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Building a Network Marketplace with XIA: Project Proposal

1. Vision and Goals Of The Project:

The expressive feature of XIA allows applications to express their intent more accurately. The ultimate goal of this project is to create a simple version of a networking marketplace using XIA. The marketplace enables users and applications to make choices among different cloud computing resources, such as storage, computing nodes, links, etc., to meet their requirements.

More specifically, the goal of this project is to port XIA into OVS (Open vSwitch) allowing a router or switch to recognize the architecture much like it would recognize protocols like Ethernet, VLAN, or IP. Once this is complete, new features will be added to XIA to expand its current functionality. Finally, an application utilizing XIA will be developed to demonstrate the architecture's performance and advantages.

Users/Personas Of The Project:

The Network Marketplace targets data center users who will be able to use XIA to choose between different links and physical links to suit their needs. It will be used to address movies, end-hosts, google searches, etc. much like how current internet protocols address hosts using an IP address.

2. Scope and Features Of The Project:

- Expand XIA in the Linux Kernel
  - Add additional features and functionality to the existing XIA code
  - Enable choice in a data center
    - Users can choose computational and storage resources from service providers in a marketplace, and can choose networking services by various vendors as well.
    - We may reuse the existing features and functionality in current XIA code
- Port XIA to a virtual network switch software (OVS)
  - Read through pre-written XIA code to determine how it works
  - Read through OVS code to understand how IP, HTTP, etc. are ported in order to add the necessary code and headers to port XIA as well

    - Revise code in order to port XIA into OVS to enable a router or switch to recognize XIA much like it recognized protocols like TCP or IP.
        - XIA can act as a transport layer, network layer, and link layer protocol. In this project, we're going to be using it as a link layer protocol that switches packets based on identifiers for links. Once XIA is in place in OVS, then the other functionality it employs (OpenFlow) will work "with" XIA.
        - We need to extend OVS to support the XIP header, so that XIA can work in the data center environment.
        - Also, we need to modify and expand XIA to fit within the constraints of OVS
- Creating an Application that utilizes XIA on OVS
    - Develop an application using XIA that displays the features and functionality of the architecture

3. Solution Concept

Global Architectural Structure Of the Project:

Below is a description of the system components that are the building blocks of the architectural design:

- XIA: an experimental network architecture created as an alternative to TCP/IP under the premise that applications should be able to more clearly express their needs to the network rather than specifying the location of where to get it from
- OVS: a virtual multilayer network switch (Open vSwitch)

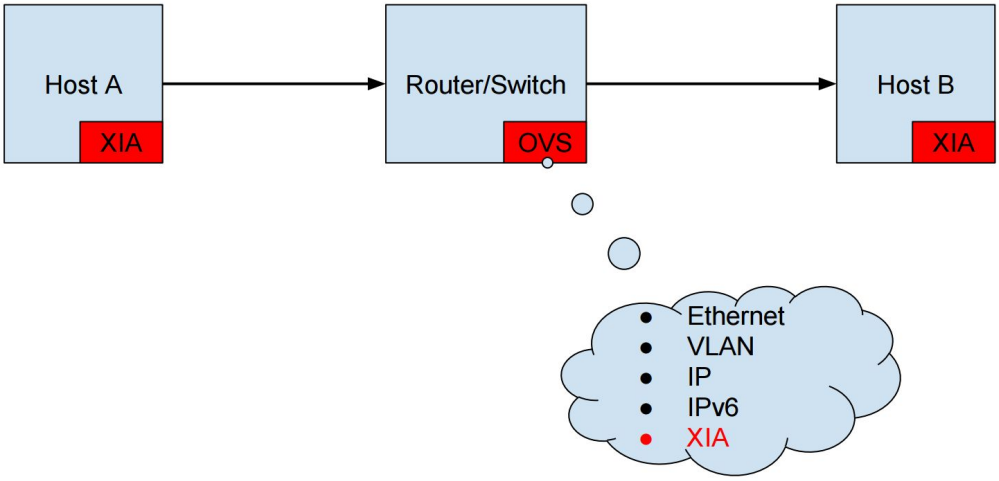

Figure 1. Host A communicate with Host B via XIA

Figure 1 shows the basic elements in the XIA enabled network. Assuming that both host A and host B are XIA enabled hosts, and A wants to

communicate with B via a router/switch with OVS support. Like TCP/IP, the router/switch on the path from A to B needs to understand XIA, otherwise, the packets from A to B cannot be forwarded correctly, or will even be dropped. This highlights one important task in our project, i.e., porting XIA into OVS and making XIA understandable to the network.

