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Expansion of Bandwidth-on-Demand Capabilities in Japanese Academic Backbone Network

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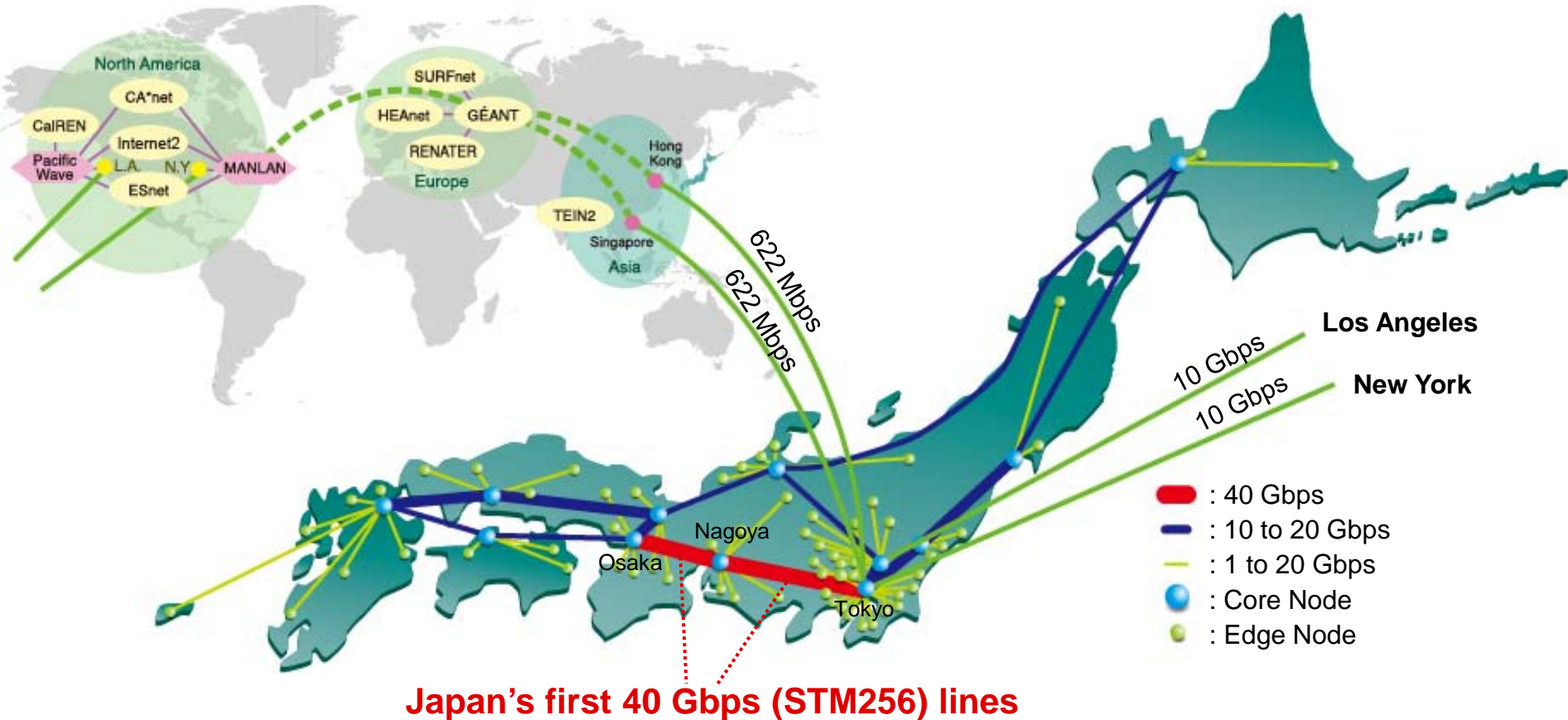
National Institute of Informatics (NII)

- 1. Layer-1 bandwidth-on-demand (BoD) service in SINET3**
- 2. Resource managements for Layer-1 BoD services**
- 3. Demand for BoD services**
- 4. Service parameters of Layer-2 BoD services**
- 5. Initial implementation image of Layer-2 BoD services**
- 6. Conclusion**

