Active Networking on the ENIAC 2000
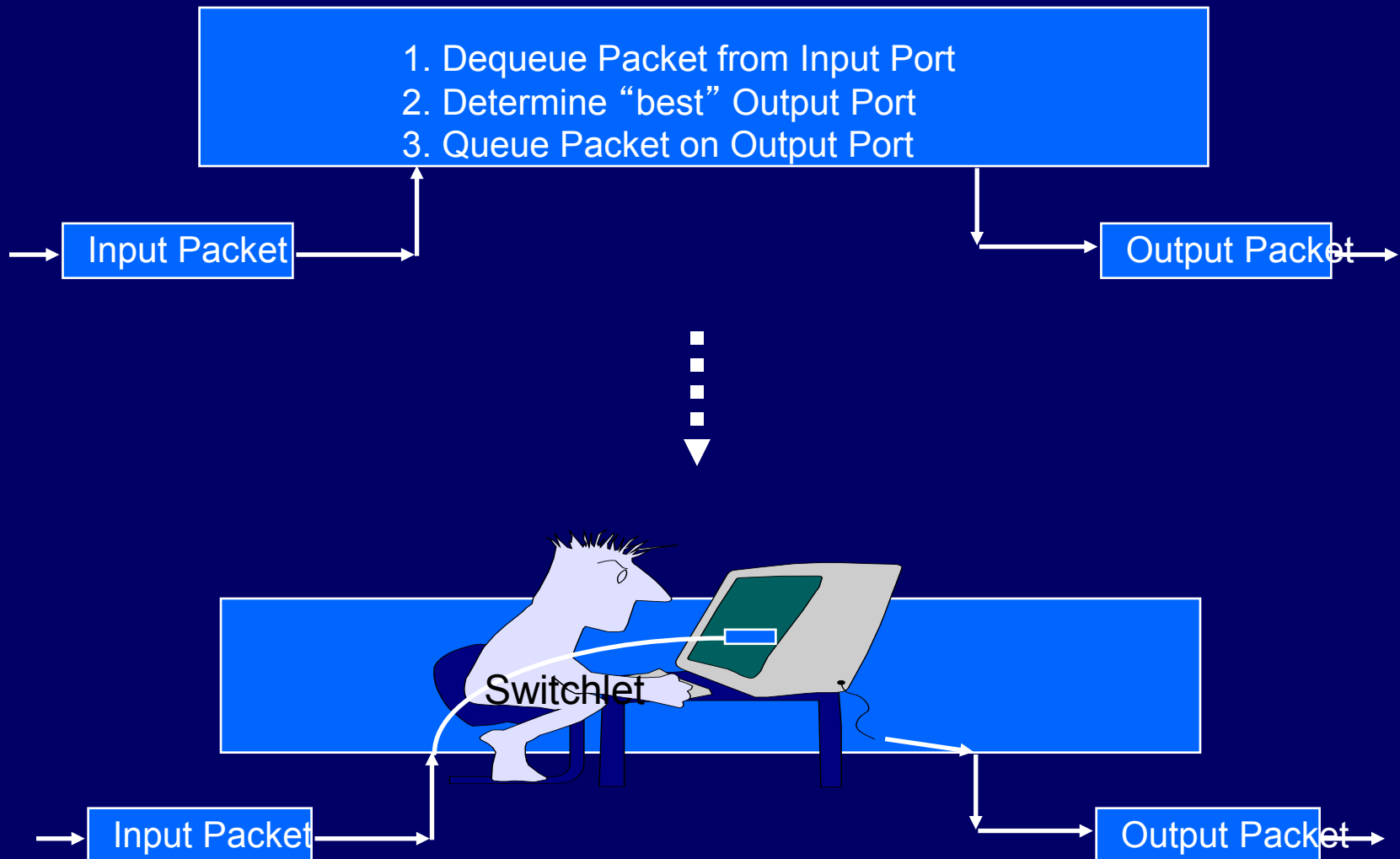
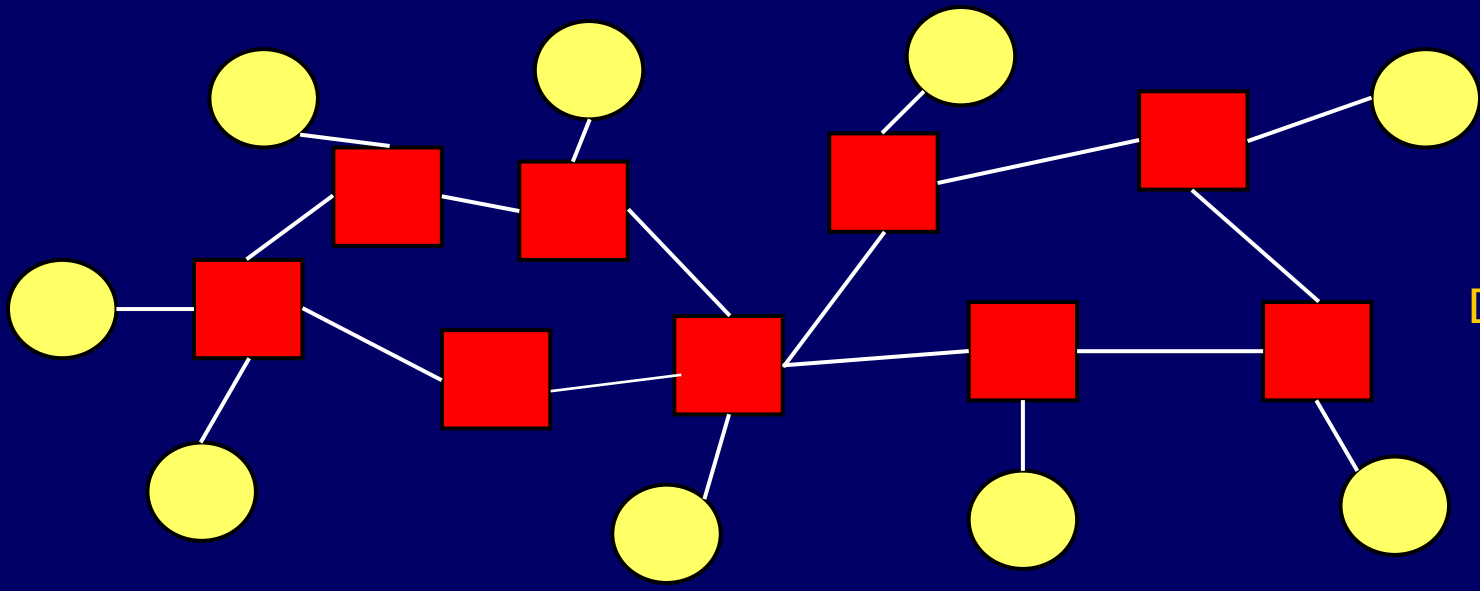## May 3rd, 1999

