

OPEN NETWORKING  
FOUNDATION

# Northbound Interfaces

Working Group



# Open Networking Foundation

## North Bound Interface Working Group (NBI-WG) Charter

### FINAL VERSION: V 1.1

**Authors:** Sarwar Raza (HP), David Lenrow (Plexxi)

**Key Contributors:** Pascal Menezes (Microsoft), Ehud Doron (Radware), Tina Tsou (Huawei), Fabian Schneider (NEC)

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## Executive Summary

The proliferation of SDN Controllers each with unique APIs creates an over-abundance of programmatic interfaces that network service vendors, orchestration systems and application vendors must develop to in order to serve diverse SDN use cases. This inhibits the widespread adoption of SDN and its associated protocols and technologies including, but not limited to, OpenFlow.

We propose creation of an ONF working group to define and subsequently standardize various SDN Controller Northbound API Interfaces (NBIs) that will be chosen by the working group. This ONF led effort will enable acceleration of SDN innovation by allowing significant application portability across SDN controllers, both open source and proprietary. We further propose that that this take place through collaboration with one or more community based open source initiatives developing working code. We suggest that it is essential to have functional proof that the APIs proposed support appropriate use cases proving utility, usefulness and market acceptance prior to standardization.

## History, and relationship to NBI Study Group

The ONF board has previously considered a proposal for a formal working group focused on the development of a Northbound API (2012). The Board decided at the time to instead task the existing architecture and framework WG with further analysis, which has subsequently been done in the form of two extensive and thorough studies of existing SDN use cases and controller interfaces.

The output from the NB-API study group provides a strong foundation and seamless jumping off point for the formal work group and standards track activity proposed here.

We propose merging the NBI Study Group activities now housed under the ARCH-WG with the activities of the NB-API WG, with continued strong linkage to the ARCH-WG and its output and recommendations.

## Motivation

SDN's ultimate promise is realized when end customers, their applications and orchestration systems are able to make full and effective use of their now decoupled network control and data planes without being tied to a single vendor's controller API.

We respectfully assert that:

- An agreed upon NBI standard is essential for establishing a vibrant SDN application ecosystem.
- The sheer number of controller APIs under independent development make it likely that there will eventually lead to definition of some common semantics. This work is so tightly coupled to the broader SDN technology responsibility of ONF that It makes sense of ONF to take the lead in leading such an effort, so the result serves the community better.
- Developer investment should be to improve and differentiate their applications, rather than porting between fragmented proprietary APIs
- Controller vendors benefit by concentrating on performance and feature richness while relying on standard and documented APIs to provide a bigger developer ecosystem
- The emerging cloud software architecture separates the job of orchestrating virtual machines from SDN controller's job of understanding topology and protocols. As a result, an NBI is required that can be applied across diverse topologies and protocol implementations.
- NBI is an evolving software artifact, not just a paper exercise: to this end, it is imperative that the output of this group be closely, formally aligned with code producing entities that will develop an implementation of APIs before they are standardized. It is thus the intent of this working group to participate in both the definition, and the implementation of the NBI in collaboration with open source communities where appropriate.
- While SDN is a relatively new paradigm, the argument that it is 'too early' to standardize APIs contradicts the fact that network operators are clearly concerned about the lack of such standards track activity as an obstacle to deployment.
- Unless there is an overall architecture for these APIs defined, they will organically grow fragmented by individual interests and domain specific implementations. A fragmented controller market without interoperability across vendors and implementations inhibit SDN adoption and potentially return us to an era of de-facto, closed standards based on the interest of a dominant vendor or result of first mover advantage.
- We assert that, in addition to defining broadly applicable APIs, this is also the right time to demonstrate leadership in defining domain specific APIs. SDN use cases such as cloud orchestration, Unified Communications and Collaboration, network virtualization, amongst others, are being deployed today and standardization of resulting APIs can occur in parallel with, and inform the work done for domain agnostic APIs.

