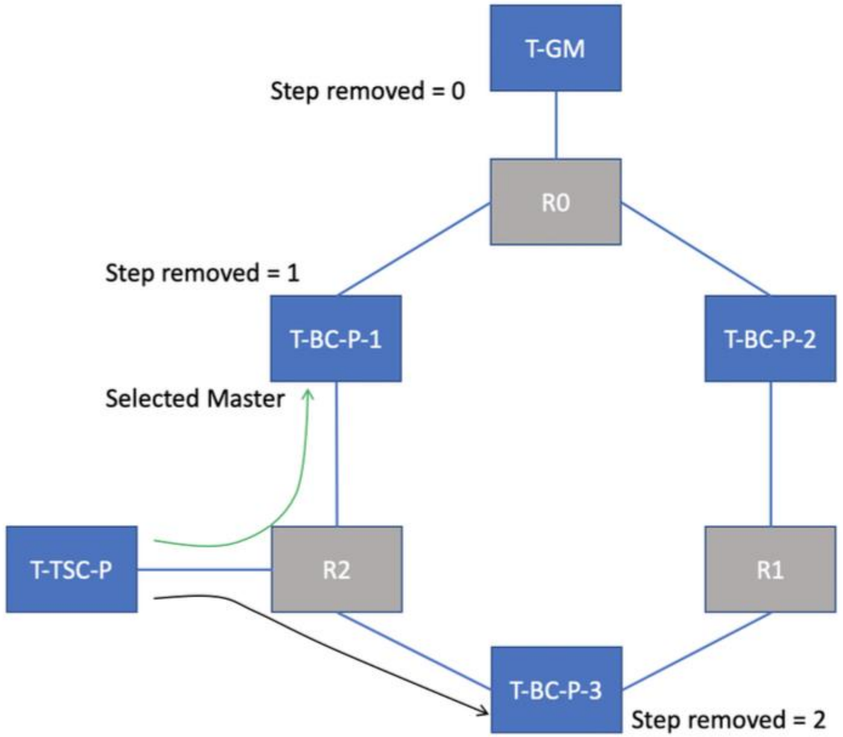
- Partial timing network typically consists of mix of PTP aware devices and Layer-3 routing PTP unaware devices.
- The IP layer, IPv4/IPv6, provides the transport for PTP messages via the Internet Gate Way Routing Protocols (IGP) such as OSPF, ISIS, etc.
- These dynamic routing protocol deliver the PTP messages through the IP transport network from the source node to destination node.

BACKGROUND

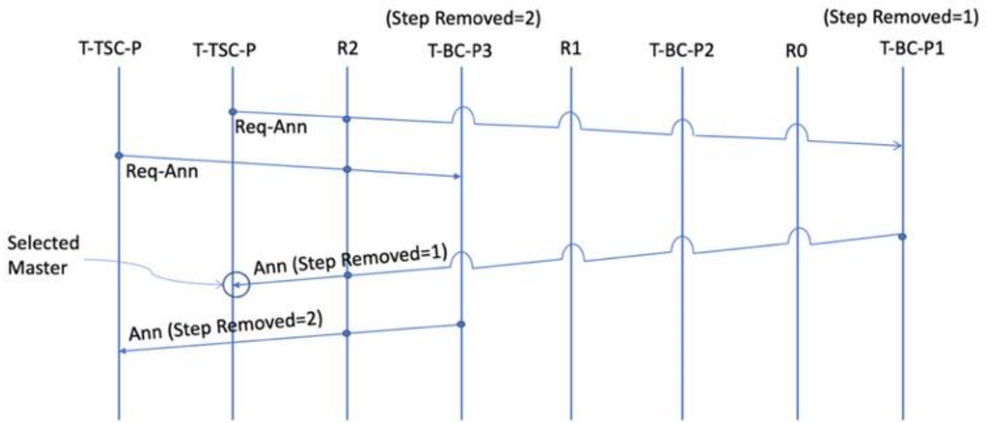


- Partial Timing Network (PTN) uses unicast-negotiation for establishing communication between Master and Sub-ordinate clock.
- There are 3 types of signalling messages initiated by the Sub-ordinate clock towards Master.
  - ✓ Unicast Request Announce Message
  - ✓ Unicast Request Sync Message
  - ✓ Unicast Request Delay Response Message
- As a response to these messages, Master sends the following messages respectively to the Sub-ordinate clock.
  - ✓ Unicast Grant Announce Message
  - ✓ Unicast Grant Sync Message
  - ✓ Unicast Grant Relay Response Message