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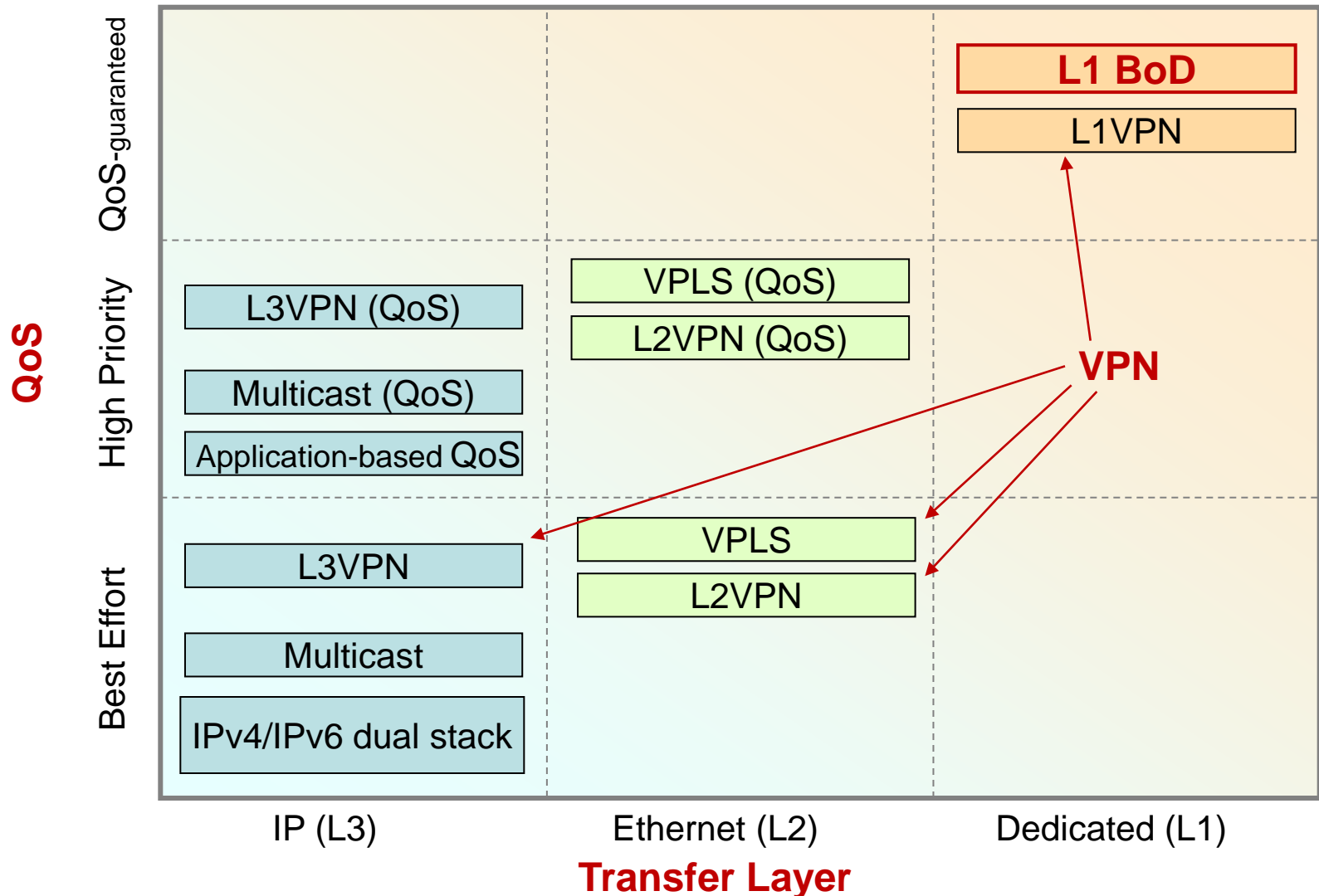
SINET3: Science Information Network 3

- ◆ SINET3 is the Japanese academic backbone network launched in April 2007 for more than 700 universities and research institutions.
- ◆ It has 63 edge and 12 core nodes and deploys Japan's first 40 Gbps lines between Tokyo, Nagoya, and Osaka.
- ◆ It has two 10 Gbps international lines to the U.S.A. and two other lines to Asia.



