International Civil Aviation Organization

ATN Seminar and Third ATN Transition Task Force Meeting

Singapore, 26-30 March 2001

Agenda Item 2: Routing, Naming and Addressing

AERONAUTICAL TELECOMMUNICATIONS NETWORK ROUTING

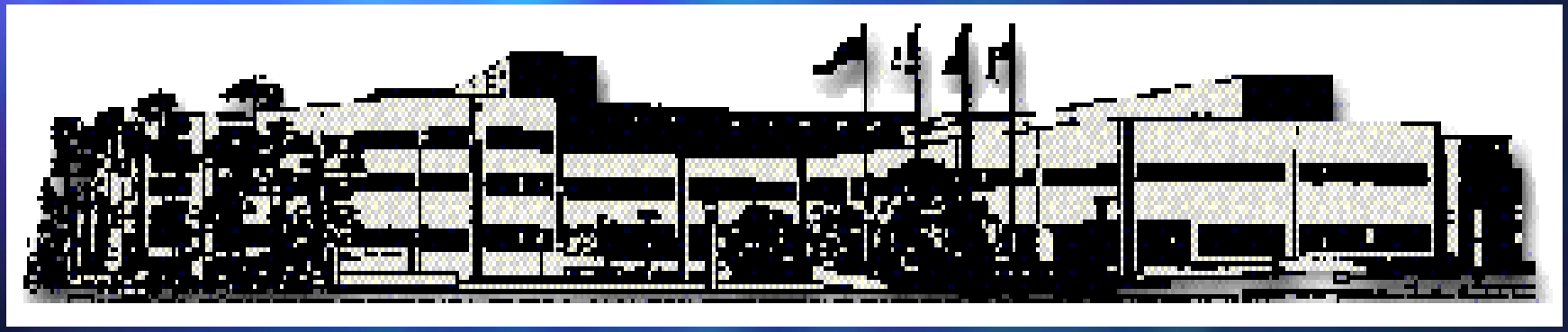
(Presented by Tom McParland, USA)

Federal Aviation Administration (FAA)

~ ATN Seminar – ATN Routing~

Singapore

March 2001



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FAA/ACT-350

ATN Technical Lead

Aeronautical Telecommunications Network Routing

Tom McParland

(US FAA)

Presentation Overview

- **Routing Concepts**
  - Route Maintenance vs Forwarding
  - Static vs Dynamic Routing (Route Maintenance)
  - PDU Forwarding
- **Routing Protocols**
  - ES-IS Protocol
  - Intra-Domain Routing Protocol
  - Inter-Domain Routing Protocol

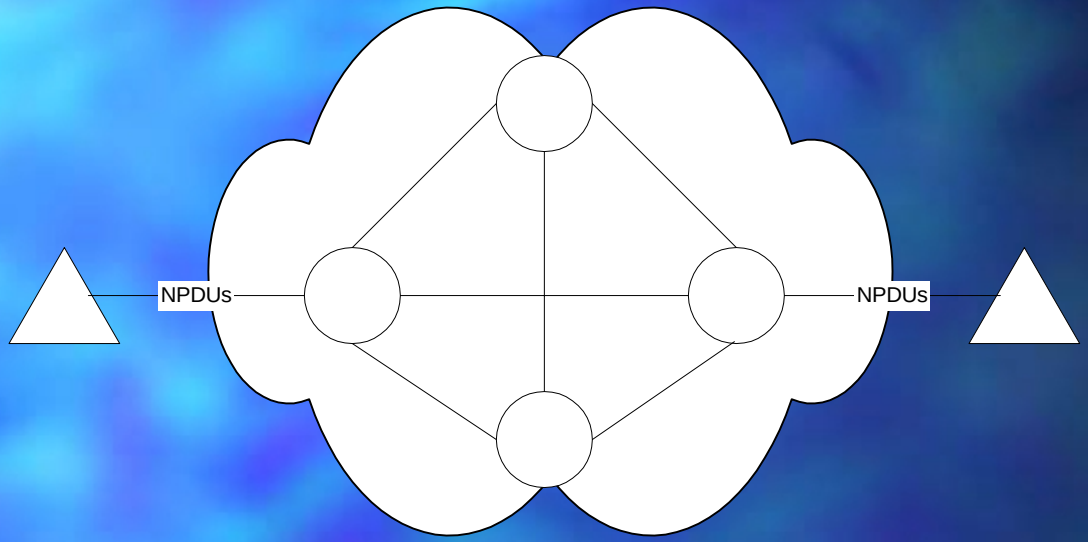
Presentation Overview

- **Routing Protocol Technology**
  - Link State Routing
  - Distance Vector Routing
- **ATN Inter-Domain Routing**
  - Support for Mobility
  - Support for Policy
- **Example of Mobile Routing**
  - Traffic Type Route Selection