BACKGROUND



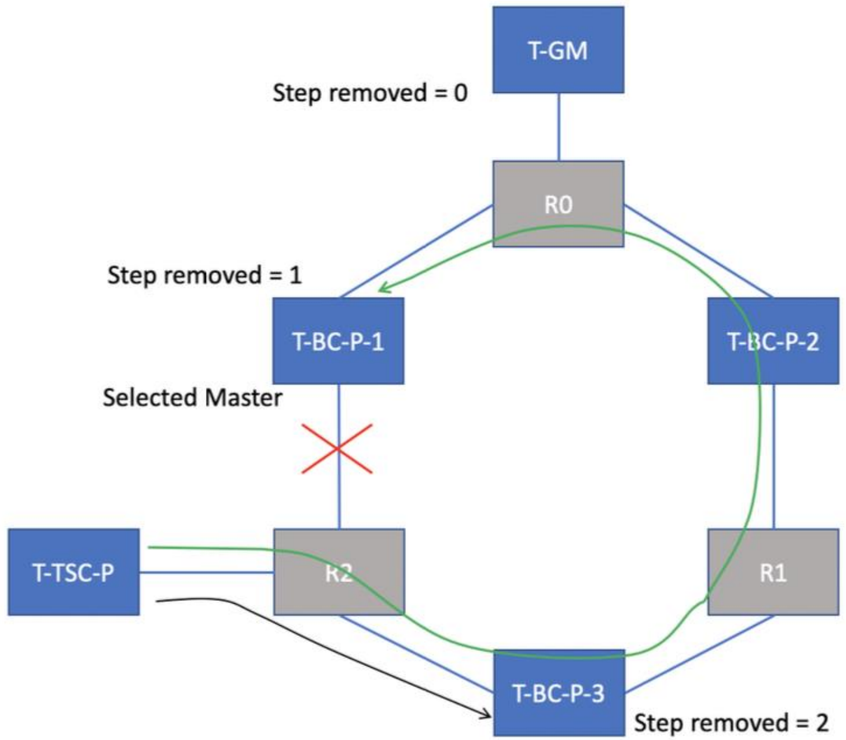
- T-TSC-P is the Telecom-Time Sub-ordinate Clock, which is configured for unicast signalling services from T-BC-P-1 and T-BC-P-3.
- T-BC-P-1 and T-BC- P-3 are boundary clocks with WAN port as the client ports and loop-back interface (lo0) as the locally configured master ports.
- Step-removal of T-BC-P-1 is 1 and that of T-BC-P-3 is 2.
- T-TSC-P shall select T-BC-P-1 as its master.
- T-TSC-P, then request service for Sync and Delay Response messages from T-BC-P-1.



CHALLENGES

- Major challenges in delivering PTP messaging over an IP transport layer.
  - ✓ IP transport path may not be same as path 'expected' for the synchronization.
  - ✓ Impose certain restrictions in the IP transport layer to control sub-optimal paths for PTP messages. (Refer ITU-T G.8275.2)
  - ✓ Ring topologies are more troublesome with topology changes due to link fail-over.
  - ✓ This is likely in ring topologies with master on the Loopback and Sub-ordinate on the WAN port.
  - ✓ No mechanism to detect the PTP unaware hops in partial timing network.