Jonathan M. Smith, http://www.cis.upenn.edu/~jms

SwitchWare is joint work with Dave Farber, Carl Gunter and Scott Nettles of Penn, and Bill Marcus and Dave Sincoskie of Telcordia. See:
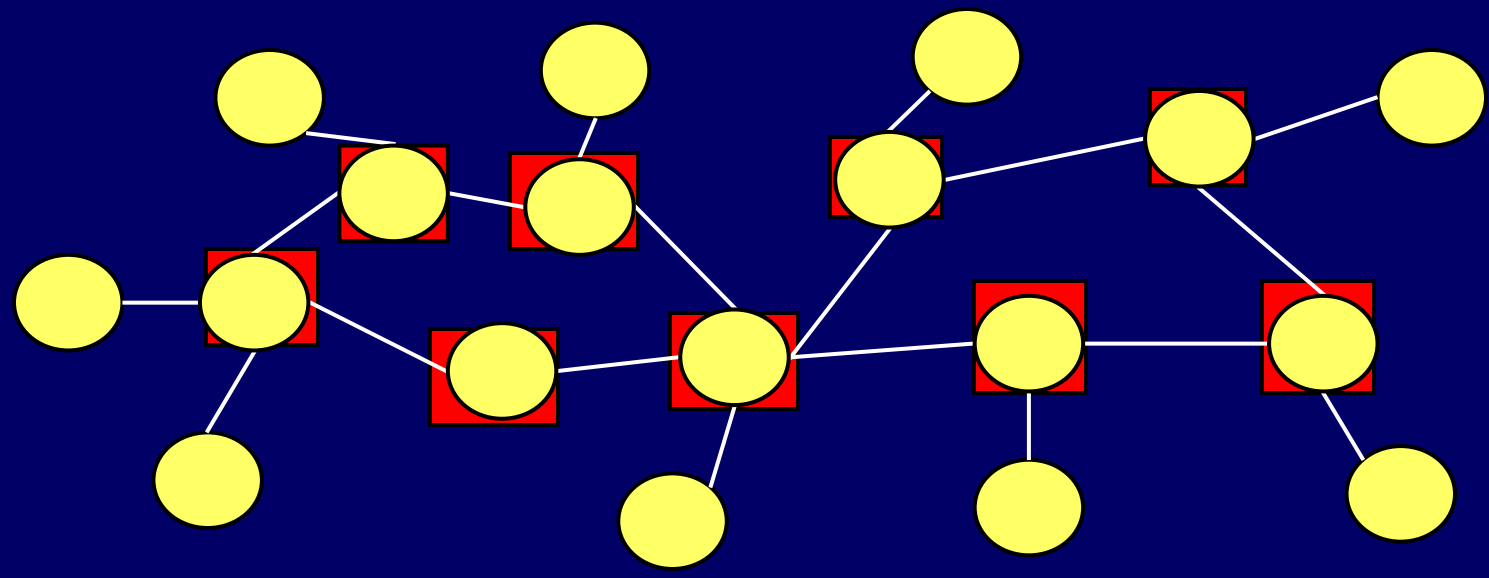
http://www.cis.upenn.edu/~switchware

