

# Synchronization Planning and Deployment Considerations for the Converged Network



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# 1

## Layer 1 Synchronization

# Synchronization Management

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Synchronization Manager needs to ensure the resilient delivery of quality synchronization references to all the network elements

Highly Specialized knowledge base

Elements

- Stratum 1 Sources, GPS Receivers
- BITS/SSUs
- Network Elements (SEC/EEC)
- Physical Links



# Management Focus

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Configuration, Fault, Performance Management

Layer 1 Synchronization Distribution

- Redundant distribution to each node
- Maximum span between SSUs
- Loop avoidance

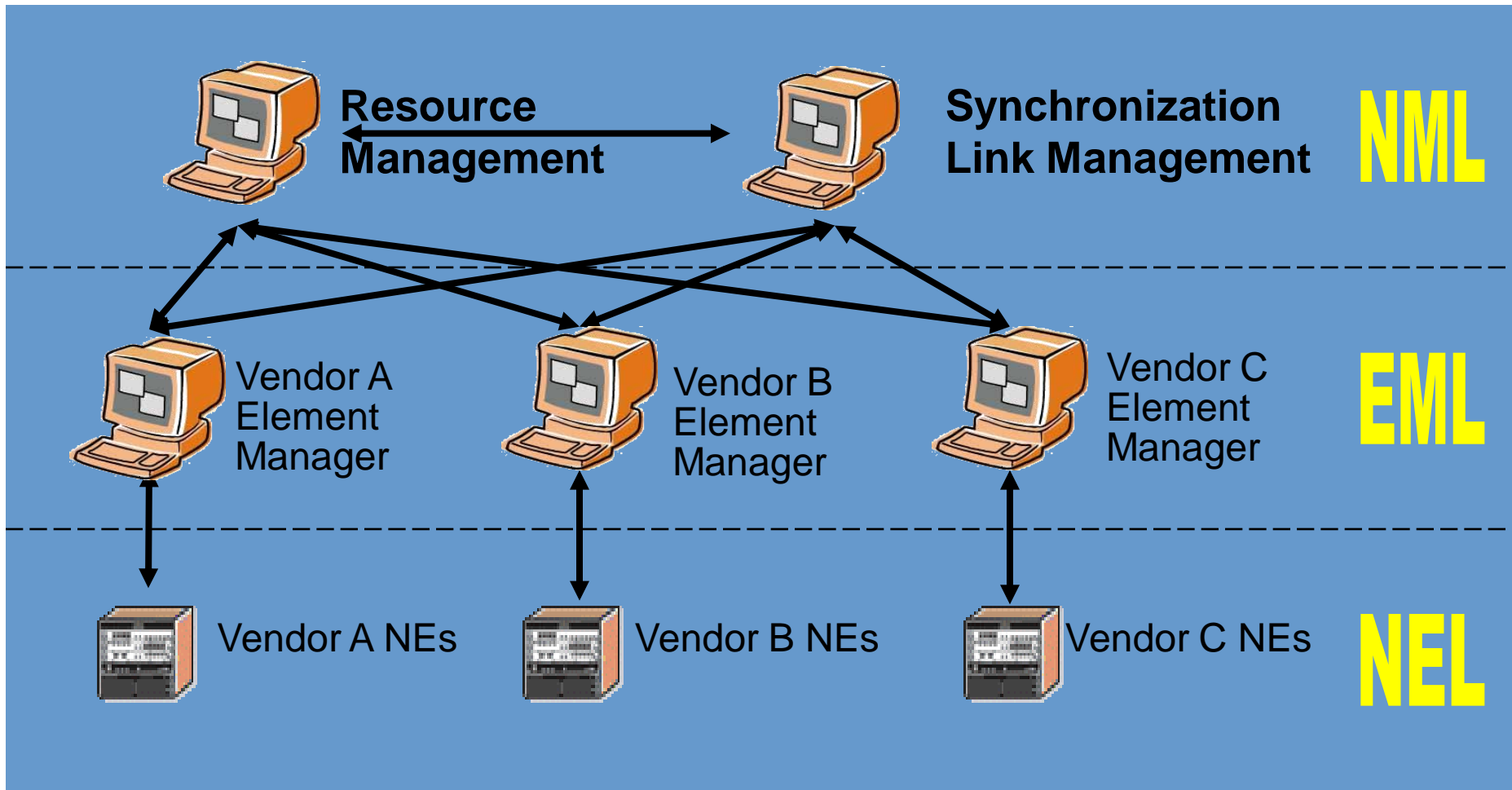
Plan vs Reality

- Monitoring of current distribution
- Analysis of failure/maintenance scenarios
- Re-architecting with the addition of network segments
- Correlation of distribution to performance