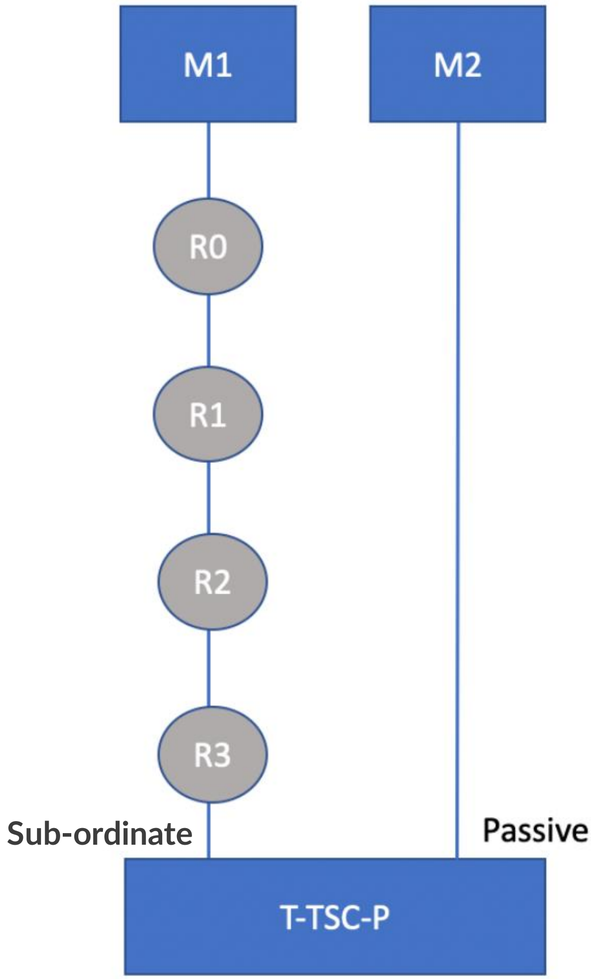
PROBLEM STATEMENT



- The Sub-ordinate clock T-TSC-P is configured for unicast service from both T-BC-P-1 and T-BC-P-3.
- T-TSC-P run the ABMCA and select T-BC-P-1 as its parent clock based on the ‘steps removed’ value of T-BC-P-1.
- If the connection between T-BC-P-1 and R2 breaks, then T-BC-P-1 is not reached through the expected path.
- T-BC-P can still be reached because routing protocols will retain the Layer-3 connection by routing the IP packets around the ring.
- T-BC-P-1 is retained as the parent clock because it is still considered better by the ABMCA.
- The most likely **desired operation** is that the Sub-ordinate clock should lock to T-BC-P-3, giving superior performance.

What is the solution for the desired operation??