From Store-and-Forward

1. Dequeue Packet from Input Port
2. Determine "best" Output Port
3. Queue Packet on Output Port

Input Packet

Output Packet

Switchlet

Input Packet

Output Packet
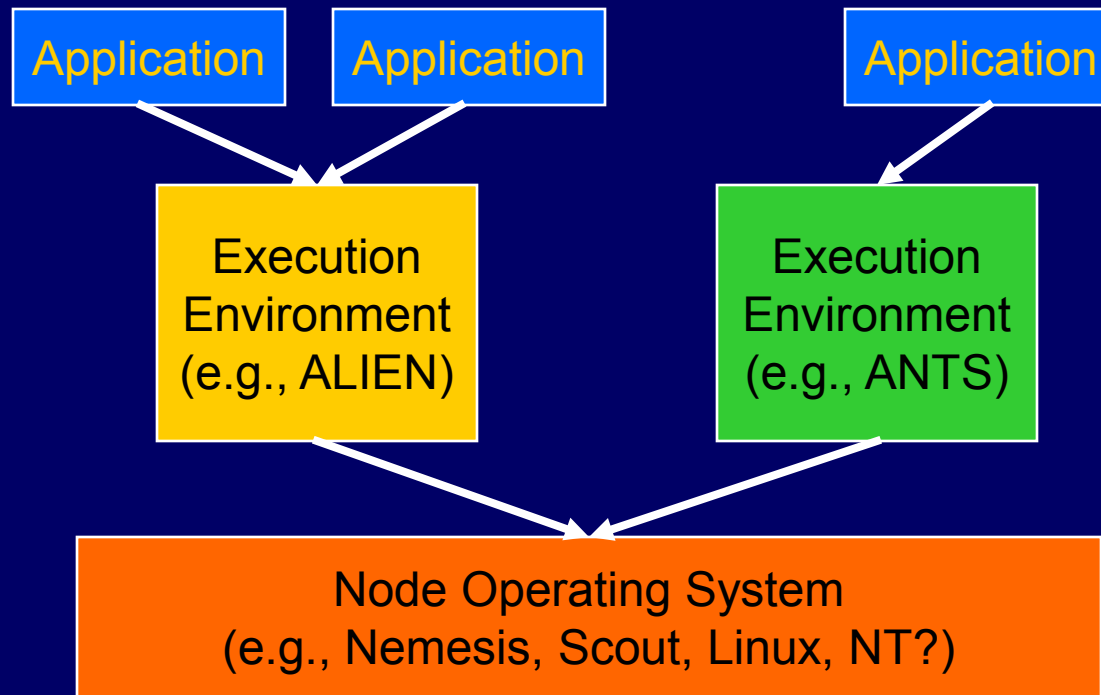
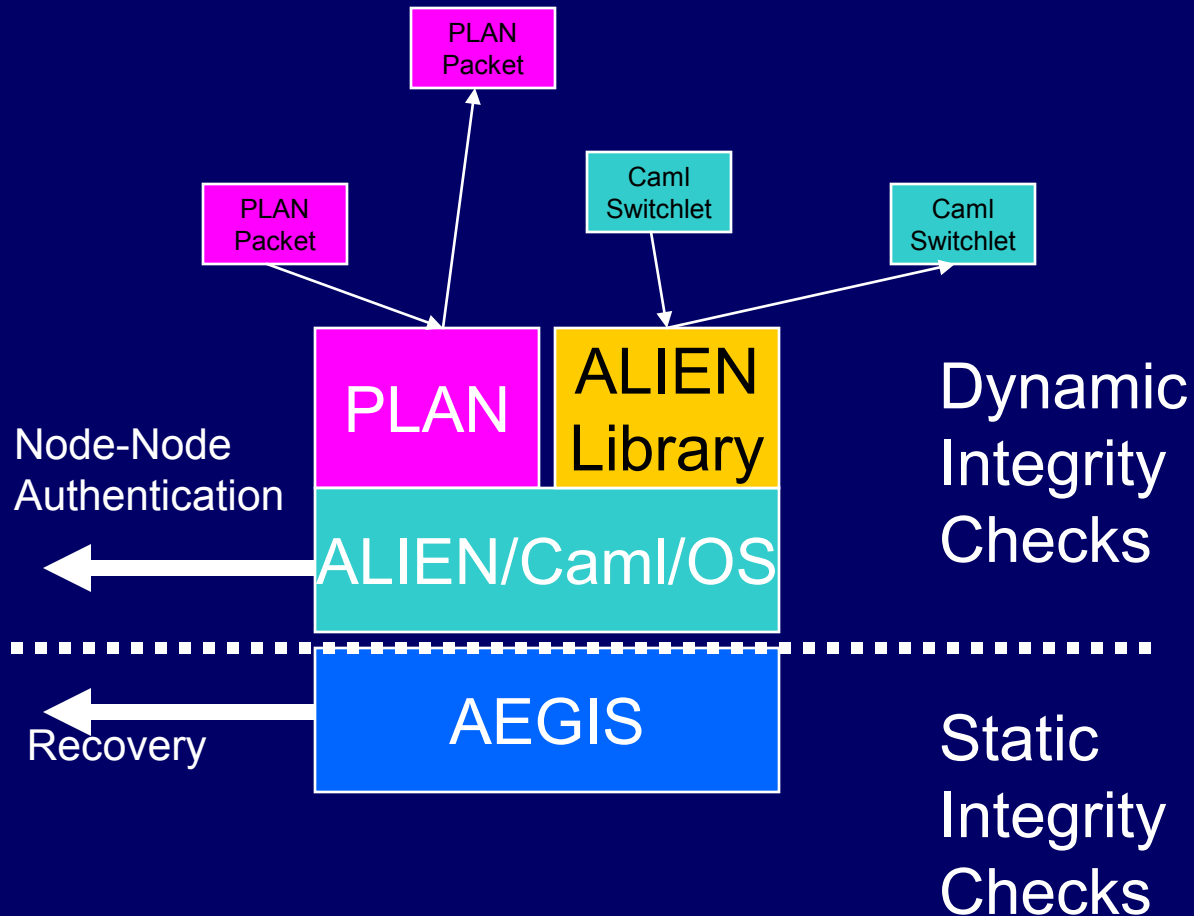## To Store-*Compute*-and-Forward!