Efficient and timely analysis

- React quickly to problems
- Speed commissioning

# Synchronization Management Tools



# Topology Analysis

The image displays two panels from a network management application. The left panel, titled 'Root', shows a physical network topology with various nodes and connections. A context menu is open over a node, listing actions such as 'Configure', 'Partitioning', 'Upload & manage', 'Run datacheck', 'Show reports...', 'View commandlog...', and 'Display'. A tooltip also shows options like 'Synchronization tree...', 'Synchronization chain...', 'NE Quality changes...', and 'Physical Links...'. The right panel, titled 'Synchronization Tree [10:37:02]', shows a hierarchical tree structure starting from a root 'SSU' node, branching into administrative nodes (ADM) and radio nodes (96H50T\_RADIO).

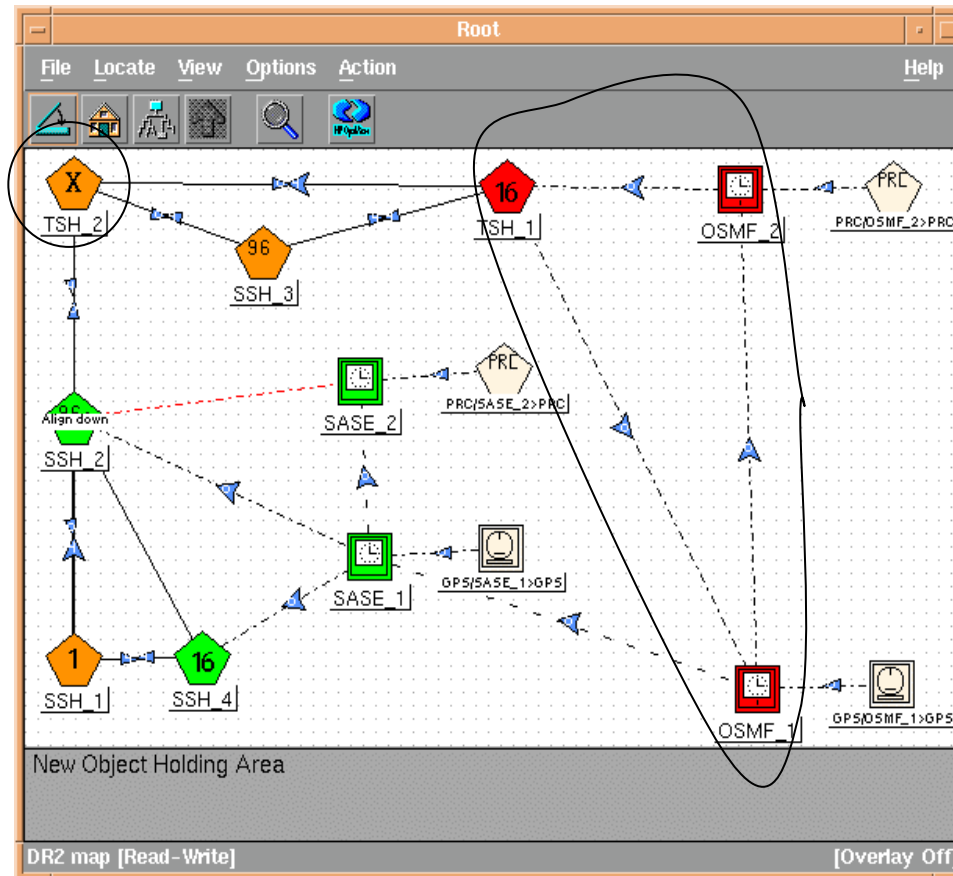
**Physical Topology (Left Panel):**

- Root: DXC16415X\_207
- Intermediate nodes: ADM16505MC\_205, ADM16505MC\_201, ADM16505MC\_202, ADM16505MC\_203, ADM16505MC\_204, ADM16505MC\_206, ADM16505MC\_299, ADM16505MC\_298, ADM16505MC\_297, ADM16505MC\_296, ADM16505MC\_295, ADM16505MC\_294, ADM16505MC\_293, ADM16505MC\_292, ADM16505MC\_291, ADM16505MC\_290, ADM16505MC\_289, ADM16505MC\_288, ADM16505MC\_287, ADM16505MC\_286, ADM16505MC\_285, ADM16505MC\_284, ADM16505MC\_283, ADM16505MC\_282, ADM16505MC\_281, ADM16505MC\_280, ADM16505MC\_279, ADM16505MC\_278, ADM16505MC\_277, ADM16505MC\_276, ADM16505MC\_275, ADM16505