PROBLEM STATEMENT

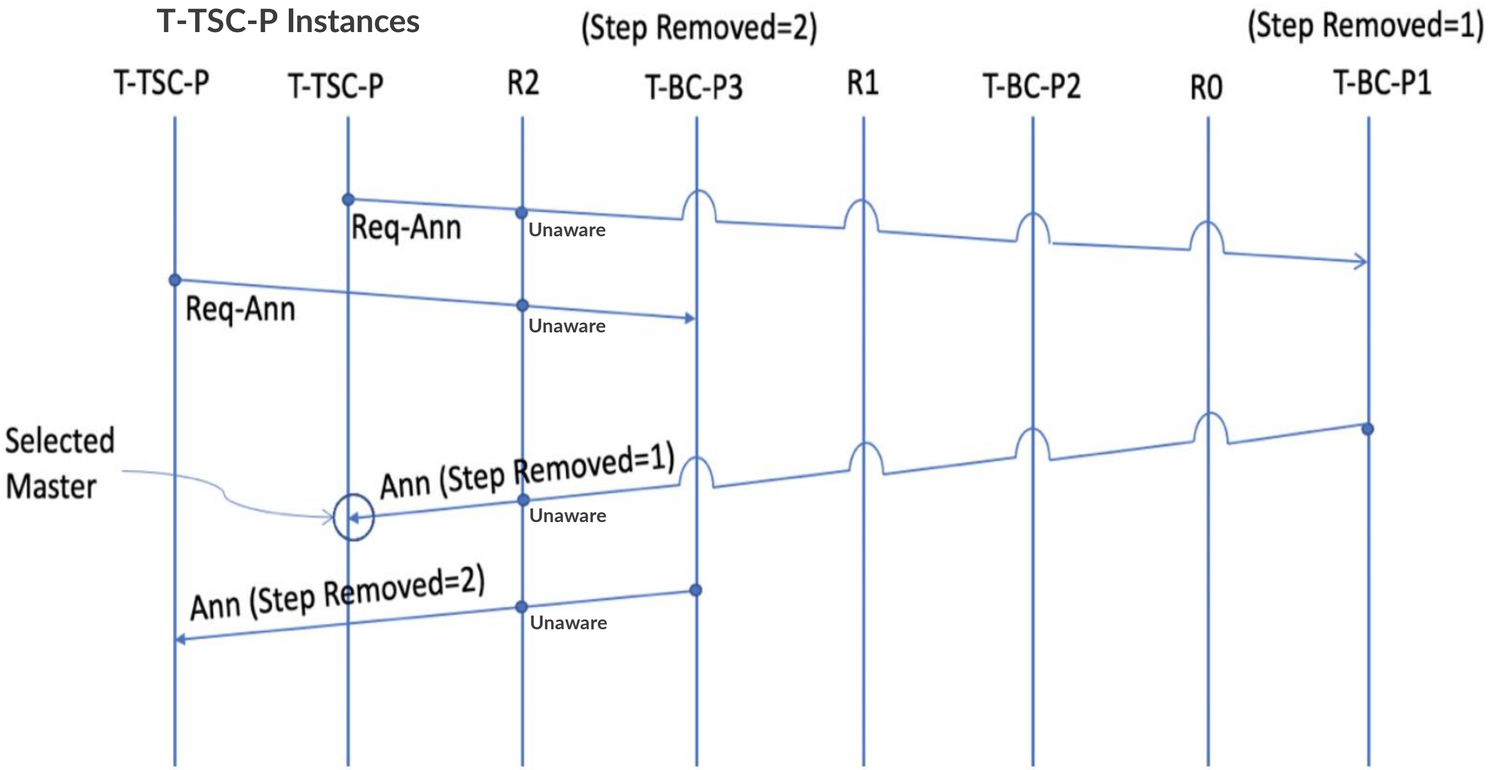


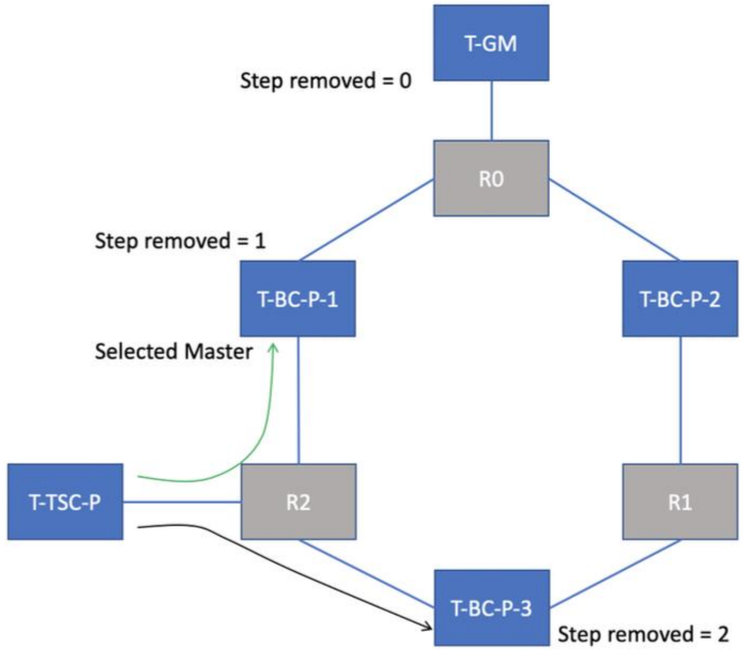
- The Sub-ordinate clock T-TSC-P is configured for unicast service from both M1 and M2.
- T-TSC-P run the ABMCA and possibly select M1 as its parent clock.
- The most **desired path** for the synchronization design is to choose the direct path to M2.
- In this case Local Priority can be configured on T-TSC-P to choose the desired path. However, operator to manually configure the same.

How T-TSC-P select M2 without manual intervention?

CLOCK SELECTION (BEFORE FAILURE)-CURRENT MODEL

- Step-removal of T-BC-P-1 is 1 and that of T-BC-P-3 is 2, T-TSC-P will select T-BC-P-1 as its master.