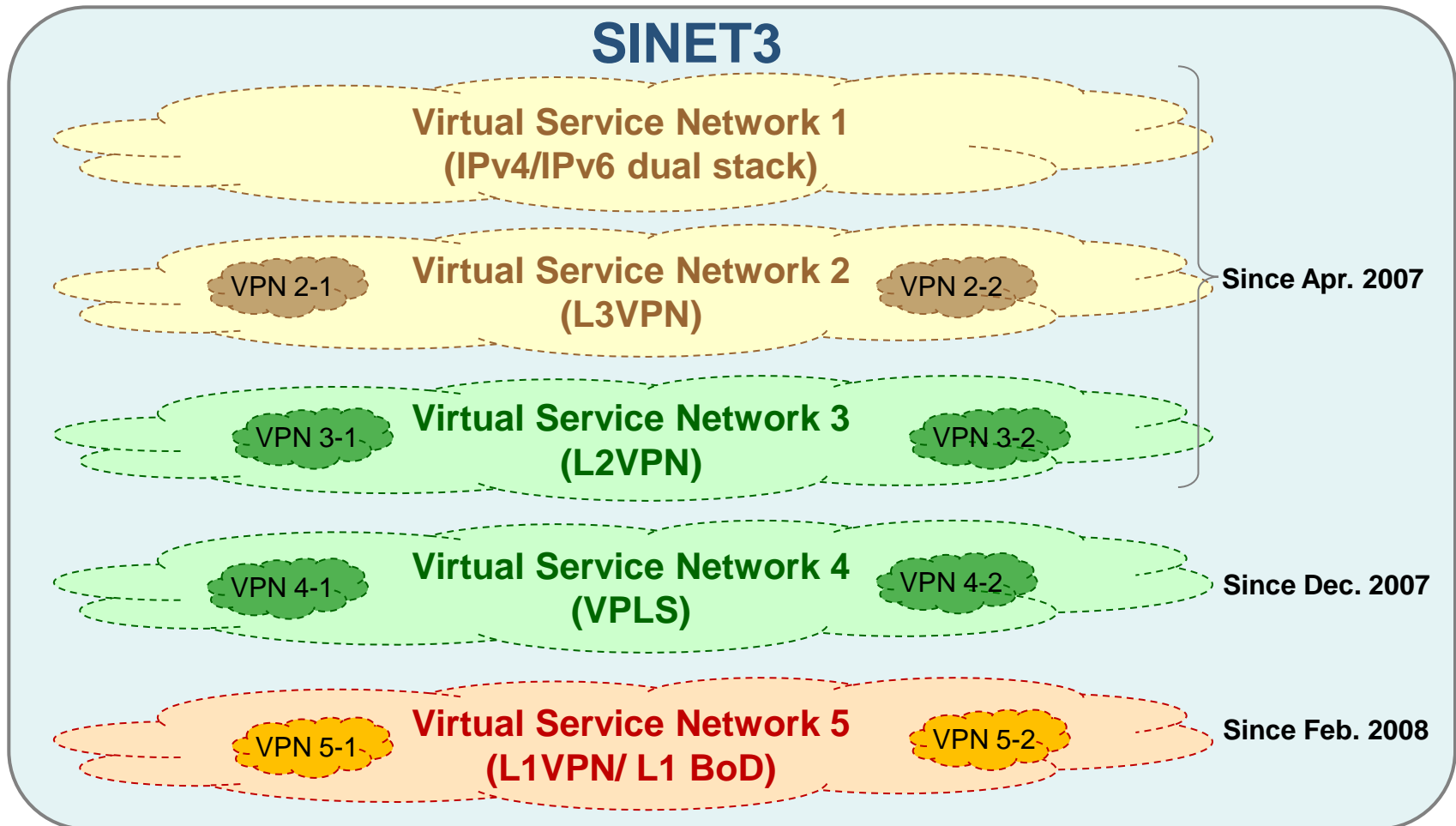
Service Features in SINET3

- ◆ SINET3 emphasizes four service aspects: transfer layer, virtual private network (VPN), quality-of-service (QoS), and bandwidth on demand (BoD).

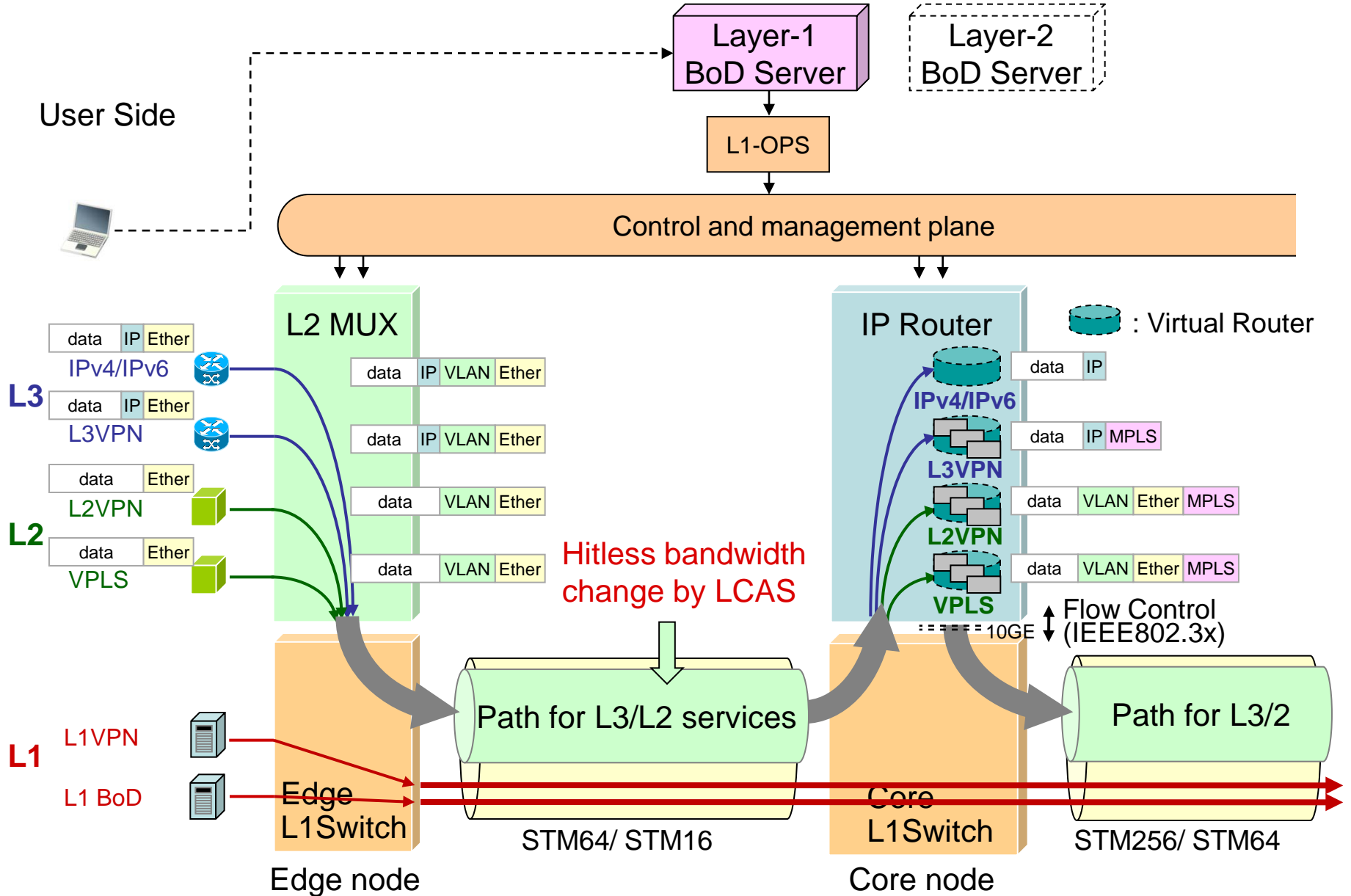


Virtual Service Networks in SINET3

- ◆ Each service is provided on the corresponding virtual service network on a single network platform.
- ◆ Each virtual service network uses its own routing and signaling protocols and has its own high-availability functions.