MC\_274, ADM16505MC\_273, ADM16505MC\_272, ADM16505MC\_271, ADM16505MC\_270, ADM16505MC\_269, ADM16505MC\_268, ADM16505MC\_267, ADM16505MC\_266, ADM16505MC\_265, ADM16505MC\_264, ADM16505MC\_263, ADM16505MC\_262, ADM16505MC\_261, ADM16505MC\_260, ADM16505MC\_259, ADM16505MC\_258, ADM16505MC\_257, ADM16505MC\_256, ADM16505MC\_255, ADM16505MC\_254, ADM16505MC\_253, ADM16505MC\_252, ADM16505MC\_251, ADM16505MC\_250, ADM16505MC\_249, 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**Synchronization Tree (Right Panel):**

- Root: SSU
- Level 1: ADM16415M\_23\_1 (T0), ADM16505MC\_201 (T0), DXC16415X\_208 (T0)
- Level 2: ADM16415M\_23\_302 (T0), ADM16505MC\_202 (T0), ADM16505MC\_205 (T0)
- Level 3: ADM16615MC\_401 (T0), ADM16415M\_23\_303 (T0), ADM16505MC\_203 (T0)
- Level 4: ADM16615MC\_402 (T0), ADM16415M\_23\_399 (T0), ADM16505MC\_204 (T0)
- Level 5: ADM16615MC\_499 (T0), DXC16415X\_207 (T0), ADM\_RAD\_501 (T0), 96H50T\_RADIO\_6 (T0), 96H50T\_RADIO\_1 (T0), ADM16505MC\_299 (T0)
- Level 6: 96H50T\_RADIO\_7 (T4), 96H50T\_RADIO\_2 (T4), 96H50T\_RADIO\_2 (T0), ADM\_RAD\_502 (T0), ADM16505MC\_206 (T0)
- Level 7: 96H50T\_RADIO\_3 (T0), 96H50T\_RADIO\_3 (T0), 96H50T\_RADIO\_4 (T0), ADM\_RAD\_503 (T0)
- Level 8: 96H50T\_RADIO\_4 (T4), 96H50T\_RADIO\_4 (T0), 96H50T\_RADIO\_5 (T0), 96H50T\_RADIO\_3 (T4), ADM\_RAD\_504 (T0)
- Level 9: 96H50T\_RADIO\_5 (T0), 96H50T\_RADIO\_6 (T4), 96H50T\_RADIO\_6 (T0)
- Level 10: 96H50T\_RADIO\_7 (T0), 96H50T\_RADIO\_5 (T4), ADM\_RAD\_503 (T0)