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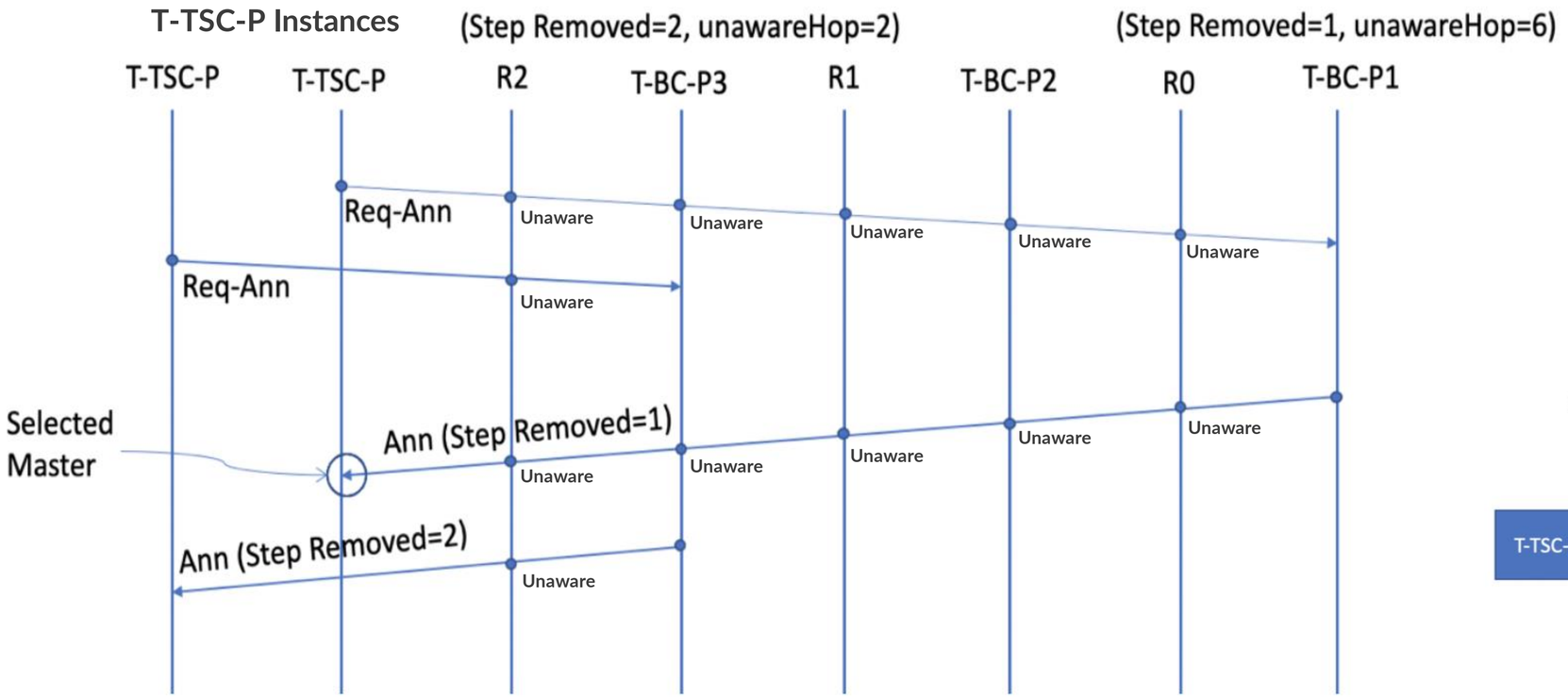
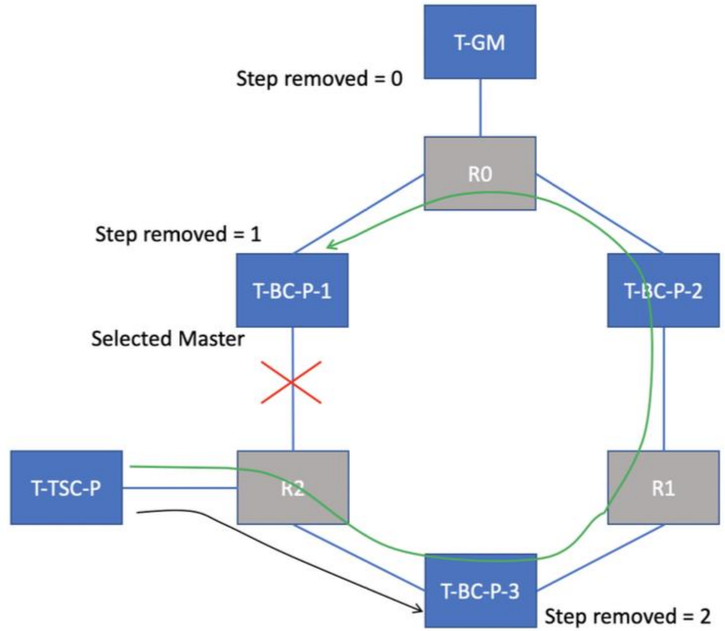




PROPOSED SOLUTION-ESTIMATE THE UNAWARE HOP-COUNT

- The proposed idea introduces ‘initialTTL’ field in the Request_Unicast_Transmission TLVs. It carries the value of ‘initial Ipv4 TTL value’ when T-TSC-P initiate the signalling request for Announce.
- When the PTP packet reaches the T-BC-P-1 via the PTP unaware hops, it estimate the ‘unawareHop’ from the incoming signalling request for Announce message.
- The Sub-ordinate clock uses this ‘unawareHop’ count value to update the Announce message from T-BC-P-1.
- The proposed idea thus establishes awareness to T-TSC-P that, the T-BC-P-1 is a ‘X’ (Ex. X=6) number of PTP unaware hop away despite the fact that it has lower step-removal of 1 as compared to that of T-BC-P-3, which is just 2 hop away with higher step-removal of 2.
- A modified ABMCA Part-2 enables T-TSC-P in selecting the right master closer to it, which can provide relatively stable clock as compared to the existing methods in Partial Timing Network based on the modified announce messages.

