IETF 94 - NMRG 38 meeting
Intent Based Network Modeling (IBNEMO)

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Gap between APP and Network

- **APP wants**
  - **A connection between two sites**
  - **A service flow with SLA**
  - **A customer network service chain**

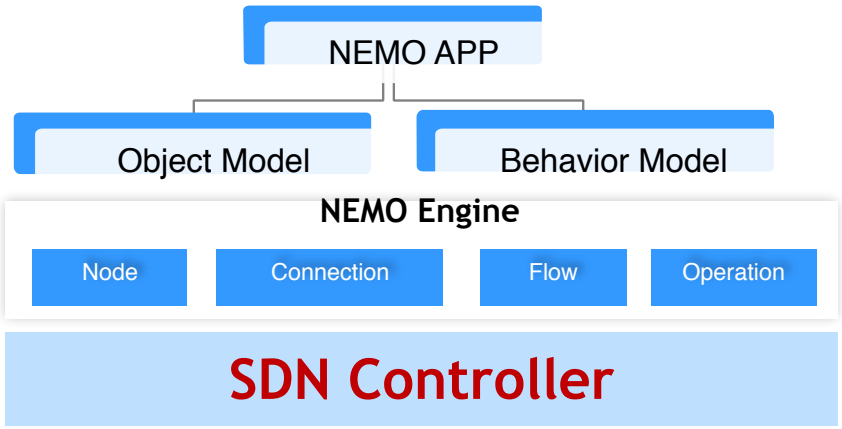
APP doesn't want

Configurations of each device between two sites

Flow entries in each device

Tunnel, ACL, PBR configurations of different devices

NEMO language for intent based network modeling



15 simple statement for hundreds of complex APIs

Resource Access		
Entity Model	node	Node/UnNode entity_id Type (FN|PN|LN) Properties key1,value1
	link	Link/UnLink entity_id Endnodes (node1_id,node2_id) Properties key1,value1 ....
	flow	Flow/UnFlow entity_id Match/UnMatch key1, value1|Range(value, value)
Policy and Event Handling		
Capability Model	Query	Query key Value {value} From entity_id
	Policy	Policy/UnPolicy policy_id Appliesto entity_id Condition {expression} Action { "forwardto" | "drop" | "gothrough" | "bypass" | "guaranteeSLA" | "Set" | "Packetout "|Node|UnNode|Link|Unlink}
	Notifica-tion	Notification entity_id On key Every period RegisterListener callbackfunc
Model Definition		
Node definition		NodeModel <node_type> Property { <data_type> : <property_name> }
Link definition		LinkModel <Link_type> Property { <data_type> : <property_name> }
Action definition		ActionModel <Action_Name> parameter { <data_type> : <property_name> }

Network application/user use NEMO Language to programming their service

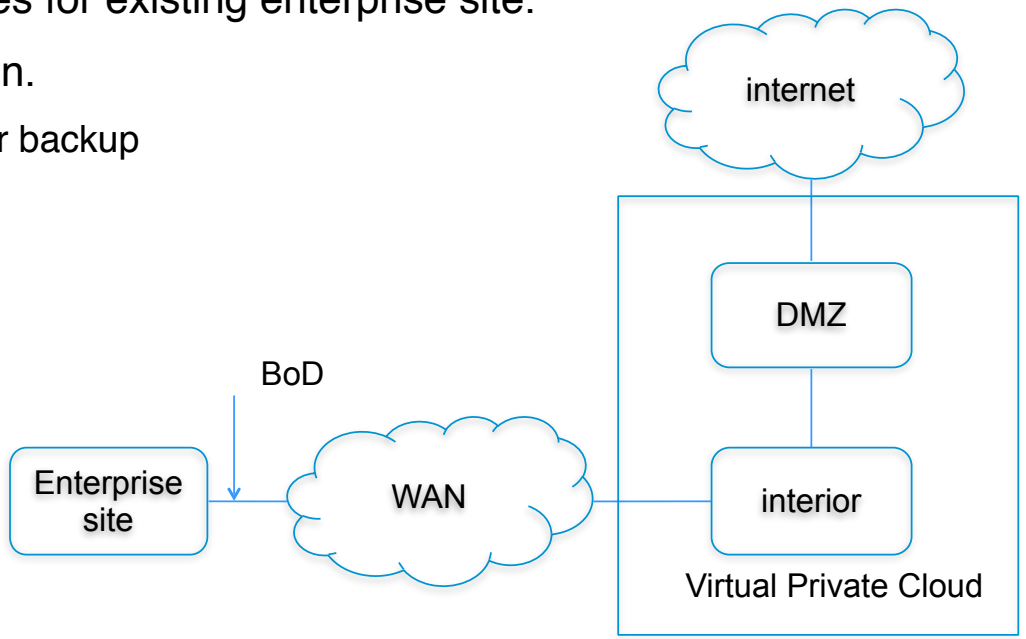
NEMO Language is an Intent oriented network DSL (domain specific language), which is a language style network open interface. Operator/End-user or 3rd party can use it to program network resource and behavior in their service applications.

NEMO Engine is a network middleware, which translate high level service intent to real network instruction base on MDA(Model Driven Architecture).