Smart Hosts
+
Dumb Switches
=
Passive Nets

Smart Hosts
+
Smart Switches
=
Active Nets

Active Network Architecture

E.g., the SwitchWare A.N. Architecture

PLAN Packet

PLAN Packet

Caml Switchlet

Caml Switchlet

PLAN

ALIEN Library

ALIEN/Caml/OS

AEGIS

Node-Node Authentication

Recovery

Dynamic Integrity Checks

Static Integrity Checks

Packet Language for Active Networks (PLAN): Ideas

- Domain-Specific Language for A.N.
  - Active packets of ML-like code (but restricted for security & performance)
  - Active extensions for restricted tasks (such as link-layer access)
  - "Glue language" to build *active applications* (think of a UNIX shell for A.N.)
- PLAN internetwork demonstrated
  - Reported in IEEE INFOCOM '99

The ALIEN Active Loader

- Focus on generality and security
  - module thinning for locally enforced "views"
  - crypto. Credentials extend to remote case
  - *active packets* and *active extensions*
  - all written in Caml with restricted runtime
- Applications to LAN bridging (SIGCOMM '97), secure active ping, ...
- Performance in Alexander Ph.D. (1998)

ALIEN in an Active Element
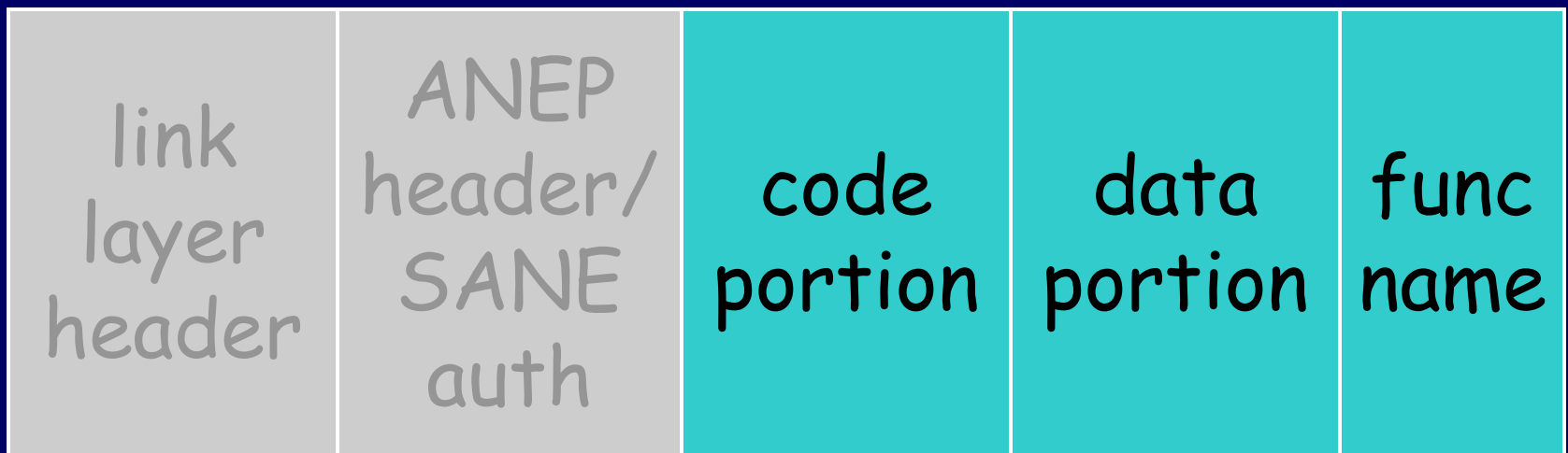