# Distribution Maintenance

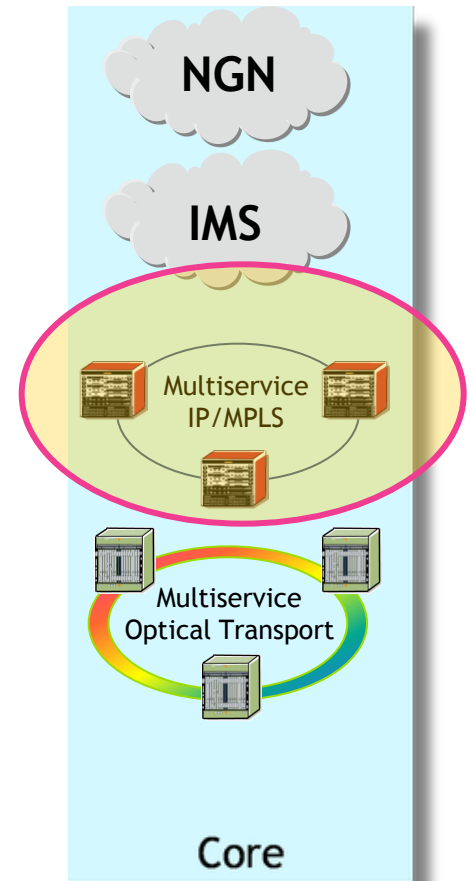
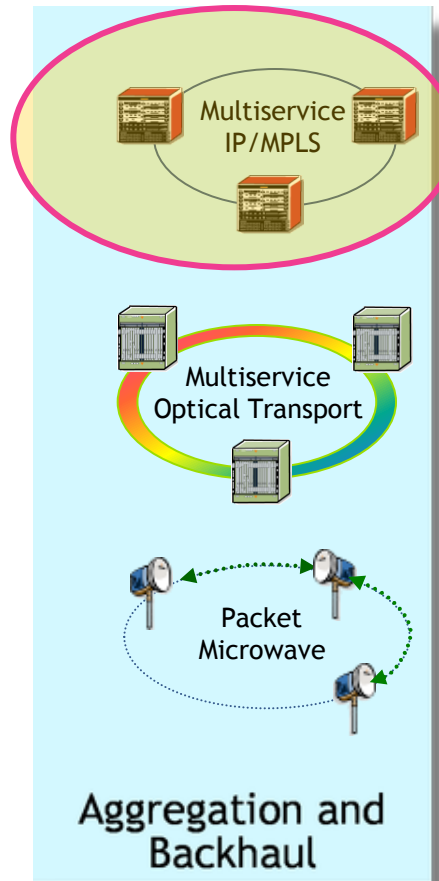
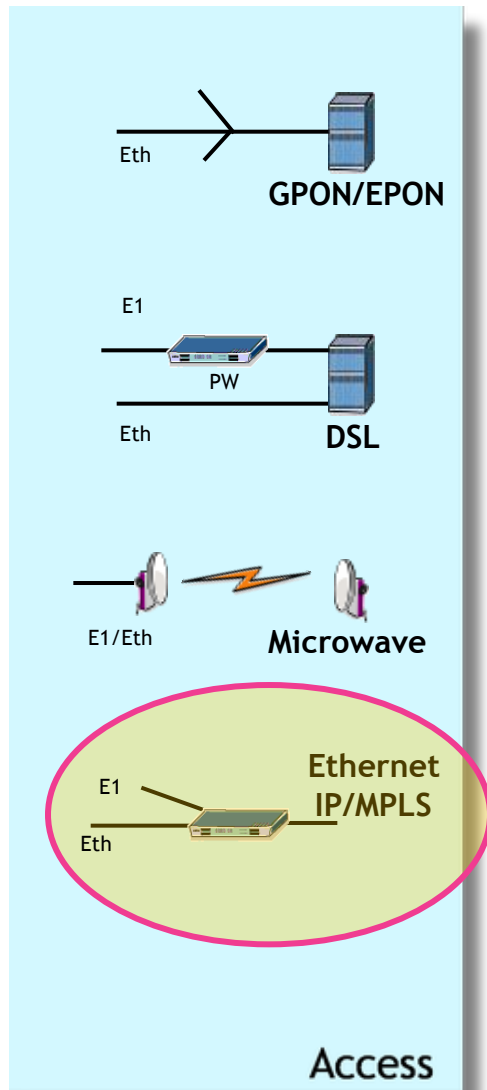
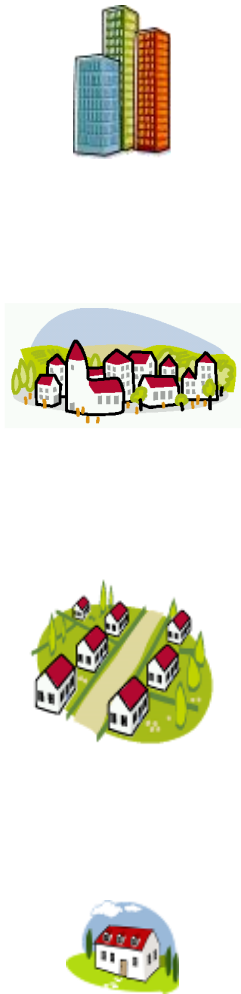