Presentation Overview

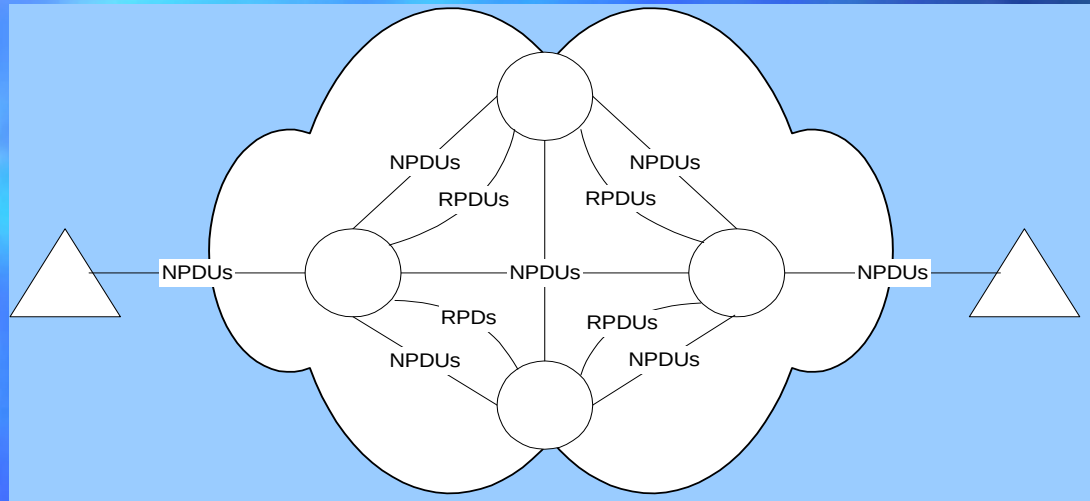
- **Example of Policy Routing**
  - Transit Policies
- **NSAP Addressing**
  - NSAP Address Format
- **Summary**

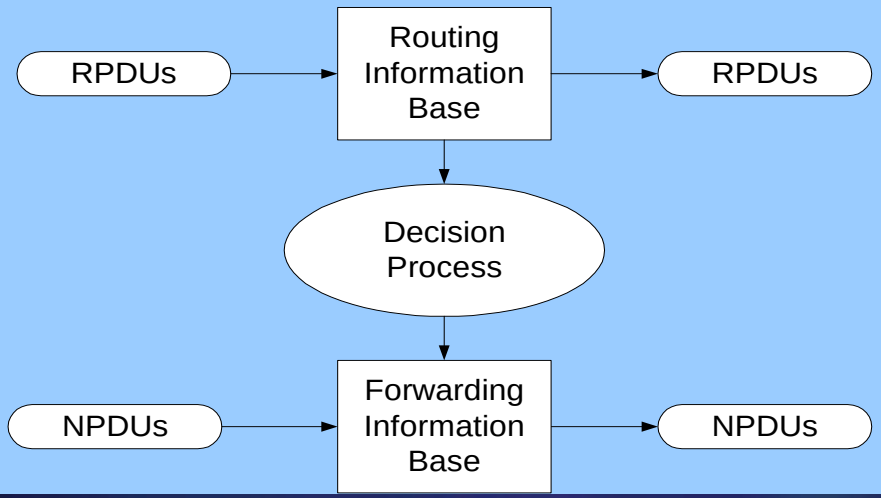
Routing Concepts



- The routing function involves “route maintenance” and “forwarding”
  - Route maintenance refers to update of the Routing Information Base
  - Forwarding refers to the actual relaying of network packets
- Route maintenance may be static or dynamic
- Dynamic routing may be centralized or distributed

