

Extensions to PCEP for Temporal LS

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draft-chen-pce-tts-00

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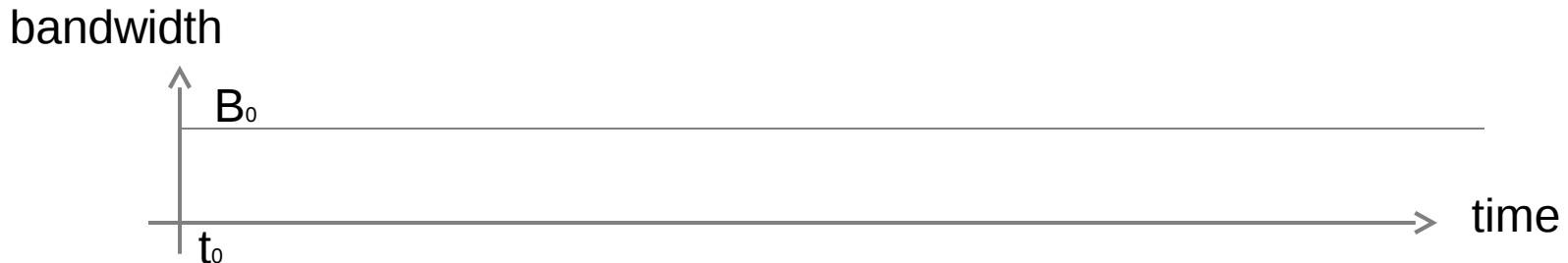
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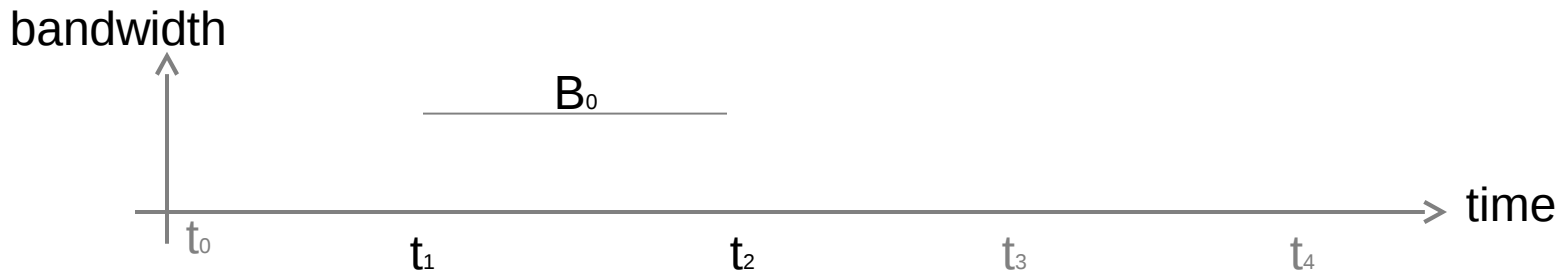
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Introduction

- Existing PCE for
 - Establishing an LSP tunnel, assuming it up and use bandwidth forever until torn down



- Extensions to PCE for
 - Creating LSP in a sequence of time intervals (e.g., a TE LSP from A to B from t_1 to t_2 , another TE LSP from C to D from t_3 to t_4 every day.)