# 2

## Convergence and Timing over Packet

# Converged Network



# Timing over Packet

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## Packet based techniques

- ACR for Circuit Emulation
- Carrier class NTP
- IEEE 1588-2008

## Dynamic Paths

- Uses physical links but not fixed
- Routing protocols select paths
- L2/L3 flows need to be modeled

# Timing over Packet Delivery

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## In band interactions

- Physical link characteristics (GE vs xDSL vs  $\mu$ Wave)
- Switch/Router forwarding characteristics
- Packet prioritization
- User traffic dynamics

## More variability in synchronization signal quality

- Increased monitoring
- Packet and frequency domain

# Distribution Planning & Maintenance

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## PDV

- Needs characterization
- Rerouting control

## Interworking Sites

- Layer 1 to Timing over Packet interchange
  - Traceability (SSM)
  - Signal Quality
- Migration from SDH to IP/MPLS may change these sites

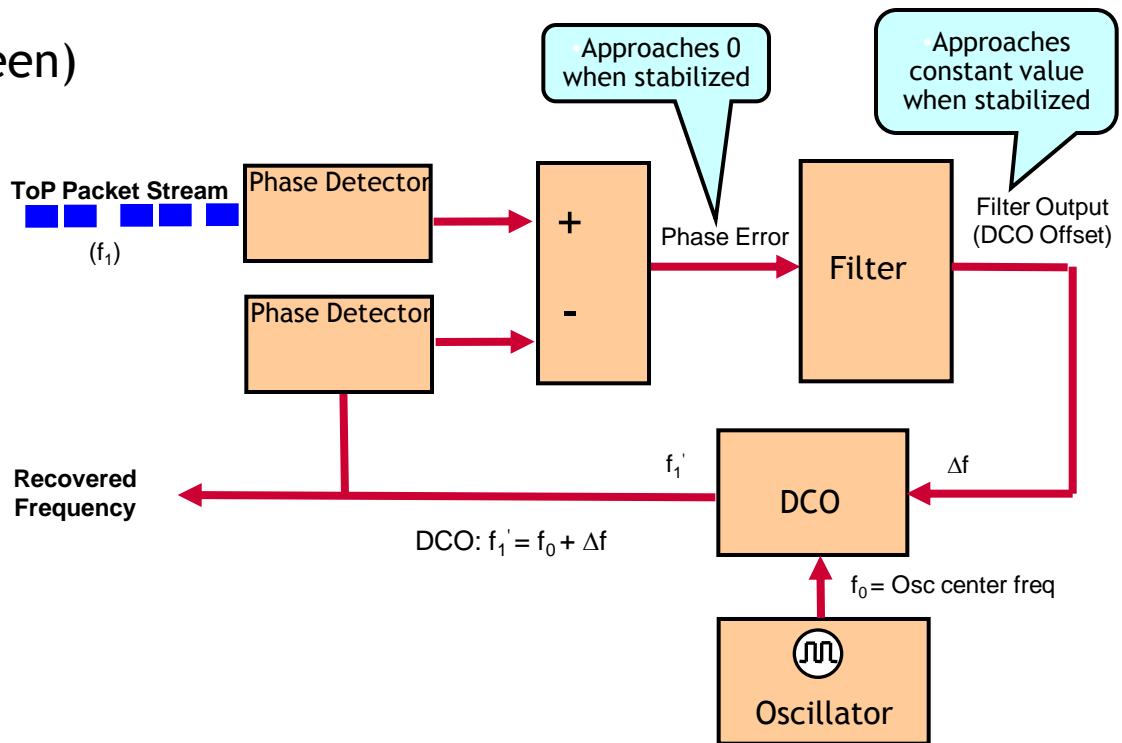
## Additions of On Path Support nodes

- NTP servers
- Boundary clocks
- Transparent clocks

# In service Monitoring

## Performance monitoring

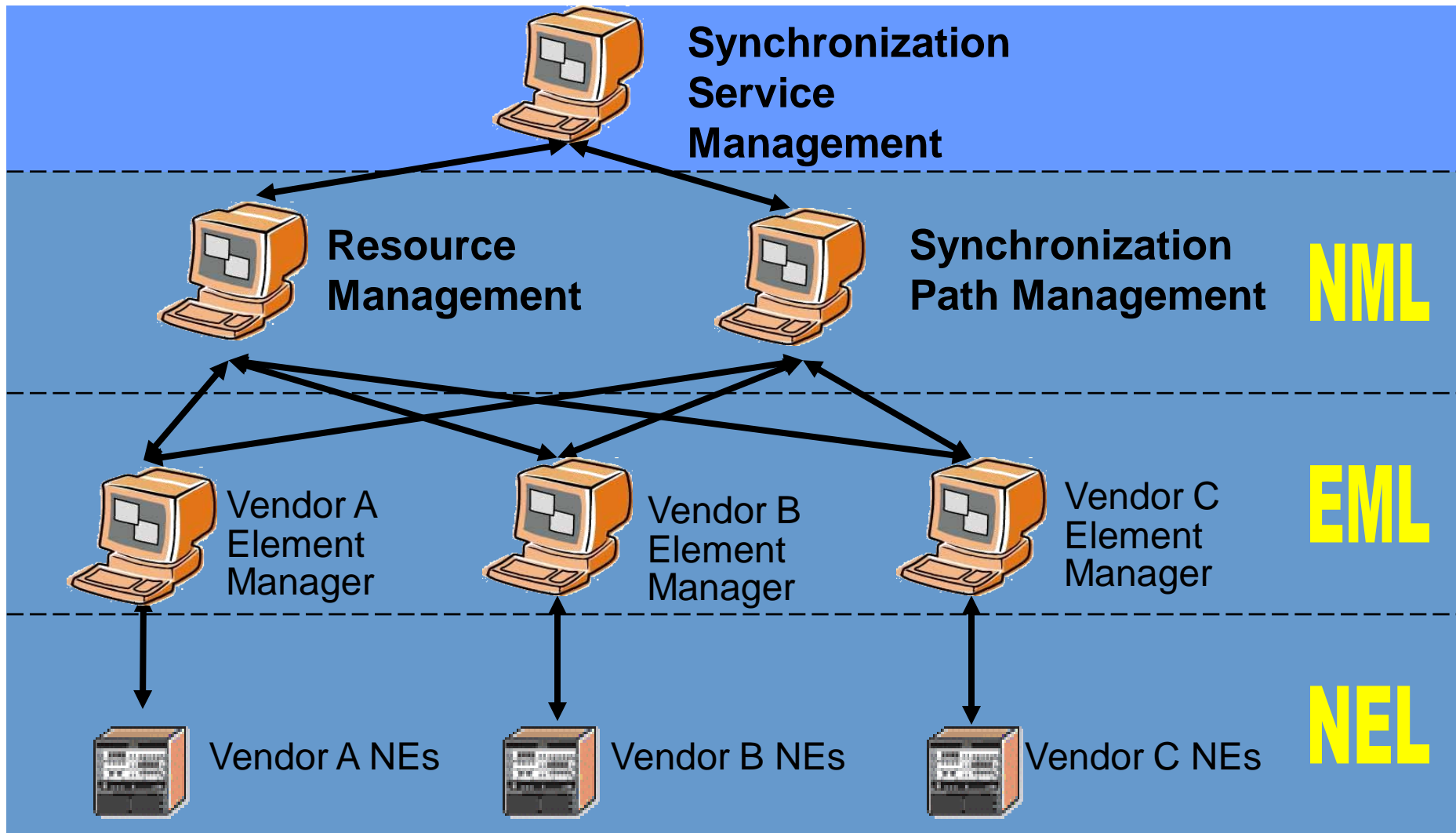
- ToP status (red/yellow/green)
- Stability metrics
- Event collection



## Performance correlation

- Timing events vs network events
- Path load monitoring

# Synchronization Management Tools



# Conclusions

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Synchronization Service planning and monitoring are essential

Addition of Timing over Packet synchronization delivery techniques increases the challenges

Automated tools for planning, characterizing, and monitoring the synchronization paths can provide significant assistance

Efficient correlation between path routing, traffic loading, and ToP performance



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