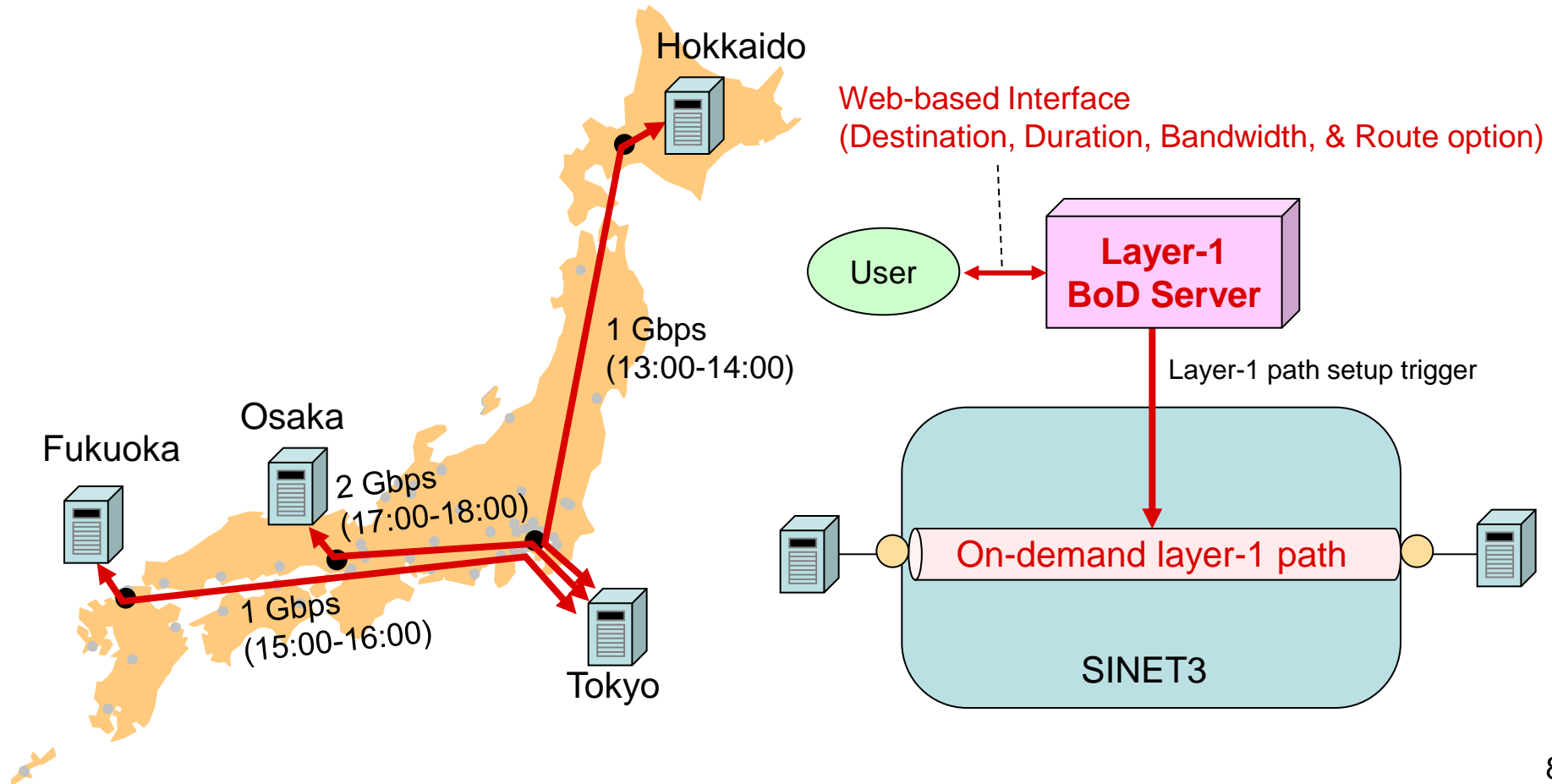


Network Structure of SINET3



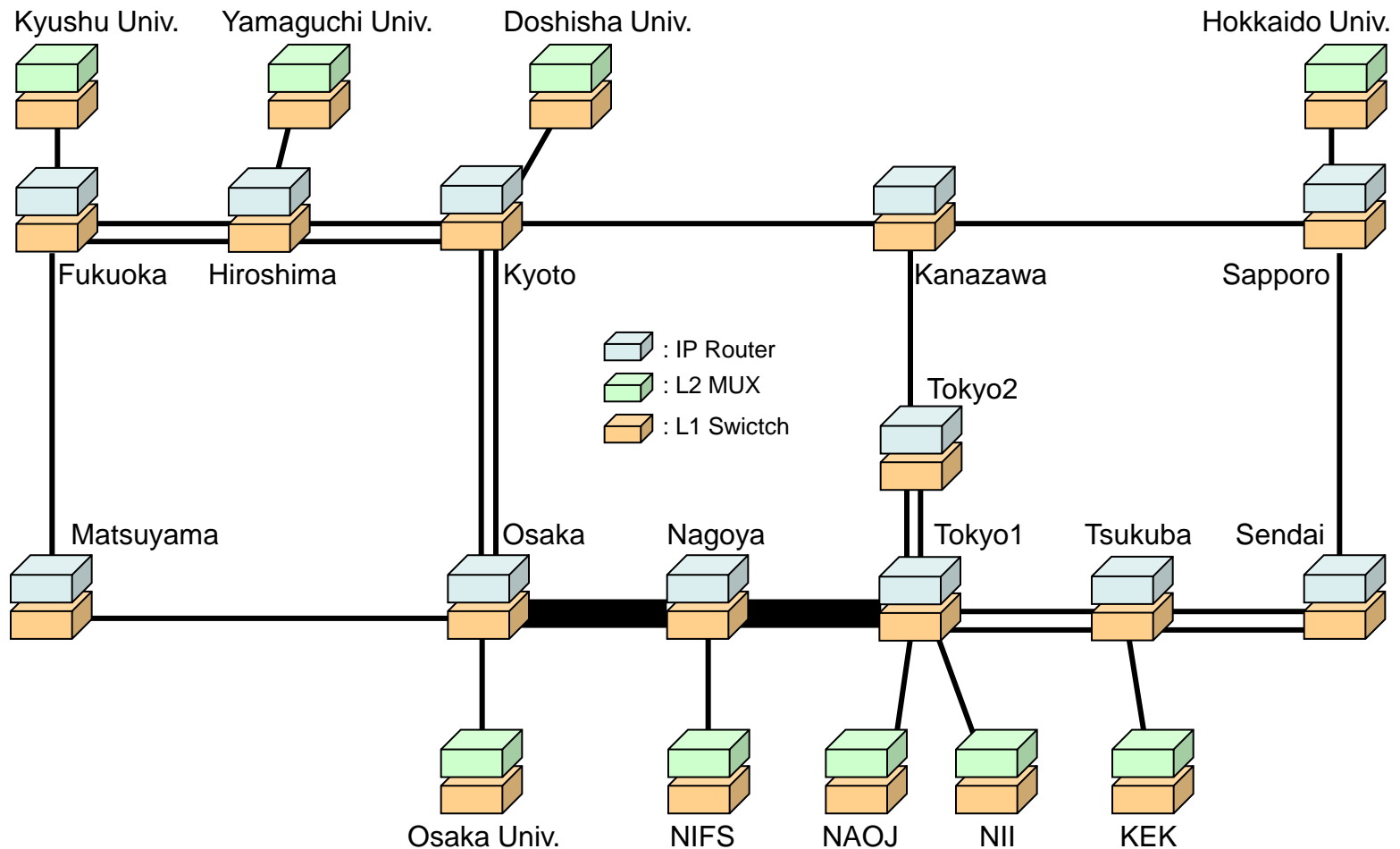
Bandwidth on Demand (BoD) Service

- ◆ SINET3 provides bandwidth-on-demand (BoD) service as part of layer-1 services.
- ◆ Users can specify the destinations, duration, bandwidth with granularity of 150Mbps (VC-4), and route option, via simple Web pages.
- ◆ BoD server receives path setup requests from users and triggers layer-1 path setup.



Core network topology and initial BoD users

- ◆ The BoD server finds an appropriate route from among several candidate routes.