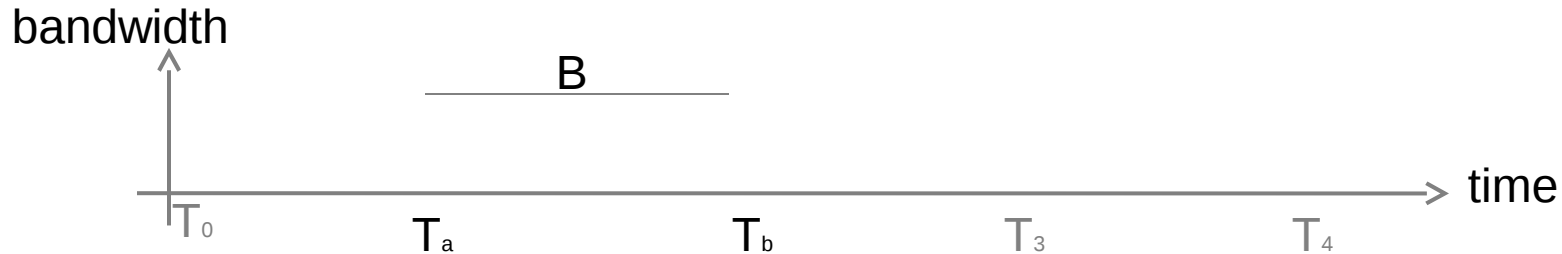
Operations Overview

Temporal LSP: LSP

with a sequence of time intervals,
carrying traffic in each of intervals

Simple time interval $[T_a, T_b]$: time period from T_a to T_b

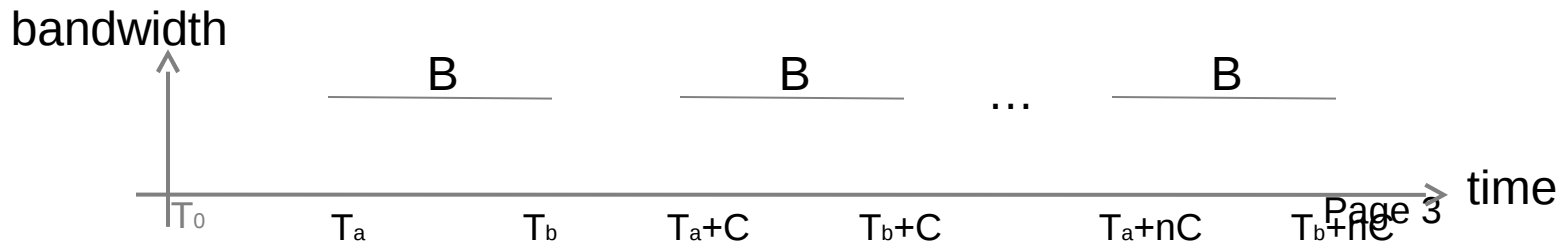
- LSP with $[T_a, T_b]$
 - path satisfying the constraints from T_a to T_b is computed
 - LSP is set up to carry traffic from T_a to T_b



Recurrent time interval $[T_a, T_b]$ repeats n times with repeat cycle C

$[T_a, T_b], [T_a+C, T_b+C], [T_a+2C, T_b+2C], \dots, [T_a+nC, T_b+nC]$

- LSP with “[T_a, T_b] repeats n times with repeat cycle C ”
 - path satisfying the constraints in each of $(n+1)$ time intervals
 - LSP is set up to carry traffic in each of $(n+1)$ intervals



Operations Overview - Continue

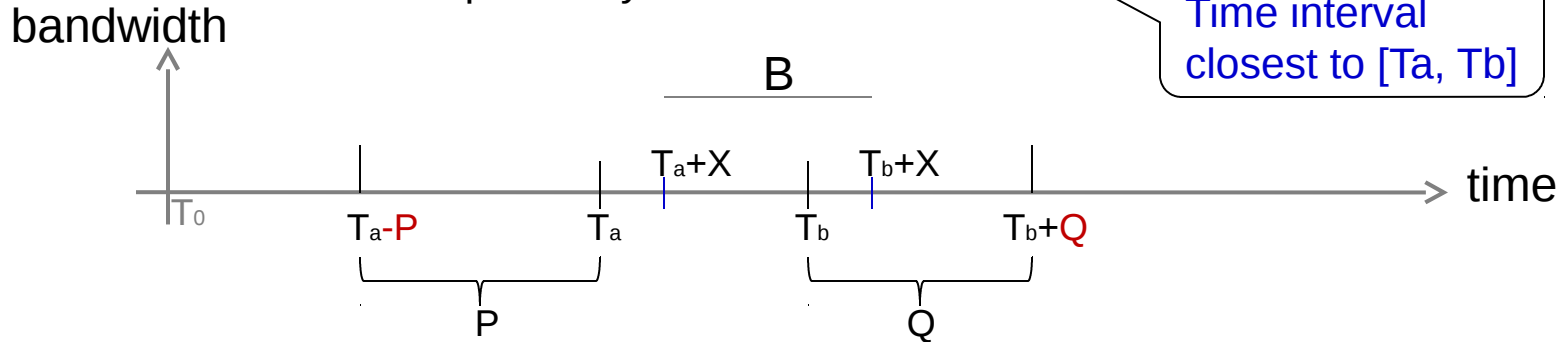
Elastic time interval $[T_a, T_b]$ within $-P$ and Q