PROPOSED SOLUTION-ESTIMATE THE UNAWARE HOP-COUNT

Modified REQUEST_UNICAST_TRANSMISSION TLV format

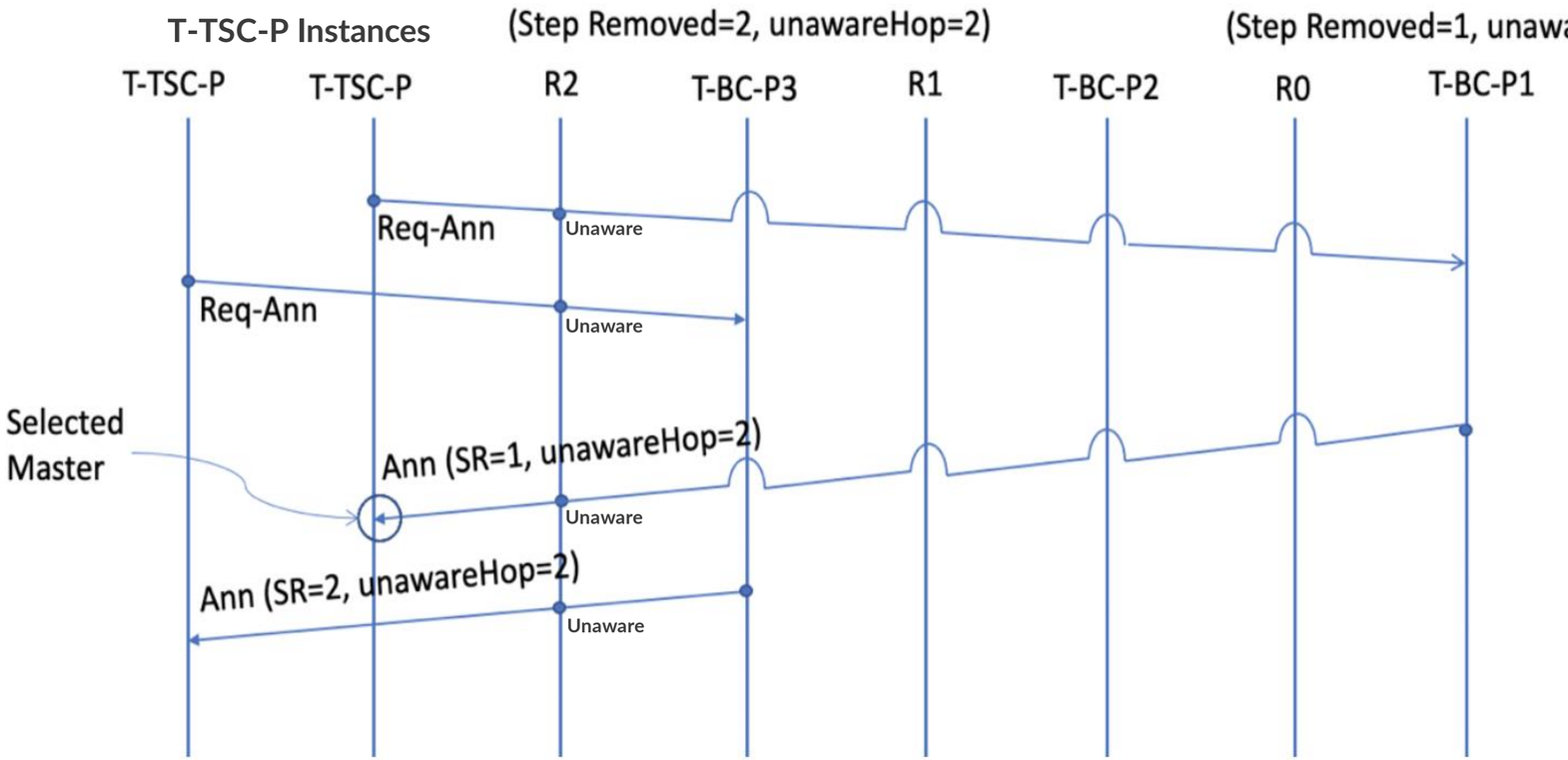
Bits								Octets	TLV offset
7	6	5	4	3	2	1	0		
tlvType								2	0
lengthField								2	2
messageType				**initialTTL**				1	4
logInterMessagePeriod								1	5
durationField								4	6

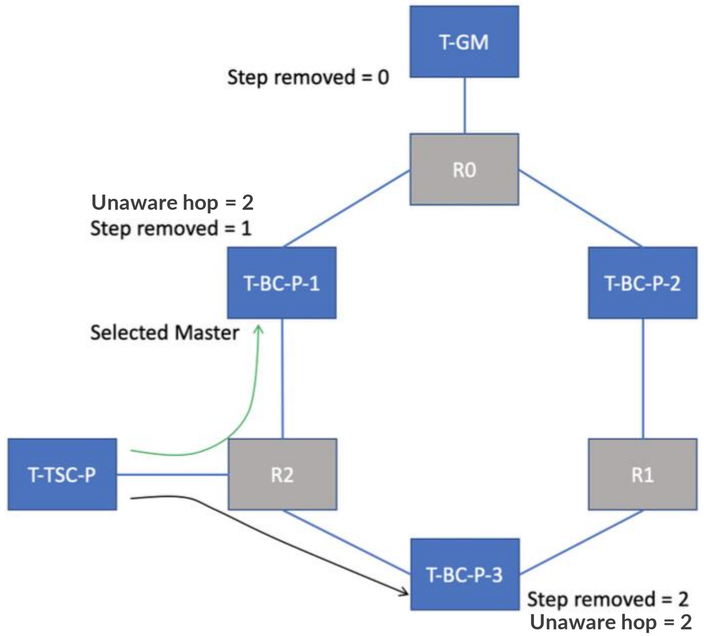
Modified Announce Message format

Bits								Octets	Offset
7	6	5	4	3	2	1	0		
header (see 13.3)								34	0
originTimestamp								10	34
currentUtcOffset								2	44
unawareHop=varTTL								1	46
grandmasterPriority1								1	47
grandmasterClockQuality								4	48
grandmasterPriority2								1	52
grandmasterIdentity								8	53
stepsRemoved								2	61
timeSource								1	63