- ◆ The BoD server usually gets the end-to-end path bandwidth from parallel and multiple routes for effective resource utilization by using virtual concatenation (VCAT) functions.

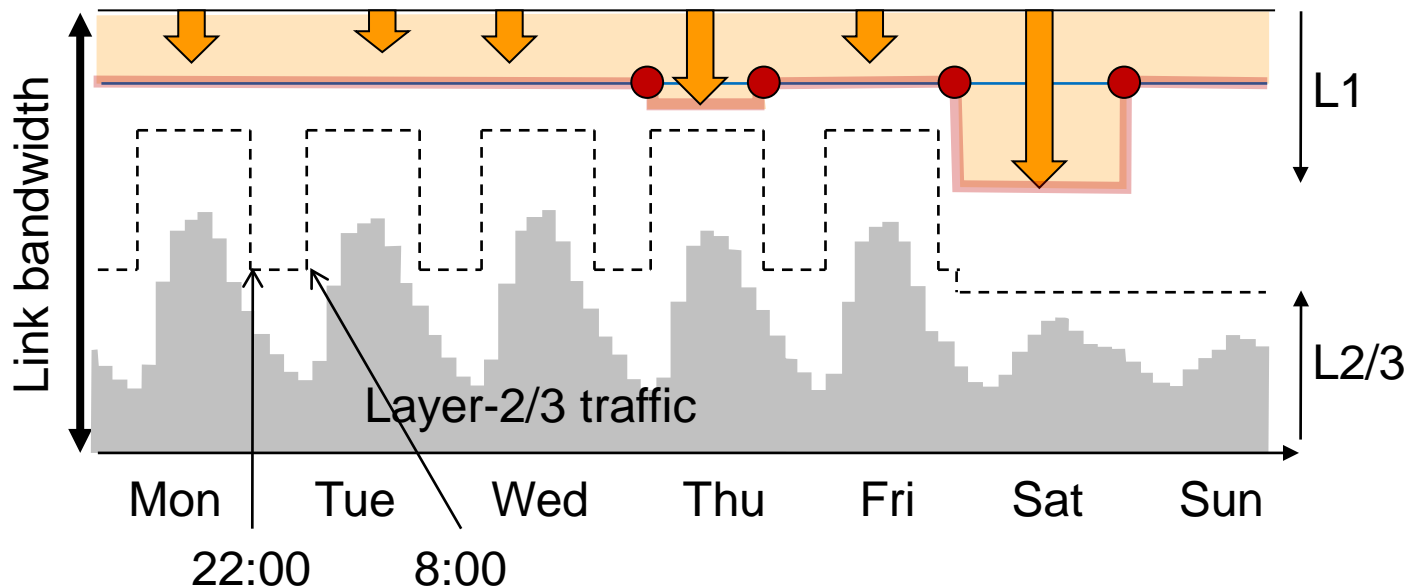


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Resource managements for Layer-1 BoD services

- ◆ The layer-2/3 traffic on each link has a very analogous daily pattern.
- ◆ The available bandwidth is set at a larger value at night and weekends.
- ◆ The default and assigned bandwidths are preset at the requisite min bandwidth.
- ◆ Exceeds its default value: the BoD server sets the assigned bandwidth to the max requested bandwidth.
- ◆ The LCAS functions are activated at the start and finishing times.