$[T_a+X, T_b+X]$, where $-P \leq X \leq Q$, P/Q is an amount of time

- LSP with “[T_a, T_b] within $-P$ and Q ”
 - path satisfying constraints in $[T_a+X, T_b+X]$ and $|X|$ is the minimum from $-P$ to Q
 - LSP set up to carry traffic from T_a+X to T_b+X

No path for LSP in $[T_a, T_b]$ is OK

Time interval closest to $[T_a, T_b]$



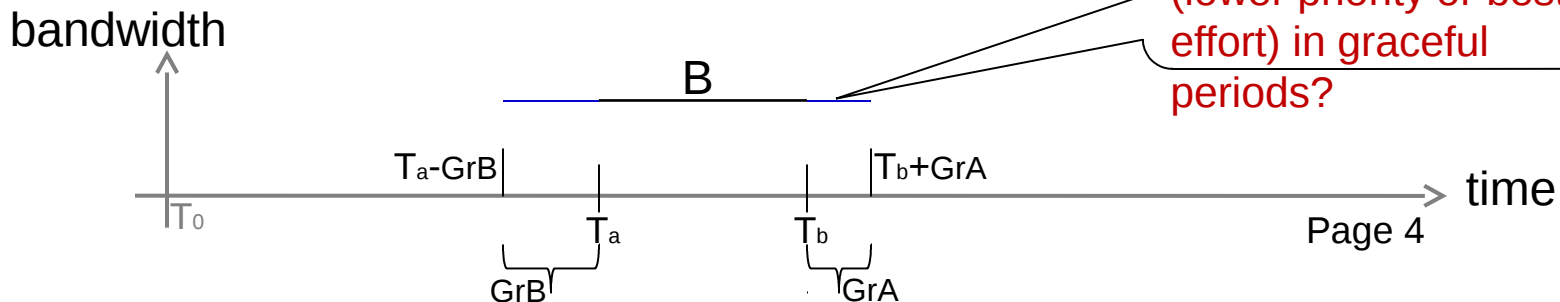
Changes to Time Intervals on LSP

New interval added, Existing one removed, extended or shrunk

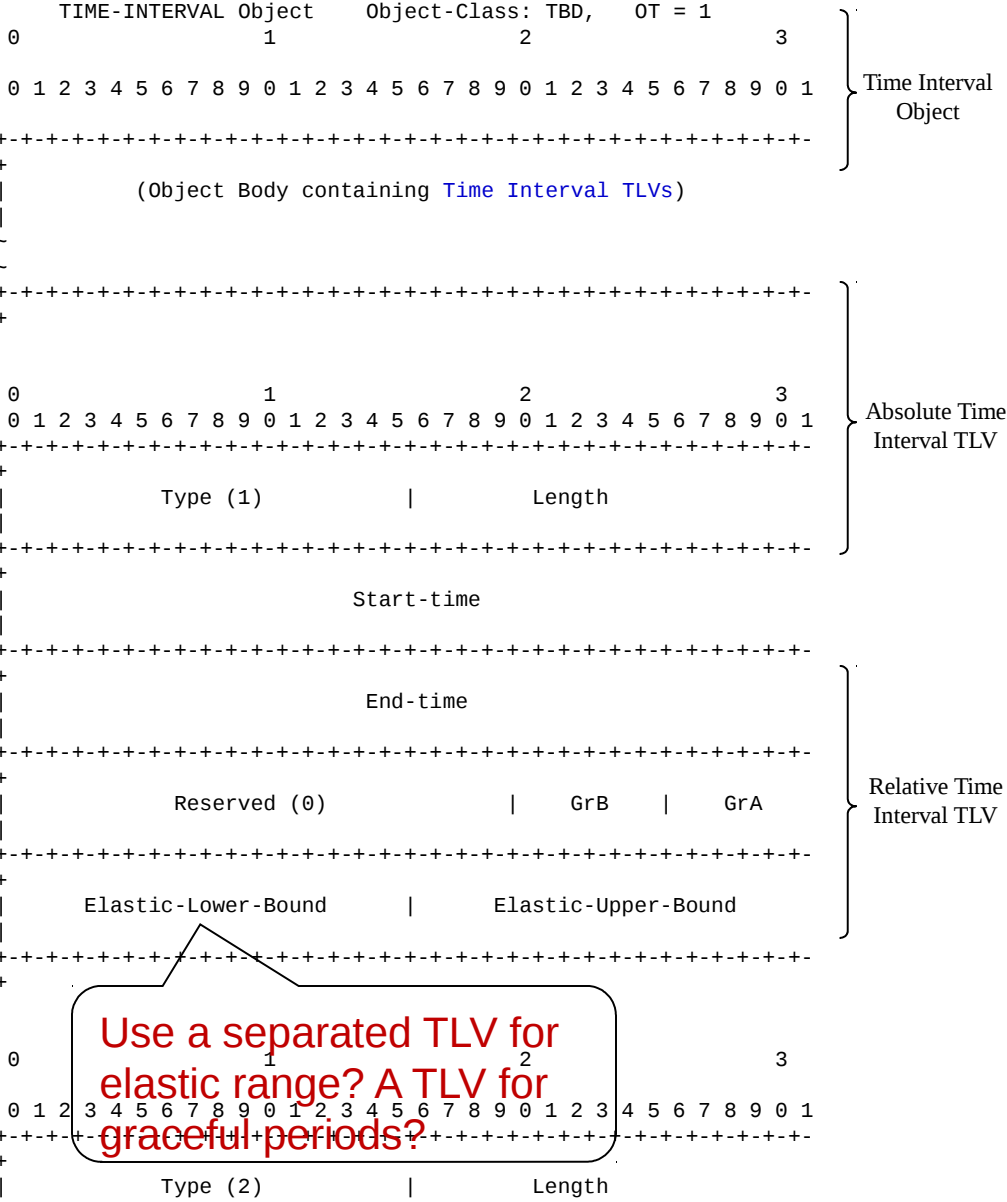
Graceful Periods: one (GrB) before and one (GrA) after a time interval