PROPOSED SOLUTION-CLOCK SELECTION (BEFORE FAILURE)

- Step-removal of T-BC-P-1 is 1 and that of T-BC-P-3 is 2, T-TSC-P will select T-BC-P-1 as its master.





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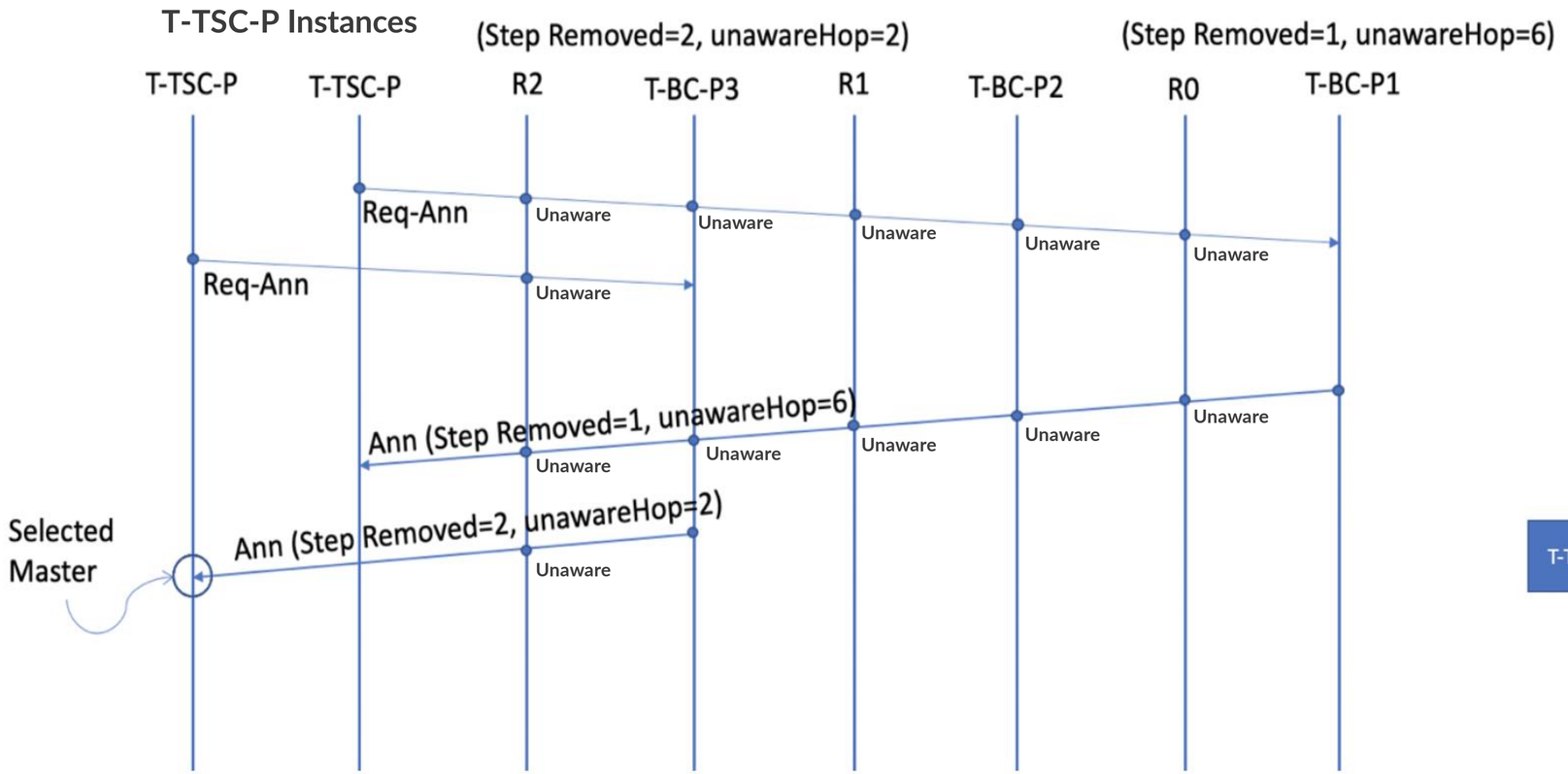