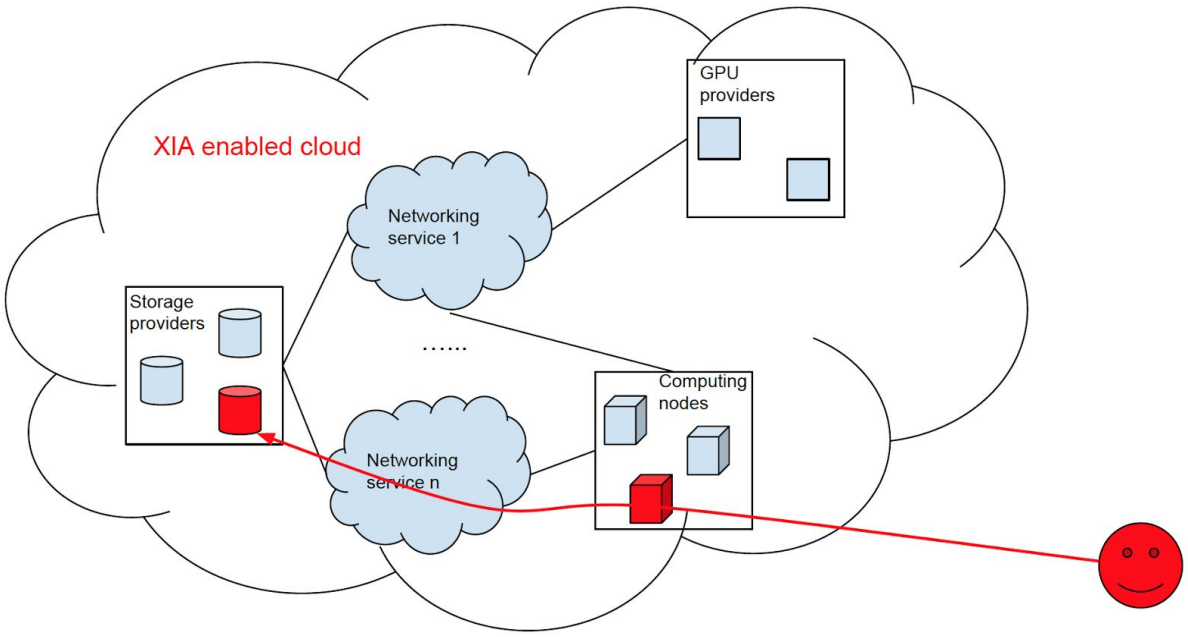

Figure 2. MOC-XIA architecture

Figure 2 shows the MOC-XIA architecture, in which all the hosts, routers, switches, etc., are XIA enabled, i.e., this is an XIA enabled cloud. In the cloud, it enables networking as a marketplace, so that users can choose better networking services from different providers to meet their desired requirements. For instance, the user may require a networking service provider that can meet their requirements of a low latency and low jitter networking service.

Design Implications and Discussion:

- Using XIA for better expressiveness: XIA enables applications to more accurately express their intent. For instance, the current Internet forces applications to say "find where this movie is, and then go retrieve it at that location." XIA allows applications to more simply say "retrieve this movie," without caring about where the movie is stored.
- Using OVS for multi-server virtualization deployments in data centers: Open vSwitch (OVS) is a production quality, multilayer virtual switch, and enables automated and dynamic network control in large-scale Linux-based virtualization environments through programmatic extension. OVS enables the network to support XIA for creating a networking marketplace.

- Creating a networking marketplace: XIA enabled cloud allows users to choose networking services by various vendors in the same way that users choose compute and storage resources from service providers in a marketplace. This meets the users' and applications' need for better networking service.

4. Acceptance criteria

Minimum acceptance criteria is a working implementation of XIA on OVS. Stretch goals are:

- Develop new functionality for XIA to build a network marketplace
- Build an application that utilizes XIA on OVS, and demonstrate its advantages

5. Release Planning:

Detailed user stories and plans are on the Trello board:
https://trello.com/b/OMzfp1ke/building-a-network-marketplace-with-xia

Release #1 (due by Tuesday Feb 9):

- Learn about the networking concepts, such as the Internet, XIA, Open vSwitch.
  - Basic Internet
    - A quick overview of how the Internet works: https://www.youtube.com/watch?v=oj7A2YDgIWE
  - Open vSwitch
    - Brief overivew of Open vSwitch: https://en.wikipedia.org/wiki/Open_vSwitch
    - Detailed of Open vSwitch (try reading sections 1-3): https://www.usenix.org/system/files/conference/nsdi15/nsdi15-paper-pfaff.pdf
    - A video that complements the above paper: https://www.usenix.org/conference/nsdi15/technical-sessions/presentation/pfaff
    - The official website: http://openvswitch.org/
  - XIA
    - The home page of one of the projects we'll be working on: the instantiation of XIA in the Linux kernel. https://github.com/AltraMayor/XIA-for-Linux/wiki
    - A (somewhat technical) overview of XIA: https://github.com/AltraMayor/XIA-for-Linux/wiki/XIA-101
    - A (somewhat theoretical) overview of XIA: https://www.cs.cmu.edu/~xia/resources/Documents/XIA-nsdi.pdf

    - A video that complements the above paper: https://www.usenix.org/conference/nsdi12/technical-sessions/presentation/han_dongsu_xia

Release #2 (due by Tuesday Feb 23):

- Show how to run XIA and OVS.

Release #3 (due by Tuesday March 15):

- Port XIA into OVS.

Release #4 (due by Tuesday March 29):

- Port XIA into OVS, release a demo to show XIA works in OVS.

Release #5 (due by Tuesday April 12):

- Write new functionality in XIA to enable choice in a datacenter.

Release #6 (final demo due by Tuesday April 26):

- Build an application on top of XIA and OVS, to allow users to choose network services for better performance.