- LSP with “[T_a, T_b] with graceful periods GrB and GrA”
- LSP set up to carry traffic from T_a-GrB to T_b+GrA

Downgraded service (lower priority or best effort) in graceful periods?



Time Interval Object



Start-time: The time LSP starts to carry traffic.

End-time: The time LSP ends carrying traffic.
(Times must be synchronized among all nodes.)

Time Interval [Start-time, End-time]

GrB: Graceful period time length Before interval

GrA: Graceful period time length After interval

Elastic-Lower-Bound: Maximum amount of interval can shift to lower/left

Elastic-Upper-Bound: Maximum amount of interval can shift to upper/right

Start-time-length: Time length in seconds interval can shift to lower/left

End-time-length: Time length in seconds interval can shift to upper/right

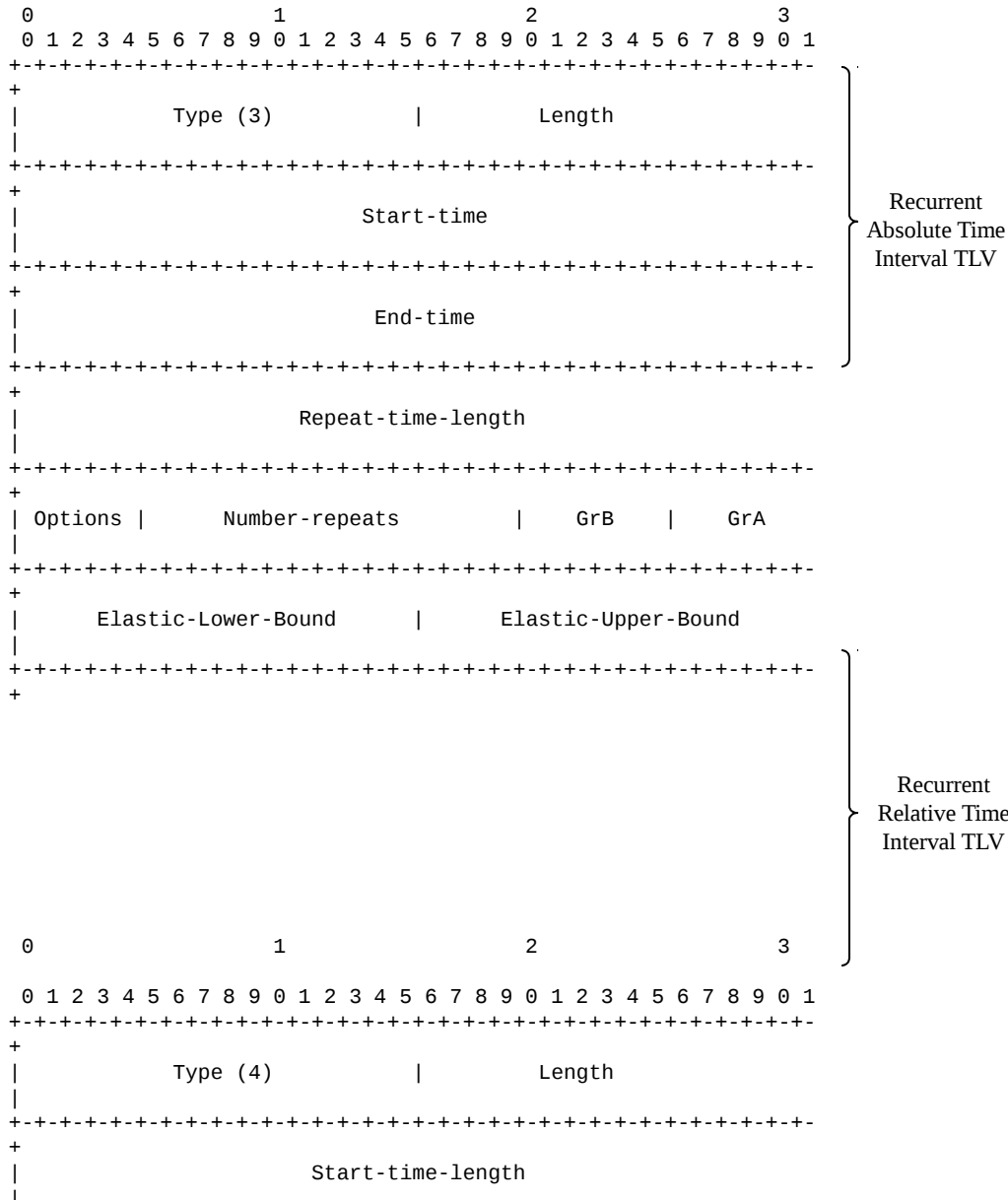
Time Interval
[CT + Start-time-length, CT + End-time-length]

CT means Current Time

Others are the same as above

Use a separated TLV for elastic range? A TLV for graceful periods?

Recurrent Time Interval TLVs



Start-time: The time LSP starts to carry traffic.

End-time: The time LSP ends carrying traffic.

(Times must be synchronized among all nodes.)

Time Interval [Start-time, End-time]

Repeat-time-length: Time length after which LSP starts to carry traffic again for (End-time - Start-time)

Options: Indicates a way to repeat

Number-repeats: # of repeats. In each of repeats, LSP carries traffic.

GrB: Graceful period time length Before interval

GrA: Graceful period time length After interval

Elastic-Lower-Bound: Maximum amount of time

Start-time-length: Time length in seconds from current to time LSP starts to carry traffic. Interval can shift to lower/left

Elastic-Upper-Bound: Maximum amount of time

End-time-length: Time length in seconds from current to time LSP ends carrying traffic. Interval can shift to upper/right

(Clocks/times on all the nodes can be different.)

Time Interval [CT + Start-time-length, CT + End-time-length]

CT means Current Time

Others are the same as above

Messages for Temporal LSP

LSP Creation Request (PCInitiate)

LSP Deletion Request (PCInitiate)

PCInitiate for LSP Creation includes objects:
SRP, LSP, ..., ERO and TIME-INTERVAL