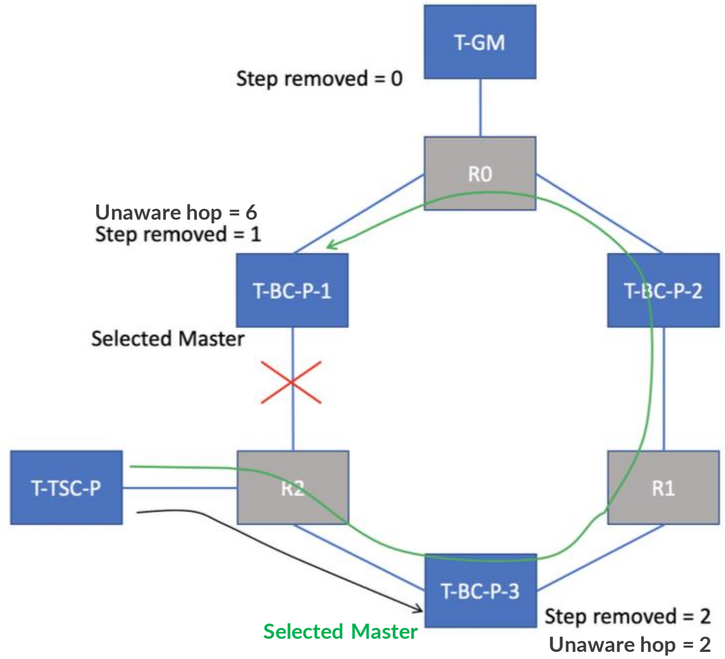
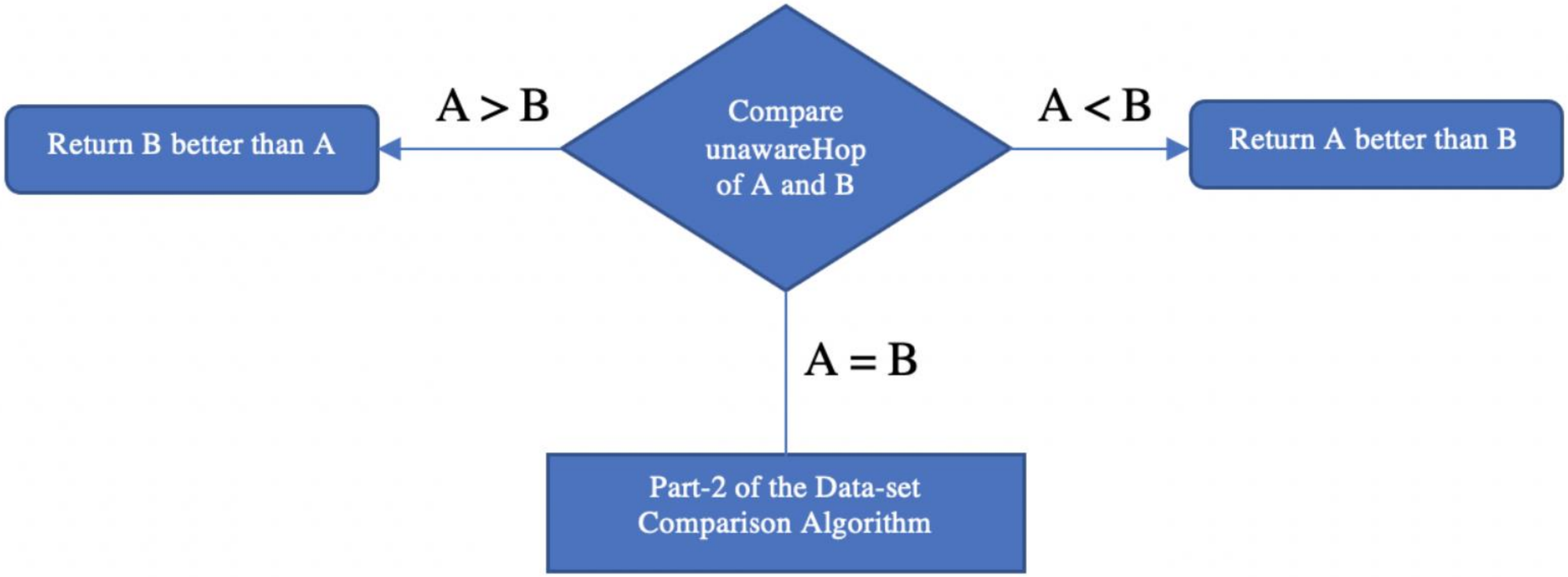




PROPOSED MODIFICATION TO ABMCA

- Part-1 of ABMCA – No change
- Part-2 of ABMCA – Needs modification as below.



QUESTIONS ??

THANKS