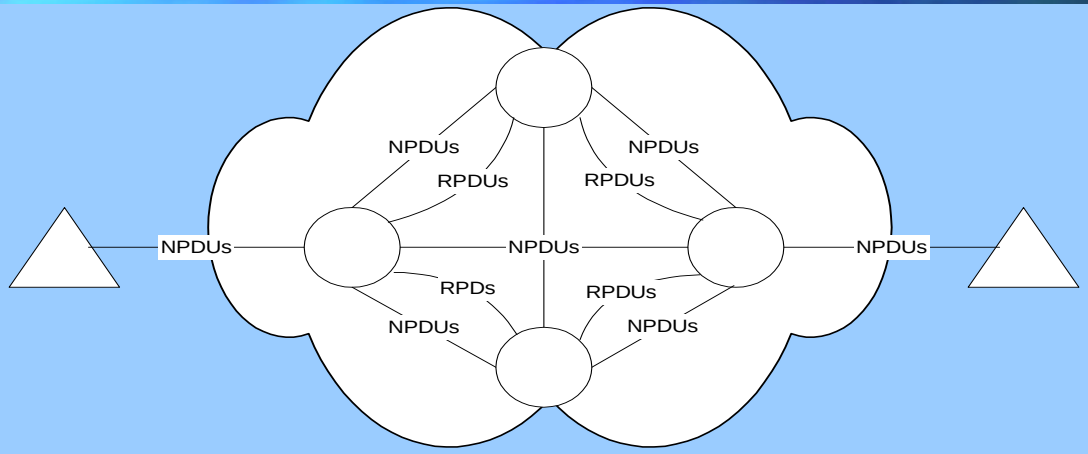
Routing Concepts

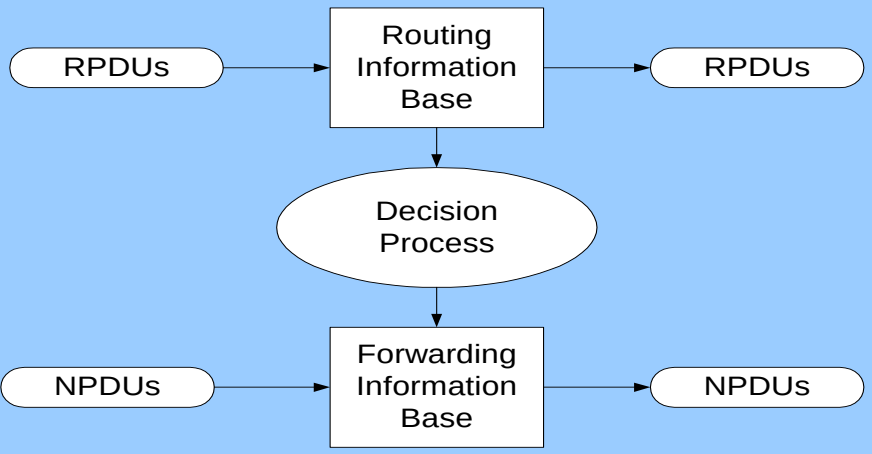


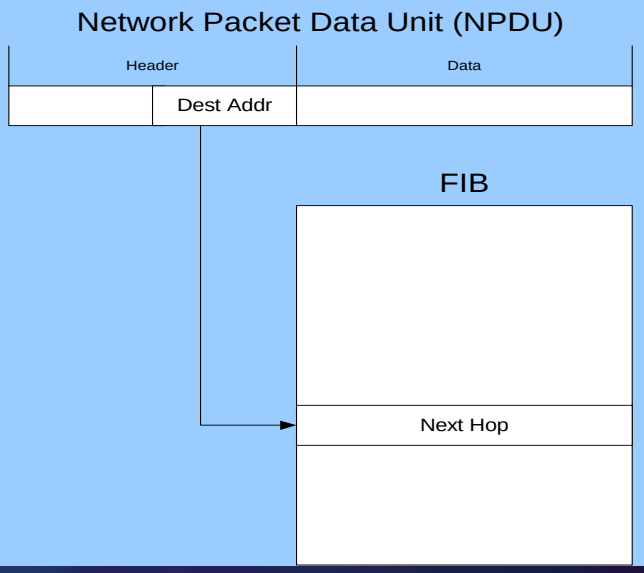


RPDU Routing Packet Data Unit
NPDU Network Packet Data Unit

Routing Concepts





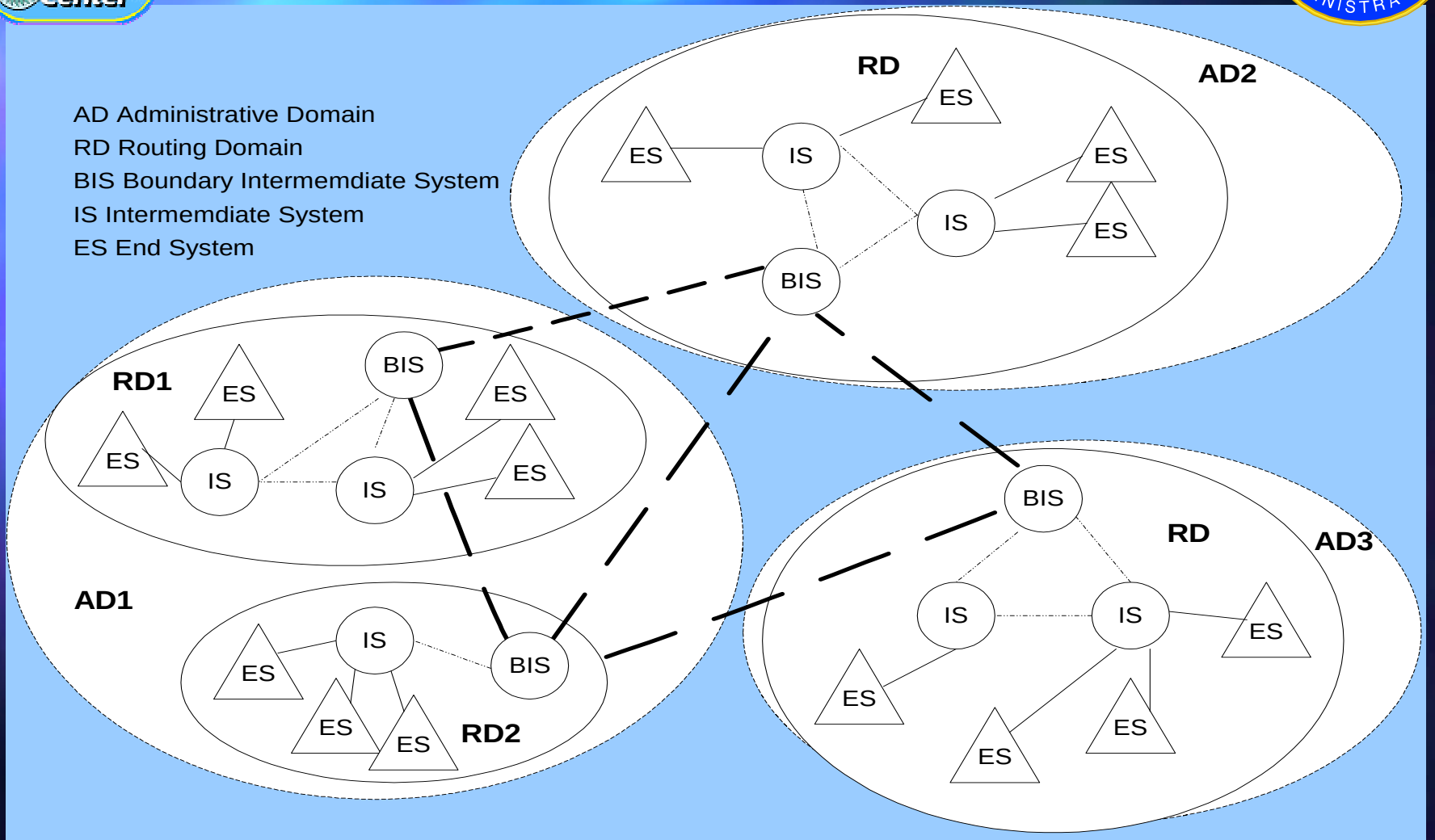


Routing Protocols

- **ES-IS Routing Protocols**
  - Provide means for End Systems to discover Intermediate Systems and vice versa
- **Intra-Domain Routing Protocols**
  - Provide means for Intermediate Systems in a single routing domain to adapt to failures
  - Example: IS-IS
- **Inter-Domain Routing Protocols**
  - Provide means for Boundary Intermediate Systems to route across routing domains in accordance with policy