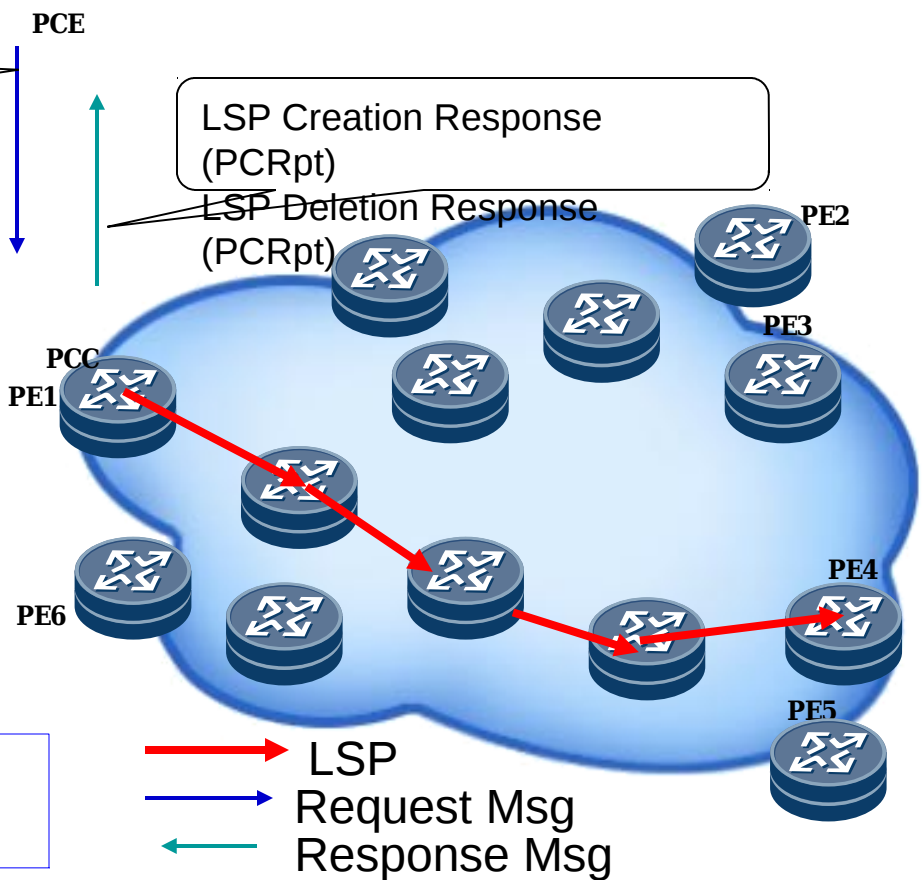
PCRpt for LSP Creation Response includes:
SRP, LSP, ERO and TIME-INTERVAL

PCInitiate for LSP Deletion includes objects:
SRP, LSP and TIME-INTERVAL

PCRpt for LSP Deletion Response includes:
SRP, LSP and TIME-INTERVAL

Should request and response message include time intervals?

TIME-INTERVAL is not used for signaling LSP.
TIME-INTERVAL may be used for informational purpose now, and may be used in future.



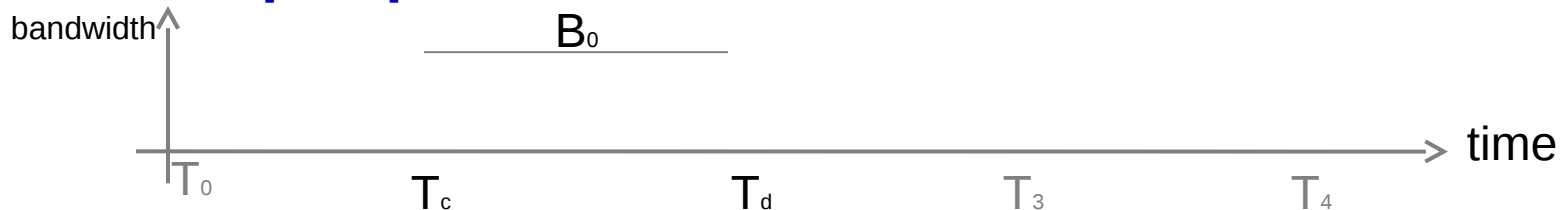
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<PCReq Message> ::= <Common Header> [<svec-list>] <request-list>
<request-list> ::= <request> [<request-list>]
<request> ::= <RP> <END-POINTS> [<OF>] [<LSPA>] [<BANDWIDTH>] ... [<TIME-INTERVAL>]

<PCReq Message> ::= <Common Header> <response-list>
<response-list> ::= <response> [<response-list>]
<response> ::= <RP> [<NO-PATH>] [<attribute-list>] [<path-list>]
<path-list> ::= <path> [<path-list>]
<path> ::= <ERO> <attribute-list> [<TIME-INTERVAL>]
    
