“Narrow Waist” of the Internet Key to its Success

• Has allowed Internet to evolve dramatically
• But now an obstacle to addressing challenges:
  – No built-in security
  – Hard to evolve
  – Limited contract between network edge and core

• XIA exploring three concepts to address issues:
  – Diverse types of end-points
  – Intrinsic security
  – Flexible addressing
Multiple Principal Types

- Associated with different forwarding semantics
  - Support heterogeneity in usage and deployment models
  - Set of principal types can evolve over time
- Hosts XIDs support host-based communication similar to IP – *who?*
- Service XIDs allow the network to route to possibly replicated services – *what does it do?*
  - LAN services access, WAN replication, ...
- Content XIDs allow network to retrieve content from “anywhere” – *what is it?*
  - Opportunistic caches, CDNs, ...
- Autonomous domains allow scoping, hierarchy
Content-centric Optimizations
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[Diagram showing relationships between HTML, Service SID, Content CID, and Host HID.]
Content-centric Optimizations
Content-centric Optimizations

[Diagram showing a network of servers and content optimization flows]
Supporting Evolvability

• New principal types must be deployed incrementally
  – No “flag” day

• Creates chicken and egg problem - what comes first: network support or use in applications

• Solution is to provide an *intent* and *fallback* address
  – Intent address allows in-network optimizations based on user intent
  – Fallback address is guaranteed to be reachable
Support for Fallbacks with DAG

- A node can have **multiple outgoing edges**

  * Outgoing edges are **prioritized**
    - Forwarding to AD, HID is attempted only if forwarding to CID is not possible

- Also supports scoping, mobility, …
Intrinsic Security in XIA

• XIA uses **self-certifying identifiers** that guarantee security properties for communication operation
  – Host ID is a hash of its public key – accountability (AIP)
  – Content ID is a hash of the content – correctness
  – Does not rely on external configurations

• Intrinsic security is specific to the principal type

• Example: retrieve content using …
  – Content XID: content is correct
  – Service XID: the right service provided content
  – Host XID: content was delivered from right host
XIA Dataplane Concepts

- Can be implemented in diverse ways
- Networks can implement different features
DEMO
4 Things Today

1. Evolvability
2. Intrinsic Security
3. Deployment over IP
4. Wireshark Plugin
Web Server

Native XIA Applications

Web Browser
Evolvability
Evolvability

Web Server

Web Browser

Host and Domain Only

Introducing Content Principal
Evolvability

Web Server

Web Browser

CID

HID

AD
1. Evolvability

Web Server

Web Browser

Upgrade with Content Support
1 Evolvability
Intrinsic Security
Intrinsic Security

Hosts

Services

Content

HID = \( H(\text{PUB}) \)

SID = \( H(\text{CERT}) \)

CID = \( H(\text{Image}) \)
Intrinsic Security

1. CID: 237cf8a2b40ee4ba1c1611e2b1d40024e87777d4

2. $H(\text{CID: 237cf8a2b40ee4ba1c1611e2b1d40024e87777d4})$

3. VS

CID: 237cf8a2b40ee4ba1c1611e2b1d40024e87777d4
Intrinsic Security

Serves Malicious Content

Web Server

Web Browser
2 Intrinsic Security
Deployment over IP
New Principal Type: IPv4

4ID = IPv4 ingress to remote XIA cloud
Deployment over IP

IPv4

128.2.1.44

64.57.12.31

HID

CID

4ID

DESTINATION

SOURCE

64.57.12.31

128.2.1.44
Deployment over IP
Wireshark Plugin
Wireshark Plugin

Debug your XIA network
4 Wireshark Plugin
One more thing...
XIA Prototype: DIY!
Public Release

Tarball

Github

VM
Running XIA on GENI

This document describes how to setup XIA experiments on GENI nodes using Flack tool.

## Contents

1. GENI Flack tool
2. Logging into Flack
3. Setting up GENI resources (via Flack)
4. Loading up XIA prototype into GENI nodes (via Flack)
5. Accessing your GENI nodes (via terminal)
6. Running XIA and initiating your experiments

### 1. GENI Flack tool

- Flack is a GUI tool for setting up GENI resources (nodes, links, connectivity, etc)
- Flack link: [https://www.emulab.net/protogeni/flack2/flack.html](https://www.emulab.net/protogeni/flack2/flack.html)
- Flack tutorials: [http://www.protogeni.net/trac/protogeni/wiki/FlackTutorial](http://www.protogeni.net/trac/protogeni/wiki/FlackTutorial)

### 2. Logging into Flack

You find a link to log in at GENI nodes with your Flack account.
eXpressive Internet Architecture: GEC 15 Demo

www.cs.cmu.edu/~xia