— : Default bandwidth for L1 ↓ : Requested bandwidth for L1
- - - : Available bandwidth for L1
— : Assigned bandwidth for L1 ● : LCAS activation



- ◆ Set the default and available values on a simple Web screen:
taking into account the traffic volume trend of the layer-2/3 services
- ◆ Set the default/available value for layer-2/3 services:
[the link bandwidth] – [the default/available value for layer-1 services]

(Link bandwidth - Default bandwidth)

(Link bandwidth - Available bandwidth)

選択	区間	デフォルト 帯域	受付可能帯域				イベント 0:00~24:00 日付設定
			平日		土曜・日曜 0:00~24:00	祝日 0:00~24:00 日付設定	
			8:00~22:00	0:00~8:00 22:00~24:00			
<input checked="" type="radio"/>	札幌DC-仙台DC	50v	50v	50v	50v	50v	50v
<input type="radio"/>	東京DC-名古屋DC (1本目)	47v	47v	13v	13v	13v	13v
<input type="radio"/>	東京DC-名古屋DC (2本目)	64v	64v	13v	13v	13v	13v

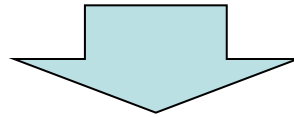
リセット 設定

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Demand for BoD services

◆ The layer-1 BoD services:

- The layer-1 resource assignment is a nice approach for accommodating data-intensive applications
- a little over-engineered for another users
- wait for the path establishment for an order of minutes
- Prepare physically separate ports for the services



◆ Layer-2 BoD services:

- a fine bandwidth granularity
- set up a high-quality path in less time
- use the services over the in-use ports as well as unused ports
- in-use ports by using tagged VLAN and QoS control capabilities

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Service parameters of Layer-2 BoD services

- ◆ Simple Web screens for the reservations similar to those of the L1 BoD services.
- ◆ Input the connection style, the source and destination nodes, and the duration
- ◆ Push the “next” key.

Web Screen Image (1)

Connection style VPN Extranet

SRC/DST Node SRC Node ▼ DST Node ▼

Start time ---Y ---M ---D ---H ---M ▼

Finish time ---Y ---M ---D ---H ---M ▼

Next

Service parameters of Layer-2 BoD services

- ◆ Indicate the available bandwidth and the rough delay between the specified nodes.
- ◆ Select the source/destination ports, the VLAN type from “port” and “tagged” along with a user VLAN ID
- ◆ Input the required bandwidth.
up to 150 Mbps (tentative value)
with a granularity of 1 Mbps.

Web Screen Image (2)

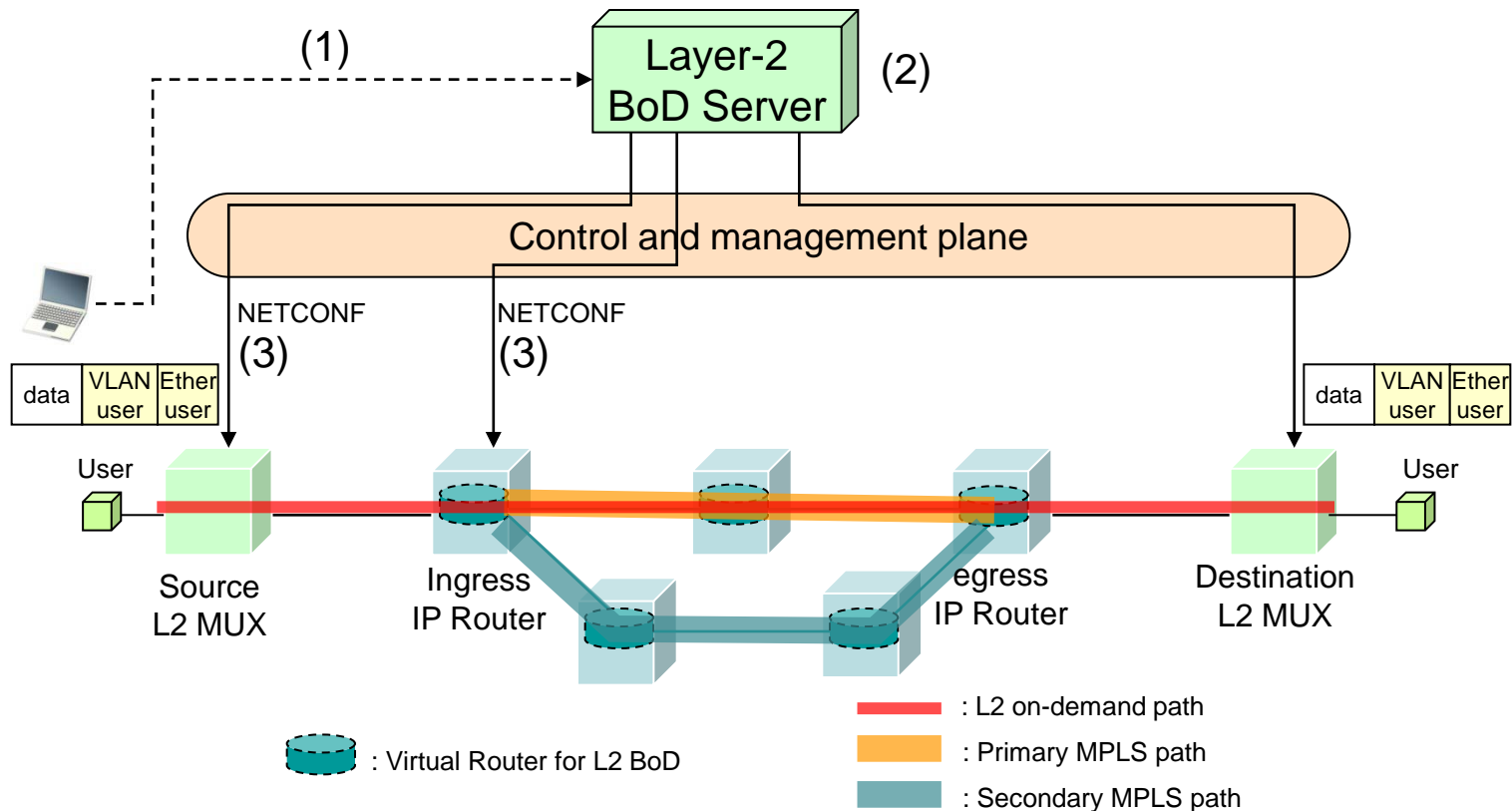
Available bandwidth and rough delay between specified nodes during duration are as follows.