## API Abstractions

Even in an individual SDN controller instance, APIs are needed at different 'latitudes' i.e. some APIs may be 'further north' than others, and access to one, several, or all of these different APIs could be a requirement for a given application.

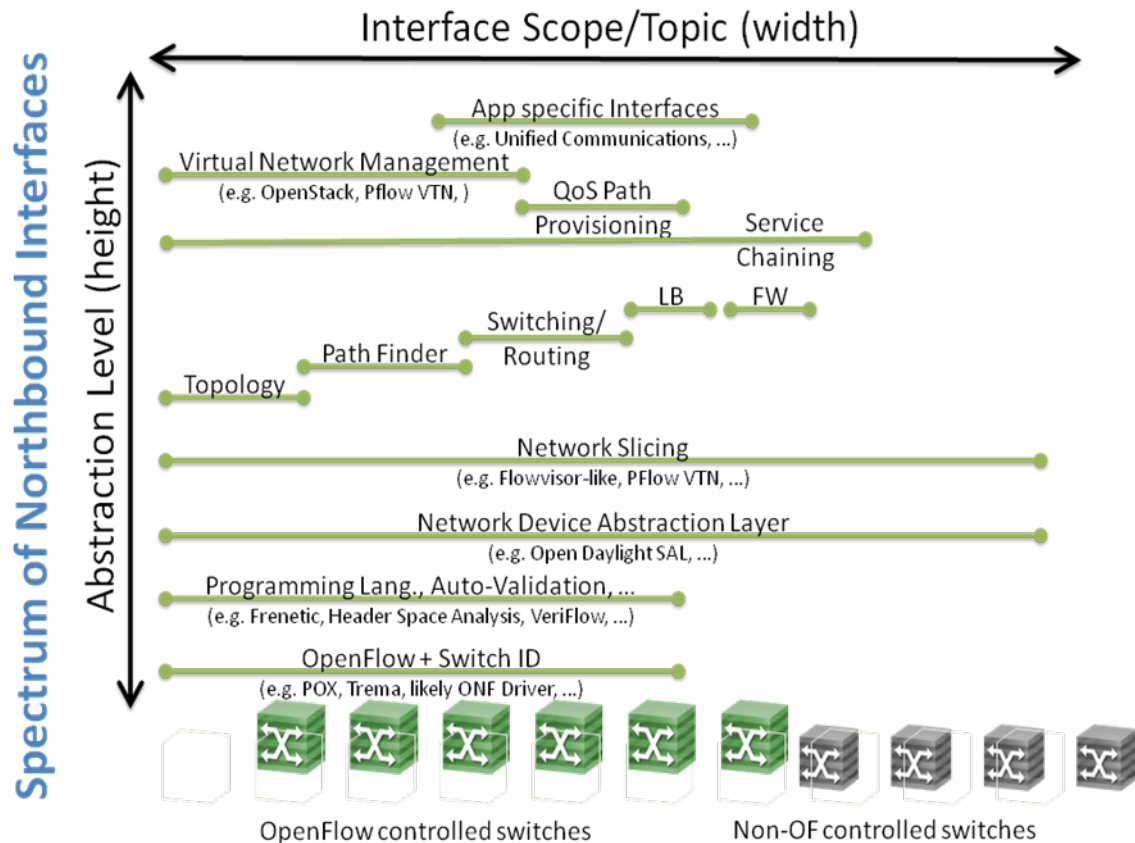


Figure 1 'Latitude' of Northbound Interfaces

The diagram above illustrates an example of the concept of multiple API latitudes, and is partly based on the ONF ARCH-WG NB API study.. The working group will define the specifics of the actual APIs standardized and where it makes sense to place them in the two-dimensional API stack.

As an example, a domain specific application may require an API that exposes very specific functionality, using some APIs to communicate directly with the controller, while at the same time using APIs from and analytics or reporting service residing on the controller. These different API endpoints may exist on the same controller instance or on different instances.