NEMO is now an OpenDaylight project coming with Beryllium release.
https://wiki.opendaylight.org/view/NEMO:Main

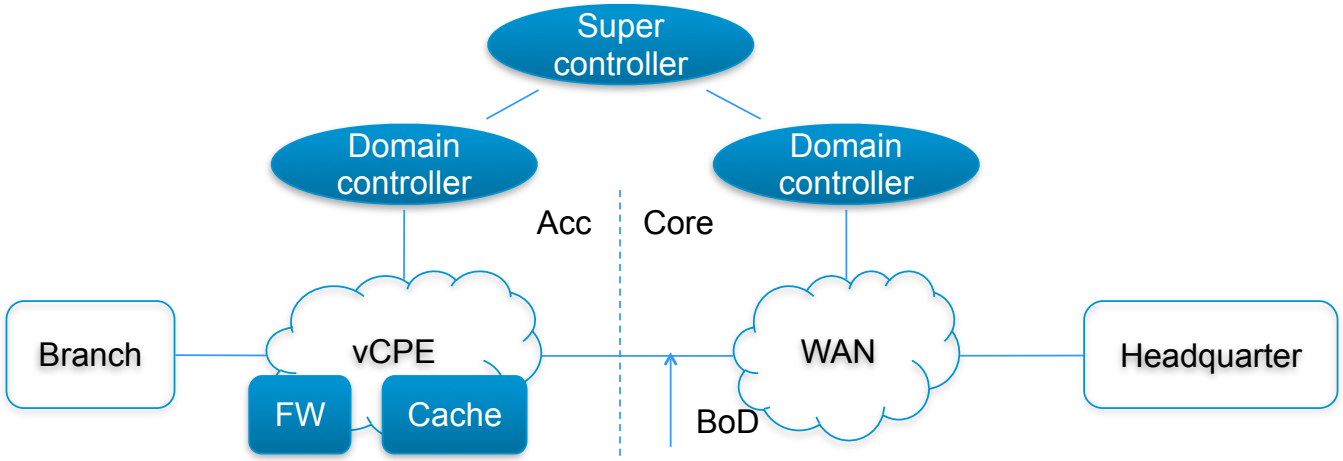
Use case : Virtual Private Cloud

- **Operator provide virtual private cloud service for enterprises.**
  - Need to allocate two zones in the VPC for security issue.
  - DMZ provide http/email/video services for access from internet.
  - Interior provide compute and storage resources for existing enterprise site.
  - Provide BoD capability on the WAN connection.
    - E.g, increase bandwidth when cloud bursting or backup



Use case: End to End Carrier Network

- **The enterprise outsources their CPE business to the service provider.**
  - The Branch site applies chained services in the vCPE before accessing WAN.
  - The enterprise requests BoD in WAN between the branch and the headquarter for different bandwidth requirements, e.g., day/work and night/backup.
- **The NEMO programmed logic runs on the Super controller and instruct domain controller to accomplish network service provisioning and policy applying.**

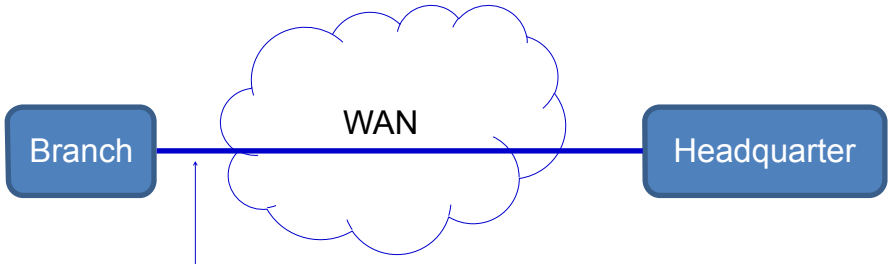


An Example: Bandwidth on Demand (B2B) DOCSIS

- There is a virtual link between the branch and headquarter offices.
  - The bandwidth of the vlink can be adjusted on demand
  - The adjustment can be triggered by "conditions" meet, e.g. The bandwidth will be adjusted when the timing meets.

NEMO Script:

```
Node branch;
Node HQ;
Connection  tunnel Type P2P
        Endnodes branch, HQ;
```



Condition: from 8am to 6pm, Bandwidth: 10G

Condition: from 6pm to 8am, Bandwidth: 1G

```
Constraint day ApplyTo tunnel
        Condition time>8am & time <6pm
        Operation set:bandwidth=10G;
Constraint night ApplyTo tunnel
        Condition(time>0am & time<8am)|(time>6pm & time<0am)
        Operation set:bandwidth=1G;
```

NEMO Editor in Eclipse

- **Program a Eclipse plug-in that highlights the keywords**
- **Integrate with the IBNEMO project**
  - **Parse the NEMO language and compose the NEMO rest API.**
  - **Call rest client/lib to send the request.**
- **Reference:**
- **Hackathon implementation result: https://github.com/paaguti-work/NEMO-IETF**

What could be the role of intent-based networking in situation where the system's goal "emerges" from the agents interactions?

- **IBNEMO can dynamically update the network behaviour.**
  - So if IBNEMO app gets alert that change is needed, it can do so
  - Tianran Zhou can demo (see him. Possibly also demo at Bits&Bytes)
- **Question: should IBNEMO also monitor network?**
  - Should that be part of IBNEMO?
  - Can it rely on other network monitoring tools that trigger IBNEMO activity?
  - Are there researchers that want to experiment with that?
  - Do we have ideas on how to do this?

What we are looking for: do you have experience in …

- **operating a network?**
  - How would you implement the use cases?
  - Feedback on the NEMO language definition, proposals for enhancements
- **the OpenDaylight project?**
  - Help us debug the current OpenDaylight NEMO Engine
- **programming plugins for Eclipse?**
  - Program the interface(s) to drive the OpenDaylight implementation
  - Integrate them with the NEMO Editor
  - You know Xtext?
    - Help us to improve the NEMO Editor plugin

Thank You