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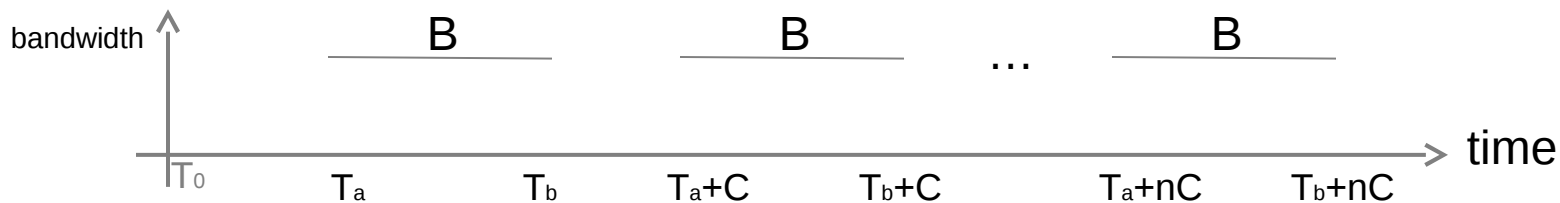
Creating/Deleting Temporal LSP

- LSP with $[T_c, T_d]$



- LSP with $[T_a, T_b]$ repeats n times with repeat cycle C

$[T_a, T_b], [T_a+C, T_b+C], [T_a+2C, T_b+2C], \dots, [T_a+nC, T_b+nC]$



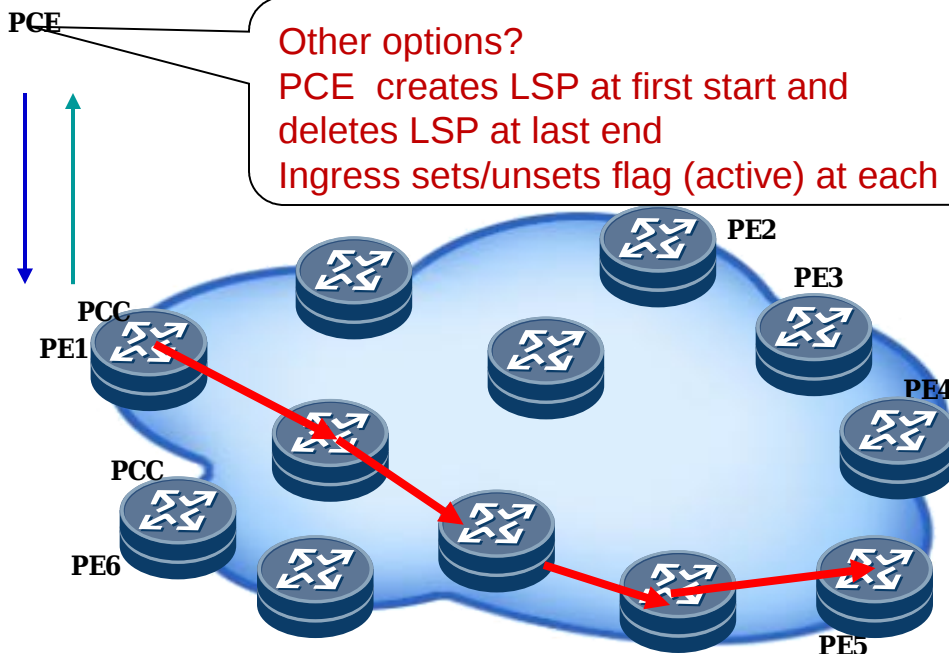
PCE:

- Gets path for LSP
- Creates LSP at start of each interval (e.g., $T_a, T_c, T_a+C, T_a+2C, \dots, T_a+nC$)
- Deletes LSP at end of each interval (e.g., $T_b, T_d, T_b+C, T_b+2C, \dots, T_b+nC$)

