Migrating to SDN with the SDN-IP Application

How does one start to deploy SDN architectures in a world of traditional IP and BGP controlled networks? SDN-IP has been developed to answer this question. With SDN-IP you can add an SDN network to your existing network, and it looks like a BGP Autonomous System (AS) to the rest of the network. Over time you can add more, grow the SDN network, and scale the SDN domains.

Architectural goals

SDN-IP has been designed with the following goals in mind:

- **Compatibility** - SDN-IP can be integrated with networks that already use BGP - externally, internally, or both.
- **Operational flexibility** - SDN-IP can run on one or multiple ONOS instances. Moreover, SDN-IP can be used in a variety of BGP deployment scenarios: full-mesh BGP, BGP Route Reflectors, BGP confederations, and with BGP Route Servers.
- **High availability** - SDN-IP provides HA within the application itself. The SDN-IP service keeps working seamlessly, as long as there is at least one instance of the SDN-IP application running. In addition, SDN-IP leverages the HA mechanisms provided by ONOS for maintaining a consistent forwarding state in the data plane.
- **Scalability** - Large-scale Software Defined Networks can be controlled by using BGP-based Confederations and multiple ONOS clusters, each running SDN-IP.
- **Protocol compatibility and vendor independence** - SDN-IP relies on the standard BGP protocol for exchanging network information, and does not require any proprietary or vendor-specific extensions.
Architecture Overview

The following figure depicts the architecture.

In a typical deployment scenario, an SDN-IP controlled network acts as a transit Autonomous System (AS) interconnecting different IP networks. Each external network is a different AS domain, which interfaces with our SDN network through its BGP-speaking border routers.

The SDN-IP network is composed of OpenFlow switches controlled by ONOS. While SDN-IP can be used even with a single ONOS instance, for high availability and scalability, there should be a cluster of ONOS instances, where some of those instances run the SDN-IP application. Within the SDN-IP network, there are one or more internal BGP speakers. The BGP speakers can be existing BGP routers or any software that implements BGP. The speakers use eBGP to exchange BGP routing information with the border routers of the adjacent external networks, and iBGP to propagate that information amongst themselves and to the SDN-IP application instances.

The routes advertised by the external border routers belonging to external
networks are received by the BGP speakers within the SDN-IP network, processed, and eventually re-advertised to the other external networks. The routes are processed according to the normal BGP processing and routing policies. Similarly, those routes are also advertised to the SDN-IP application instances which act as iBGP peers. The best route for each destination is selected by the SDN-IP application according to the iBGP rules, and translated into an ONOS Application Intent Request. ONOS translates the Application Intent Request into forwarding rules in the data plane. Those rules are used to forward the transit traffic between the interconnected IP networks.

In addition, SDN-IP creates the appropriate ONOS Intents that would allow the external BGP routers to peer with the BGP speakers by using the data plane. Thus, BGP itself can also detect failures in the data plane that affect the transiting traffic and act accordingly.

Among the SDN-IP application instances, each instance receives and contains exactly the same set of BGP routes (and the corresponding Application Intent Requests), but only one instance, the SDN-IP Leader, is responsible for making the appropriate ONOS API calls to install the necessary intents at any given time.

Additional Information
The wiki contains much more technical information about SDN-IP. There is a video demonstration of SDN-IP here.