● Three layer architecture
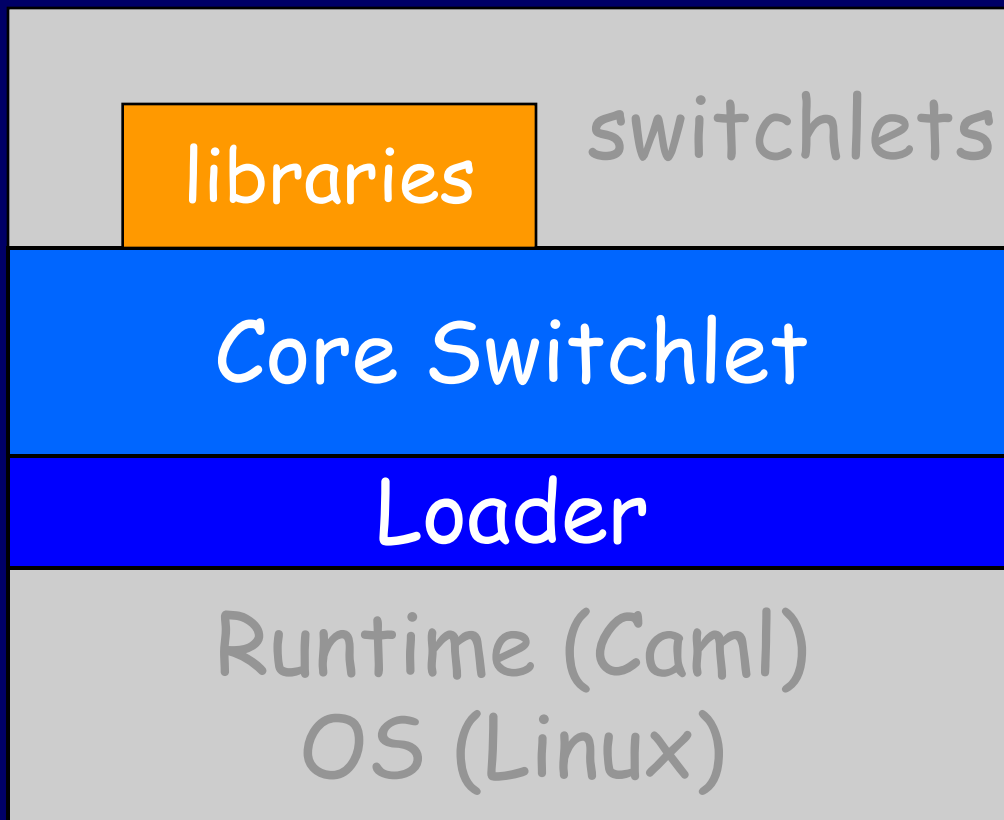
Active Packets in ALIEN
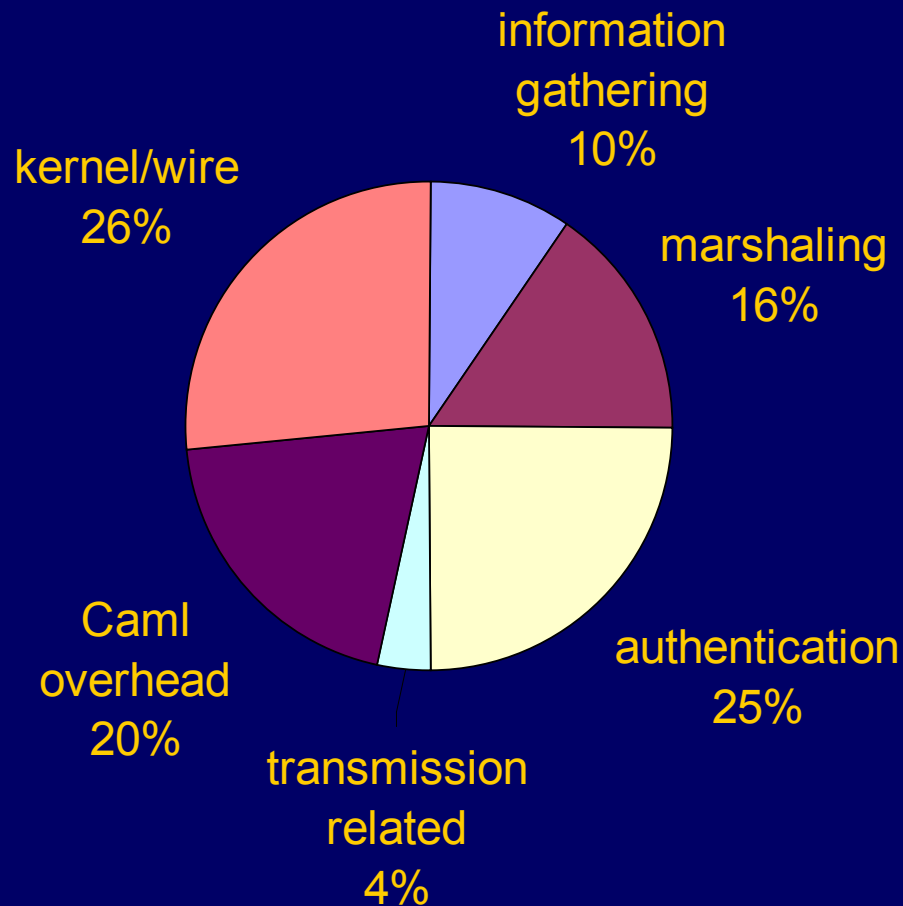
- If ANEP header indicates ALIEN
  - SANE processing as part of ANEP
  - Code portion is loaded
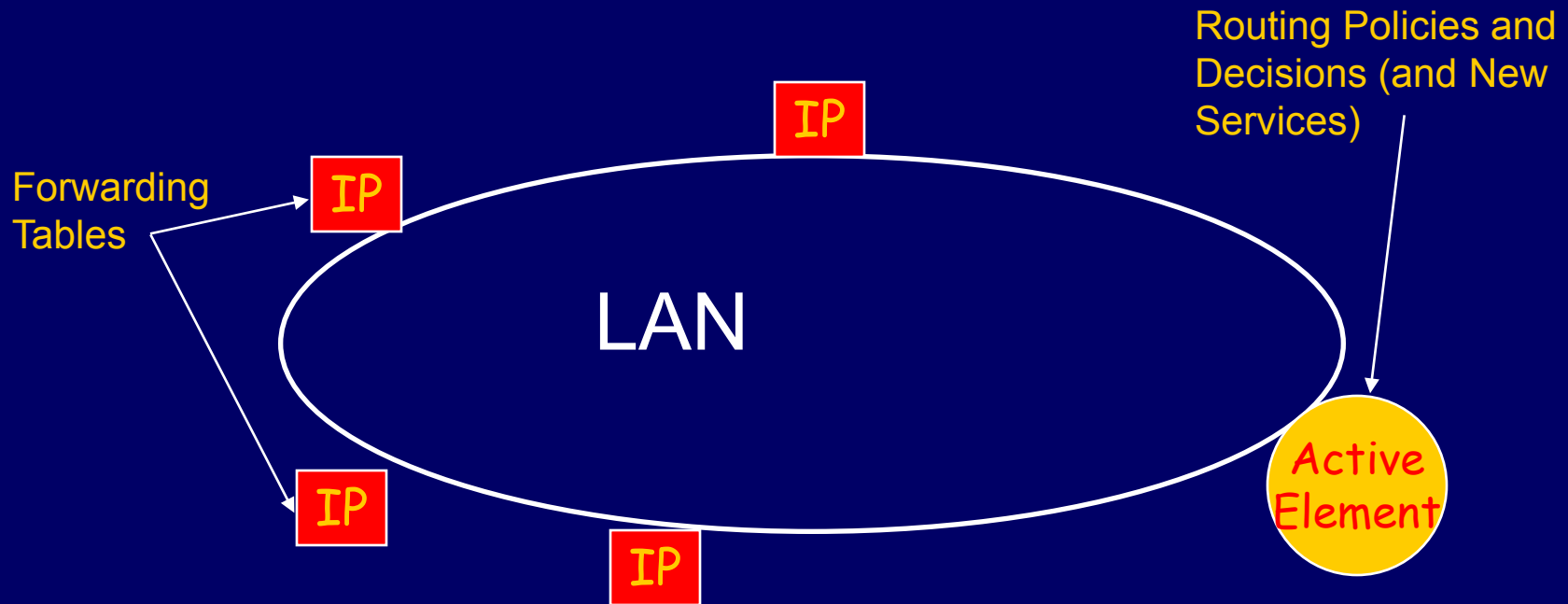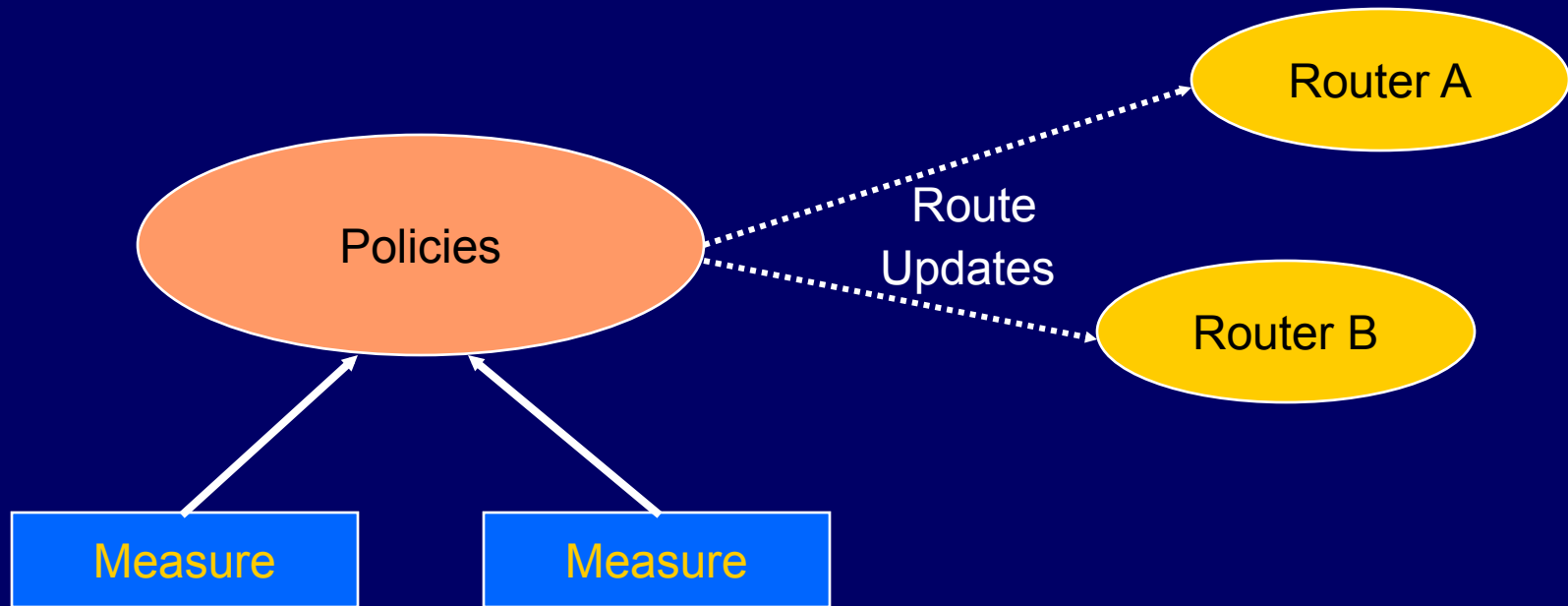 - *func* is called with code, data, and func name as arguments