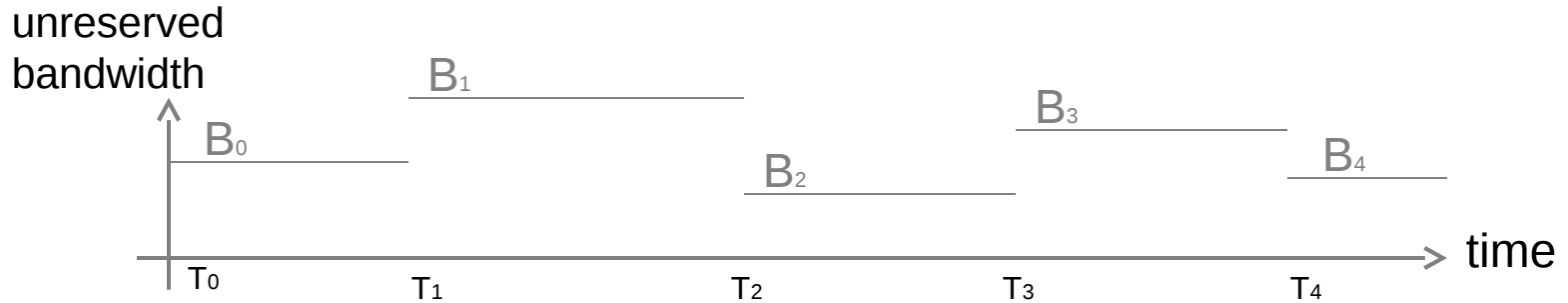
Other options?

PCE creates LSP at first start and deletes LSP at last end
 Ingress sets/unsets flag (active) at each start/end

- LSP
- Request Msg
- Response Msg



TEDB: Link Bandwidth Representation in Absolute Time

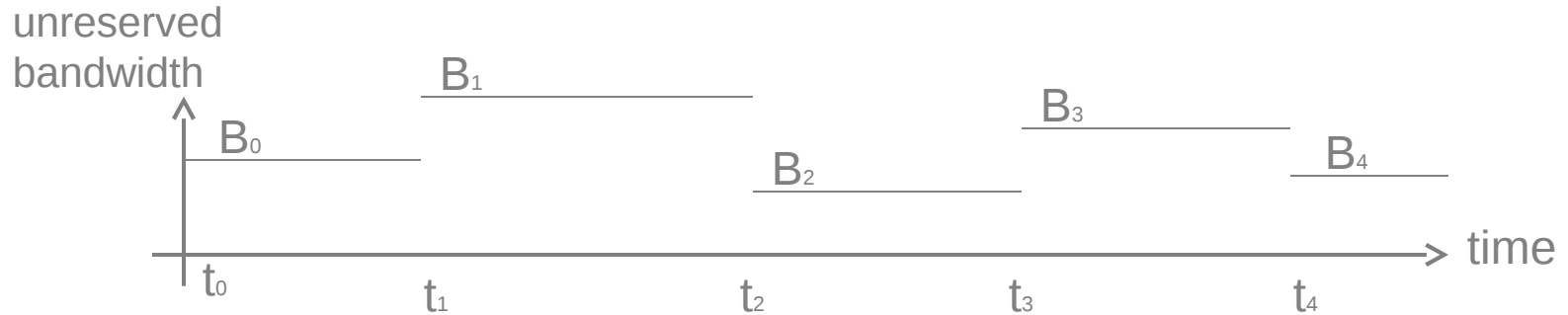


Absolute time representation of bandwidths for a link:

Requirement: The times/clocks on all the nodes in a network must be synchronized (the same).

- $[T_0, B_0]$, $[T_1, B_1]$, $[T_2, B_2]$, $[T_3, B_3]$, . . .
- If an LSP is completely deleted at time T and uses bandwidth B , then for every time interval (after T) during which bandwidth B is reserved for the LSP on a link, B is added to the link for that interval.
- If an LSP is to be set up at time T and uses bandwidth B , then for every time interval (after T) during which bandwidth B is reserved for the LSP on a link, B is subtracted from the link for that interval.

TEDB: Link Bandwidth Representation in Relative Time



Relative time representation of bandwidths for a link:

- $[P_0, B_0]$, $[P_1, B_1]$, $[P_2, B_2]$, $[P_3, B_3]$, . . . where $P_j = t_{j+1} - t_j$ and $j = 0, 1, 2, 3, \dots$
- A timer expires every time unit (e.g., every second), triggers $P_0 \rightarrow P_1$; when $P_0 = 0$, P_1 becomes P_0 , P_2 becomes P_1 , and so on
- If an LSP is completely deleted at time t and uses bandwidth B , then for every time interval (after t) during which bandwidth B is reserved for the LSP on a link, B is added to the link for that interval.
- If an LSP is to be set up at time t and uses bandwidth B , then for every time interval (after t) during which bandwidth B is reserved for the LSP on a link, B is subtracted from the link for that interval.

Advantages of this representation: The times on all the nodes can be different.

Next Step

- Welcome comments