This group intends to define and develop APIs various API latitudes for both domain specific and more general interaction.

## Goals

1. Provide extensible, stable, and portable NBI APIs to controller, network services, and application developers.

2. Increase portability of software designed to interact with SDN controllers. This will be done by defining multiple APIs at differing levels of abstraction and breadth of domain to allow network behavior to be more programmable, and automated.
  - a. It is necessary, but not sufficient, to develop APIs that exploit protocol, vendor, or media specific features. This means that in addition to defining a standard API for programming to the specific OpenFlow wire protocol, for example, the WG can also develop other standards for more abstract APIs that are independent of protocol. Widespread and rapid SDN adoption will require making APIs available to larger numbers of developers including those who are not network equipment experts. By encapsulating some of the complexity and details of the underlying implementation. Such APIs would capture user/app/service “intent” and remove vendor/protocol/controller/media specifics
3. Ensure that controller vendors are free to innovate, using API extensions, within their designs

## Scope of Working Group

The scope includes any API that adds abstraction and encapsulates implementation complexity, northbound from the SDN controller platform.

## Defining NBI

In the most general case, an SDN controller can be thought of as a platform that has an upper or north-side component (based the observation that by convention the compass arrow pointing towards the top of a two dimensional map points north) and a lower or south-side component. The lower portion consists of “drivers” for “southbound” protocols such as the OpenFlow Wire protocol, which are used to control individual (virtual or physical) network devices. There is an interface between these southbound drivers, and the network (rather than device) specific logic that implements more abstract components. The network level of abstraction lives on the North side of this same interface as below:

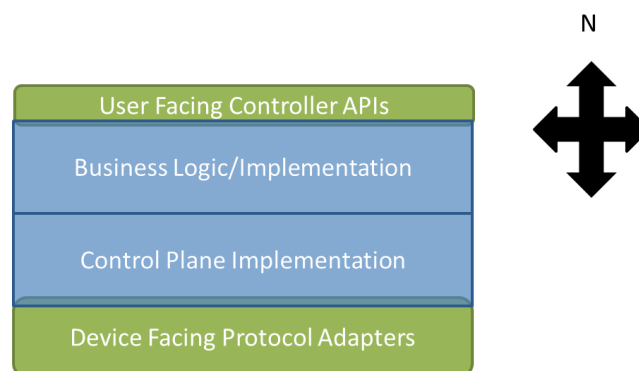


Figure 2

Based on the diagram above, it is clear that when the SDN community talks about Northbound APIs they are referring to programmatic interfaces that live on the northern side of the controller interface and not the south-side protocol driver interfaces.

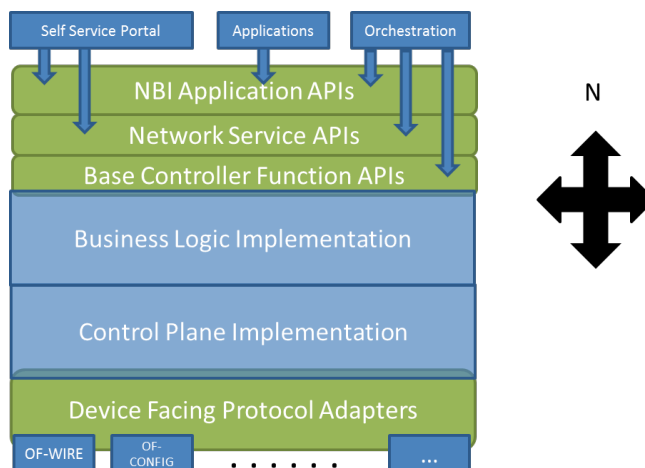


Figure 3

There are APIs that are typically considered to be part of the controller platform itself and are used by higher-level software to create network services, which are exposed “to the North”. There are also APIs exposed by the network services built above these APIs. Both provide value to developers and both can be technically described as controller “NBIs”.