link layer header	ANEP header/ SANE auth	code portion	data portion	func name

Breakdown of Costs in Alien

Active Router Control (Active Border Gateways?)

- IP Router/Forwarders co-located with Active Elements:

Routing Policies and Decisions (and New Services)

Forwarding Tables
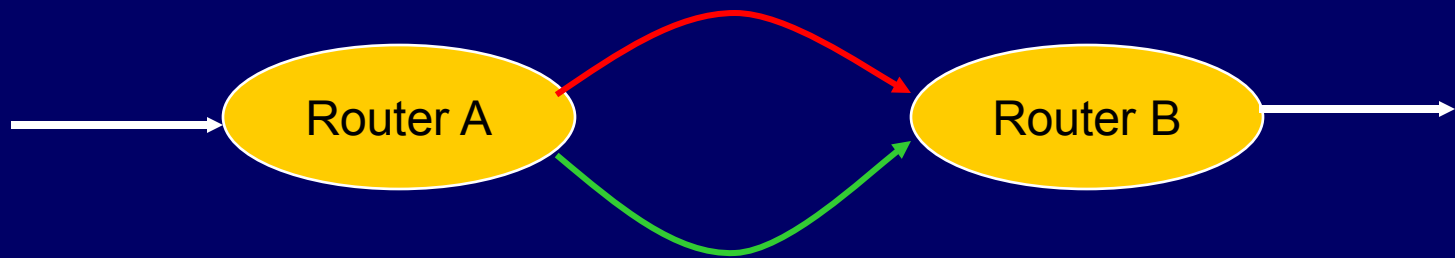
IP

IP

LAN

IP

IP

Active Element

The basic architecture

The Basic Opportunity:
Internet routing does not utilize the available network topology unless manually configured:

Goal: Resource Discovery and Exploitation!