Available bandwidth: -- Gbps delay: -- msec

<i>SRC/DST Port1</i>	SRC Port <input type="button" value="▼"/>	DST Port <input type="button" value="▼"/>	
<i>VLAN1</i>	<input type="radio"/> Port	<input checked="" type="radio"/> Tagged	VLAN ID <input type="button" value="▼"/>
<i>Bandwidth</i>	<input type="text"/>	Mbps	
<i>Route</i>	Minimum delay (default)		
<i>Additional Port</i>	Yes/No <input type="button" value="▼"/>		
<i>SRC/DST Port2</i>	SRC Port <input type="button" value="▼"/>	DST Port <input type="button" value="▼"/>	
<i>VLAN2</i>	<input type="radio"/> Port	<input checked="" type="radio"/> Tagged	VLAN ID <input type="button" value="▼"/>
<i>Bandwidth</i>	<input type="text"/>	Mbps	
<i>Route</i>	Minimum delay (default)		
<input type="button" value="Reserve Request"/>			

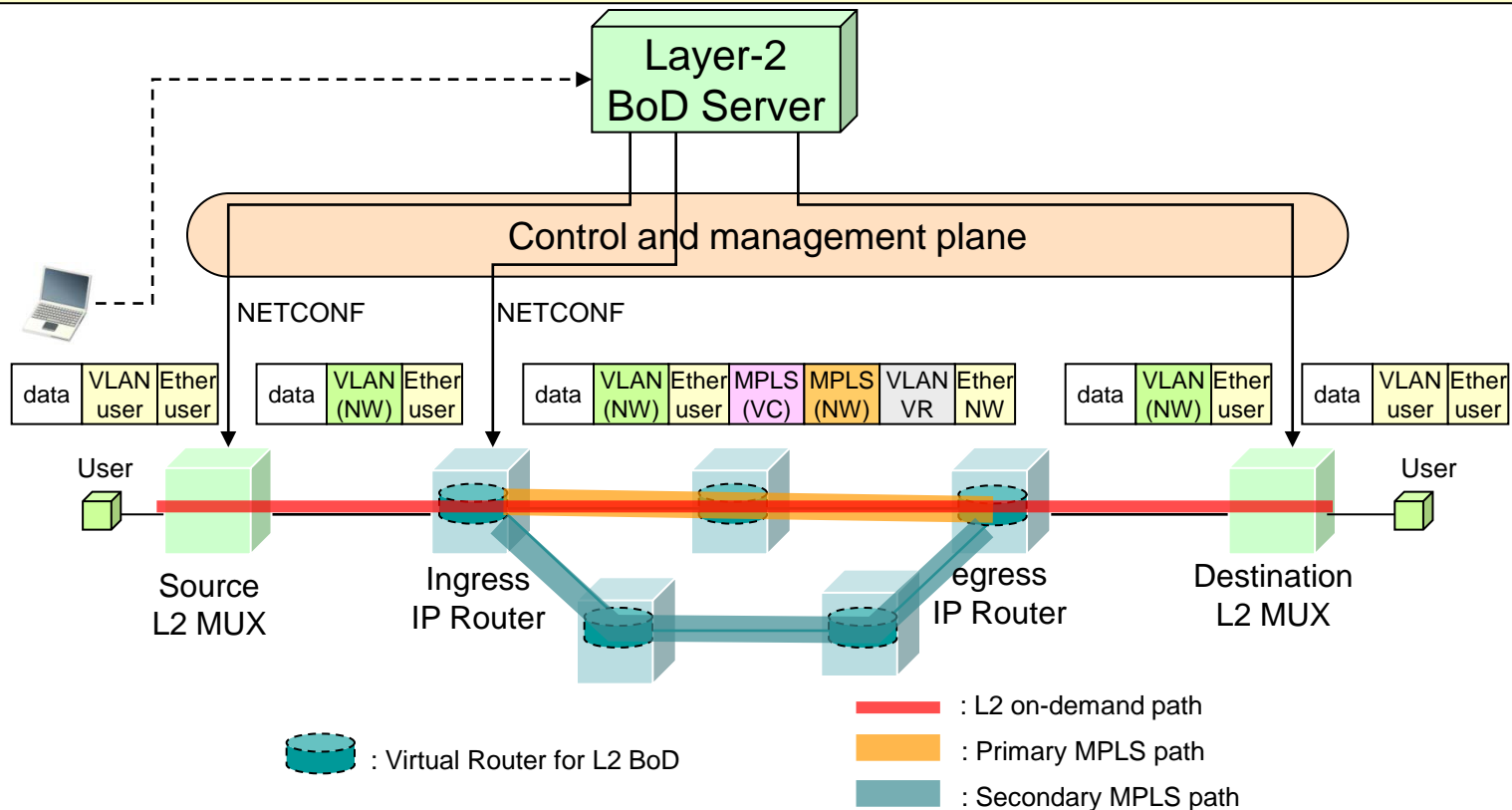
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- ◆ Layer-2 BoD services rely on a layer-2 BoD server: (1)receives the user requests, (2)manages the network resources, (3)orders layer-2 multiplexers and IP routers to setup/release end-to-end layer-2 paths
- ◆ Add one more virtual router in each IP router in order to avoid any influence being put on the existing services.