Within this working group, different APIs with different levels of abstraction shall be developed. It is possible to define both a “developer toolkit” API appropriate for SDN software developers and, for example, a network virtualization API appropriate for end customer integration (this would be an application NBI). This group will thus develop APIs that are protocol specific, and APIs that are specifically independent of protocols (including abstraction of OpenFlow protocol specifics).

We propose that a ‘core’/base API be defined and established to cover common SDN controller (platform SDK) capabilities and functions, and that use case or domain specific APIs (application NBI) also be developed by this group. We intend to draw upon the work of the ARCH-WG’s NB-API study group to make a determination as to what functionality is common across currently known implementations for both core and application NBIs.

## API Implementation

We propose the development of an information model and proposed encodings for SDN Controller NB APIs in a programming language neutral manner, as a data model. Implementations of these API data models are then the responsibility of API implementers and consumers.

ONF NB-API WG will, as part of its charter, drive the development of at least ONE complete implementation (working code) of each of the APIs defined by the group. This requires both a controller

side implementation of the prescribed information model, as well as the consumer side of the NB-APIs from that controller.

An API has potential for future ‘standardization’ once it has successfully been implemented in working code, and has met some measure (undefined here) of market acceptance. This insures that standards reflect deployed, proven technology. A standards effort thus always follows running code.

We propose a formal working relationship with at least one open source code producing community that will produce a reference implementation of the upper half of APIs specified by the NBI WG. It is within the scope of this working group to work with vendors and open source communities to develop proof points for the lower (controller) half of a particular NBI. Similarly it is within the scope of this working group to work with any existing orchestration/CMS/application candidates as they choose.

## Deliverables and Timeline

Note: The workgroup, once constituted, may choose to review the timelines below to reflect changes in scope and relative size and priority of proposals.

1. Workgroup setup – appointment of Editor/Chair/Vice-chair T0+1 Month
2. Formalize workgroup scope for first year T0+2 Months
  - a. Initial proposals for general API framework and architecture
  - b. Identification of key use cases for Application NBIs
    - Based on NB-API Study group review and new submissions
  - c. General plan for code development/contributions and potential alliances/liaisons
3. Development of functional requirements T0+3 Months
  - a. Base (common) Controller APIs
  - b. Use case documents and requirements for selected App NBIs (from 2b)
4. Prioritization and decision on implementation of APIs T0+3.5 Months
  - a. Determine if existing API definitions and implementations suffice for any selected use case or base API, and make necessary recommendations for extension, adoption etc.
  - b. For domains and applications where net new API definition effort is required:
    - Finalize at least one open source or vendor implemented project that will host NB consumer implementation
    - Finalize at least one open source or vendor implemented SDN controller project that will host controller side implementation
5. Implementation of base reference API based on ONF NBI info model T0+7 Months
  - a. Controller side implementation
  - b. API consumer side implementation (SDN application to exercise APIs)
6. Implementation of selected use case APIs based on ONF NBI info model T0+9 Months
  - a. Controller side implementation
  - b. API consumer side implementation
7. Recommendations on next steps T0+12 Months

## Considerations

- There is a critical need to allow participation by non-ONF-members while developing Northbound API standards. This needs to be an open community effort not a vendor driven activity, and ONF's end user focus and novel governance model make it an ideal forum to host this effort.
- The ONF should consider developing a mutual non-disclosure agreement and/or IPR release agreement, sufficient to support participation by non-members while also complying with ONF's existing IP and confidentiality requirements.

## Working Group Name

The working name 'Northbound API WG' and the acronym 'NBI' were not chosen explicitly to convey any formal scope. More often than not, we are called upon to disambiguate what SDN system component we are technically Northbound from, since North and South interfaces exist at every layer of the architecture. We are open to suggestions from the ONF board or marketing WG with regards to a scope and charter appropriate moniker for the group.