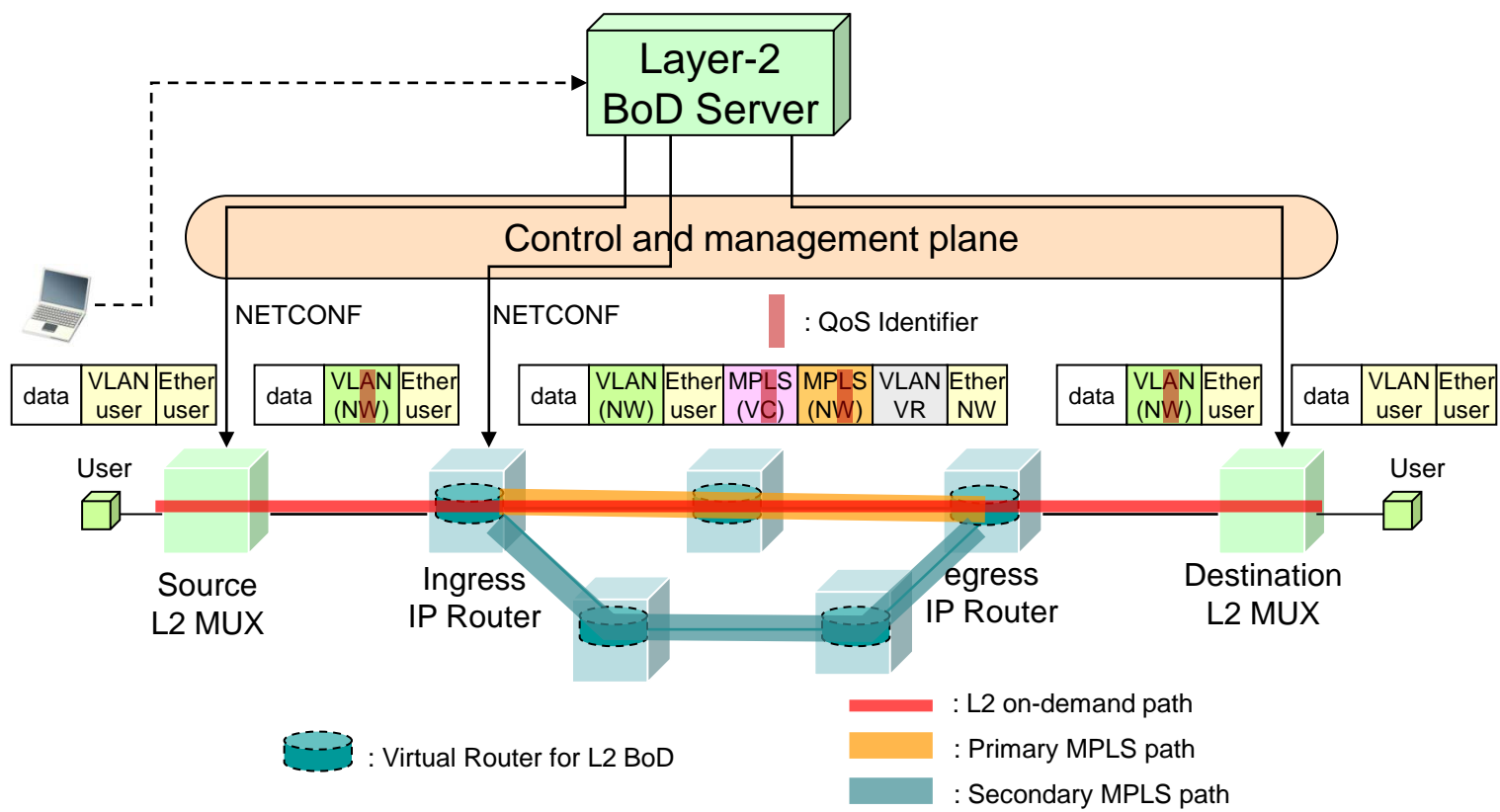
Initial implementation image of Layer-2 BoD services

- ◆ Simply sets up a VLAN circuit:
 - an internal VLAN tag between a layer-2 multiplexer and the virtual router
 - the VLAN circuit over a MPLS path between the virtual routers
- ◆ Primary MPLS paths: on the minimum delay routes between all of the virtual routers for quality reasons.
- ◆ Secondary MPLS paths: on the disjoint routes for reliability reasons.



Initial implementation image of Layer-2 BoD services

- ◆ Mark the user priority bits of the internal VLAN tag with an EF class (or AF class) value at the source layer-2 multiplexer
- ◆ Copy to the EXP bits of the MPLS labels in the ingress IP router
- ◆ Copy to the user priority bits of the internal VLAN tag in the egress IP router
- ◆ QoS control is performed at each device by using the user priority bits of the internal VLAN tag and the EXP bits of the MPLS labels.



- ◆ The network configuration protocol :
NETCONF: candidate control protocol (L2 BoD server ,layer-2 multiplexers and IP routers to set up/release VLAN circuits)
- ◆ The network resource management for L2 BoD services:
similar to that of L1 BoD services.
- ◆ Database of the L2 BoD server:
 - the available bandwidths for L2 BoD services
 - the delay values on a link-by-link basis
- ◆ Calculate the end-to-end available bandwidth along with the total delay between the specified sites in response to a user request
- ◆ Reflect the resource reservation results and performs admission control for user requests.

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Conclusion

- ◆ The current status for the BoD capabilities in SINET3.
 - The layer-1 BoD services have been used as full-scale services.
 - The network resources have been flexibly assigned depending on the user requests and traffic volume of the layer-2/3 services.

- ◆ The near-future plan for the BoD capabilities.
 - Approaching layer-2 BoD services for small amounts of bandwidth.
 - Presented the initial implementation image.
 - After confirming the stability of the control protocols, we will launch a trial service in our network.

Thank you for your attentions !