Routing Protocols

AD Administrative Domain
RD Routing Domain
BIS Boundary Intermemdiate System
IS Intermemdiate System
ES End System



Routing Protocol Technology

- **Link State Routing Protocols**
  - Link State routing procedures involve the broadcast of local information to all routers
    - The routing information base contains a complete “topological map” of the network from which the forwarding information base in computed (using a “shortest path” algorithm)
    - Link State routing is efficient for routing within a single routing domain

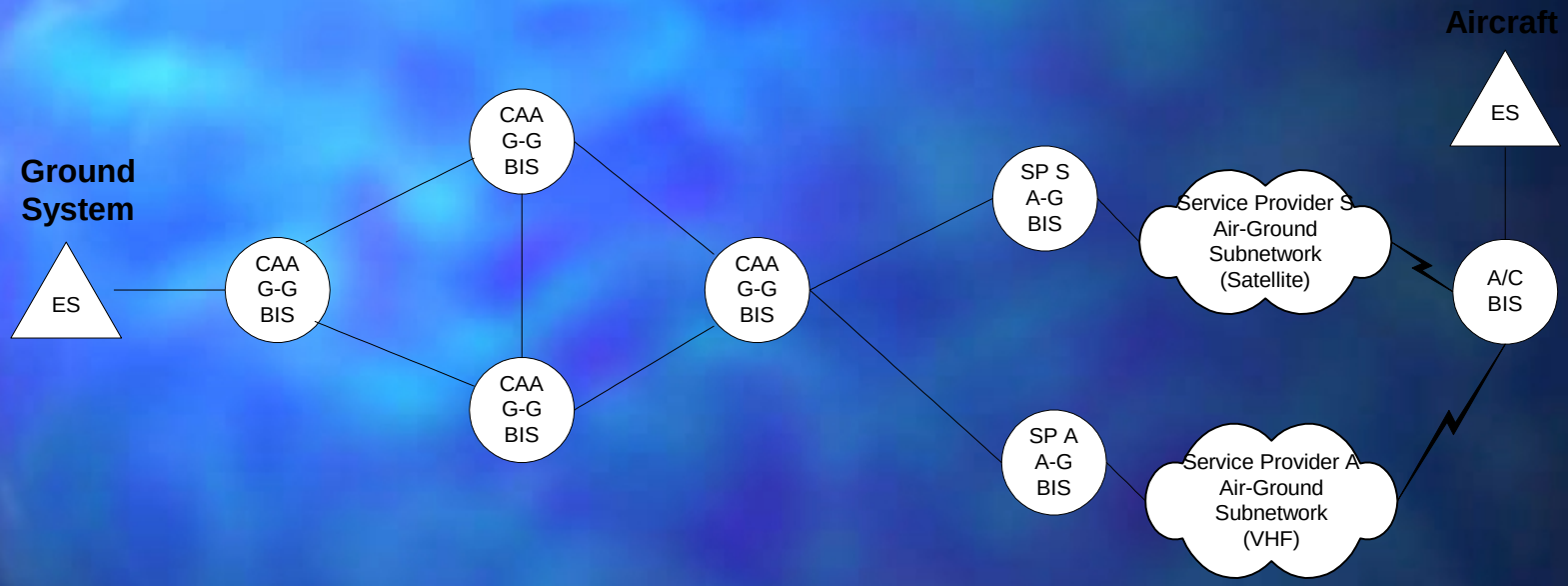
Routing Protocol Technology

- **Distance Vector Routing Protocols**
  - Distance Vector routing procedures involve the propagation of routing information along a “tree” rooted at the source
    - Distance Vector routing permits aggregation of routing information (individual routes do not have to propagate through the entire network)
    - Distance Vector routing permits policy-based routing
      - Transit routers will not propagate a route which they do not wish to support by “selective advertisement of routing information”
    - Distance Vector routing is efficient for routing across domains and administrations

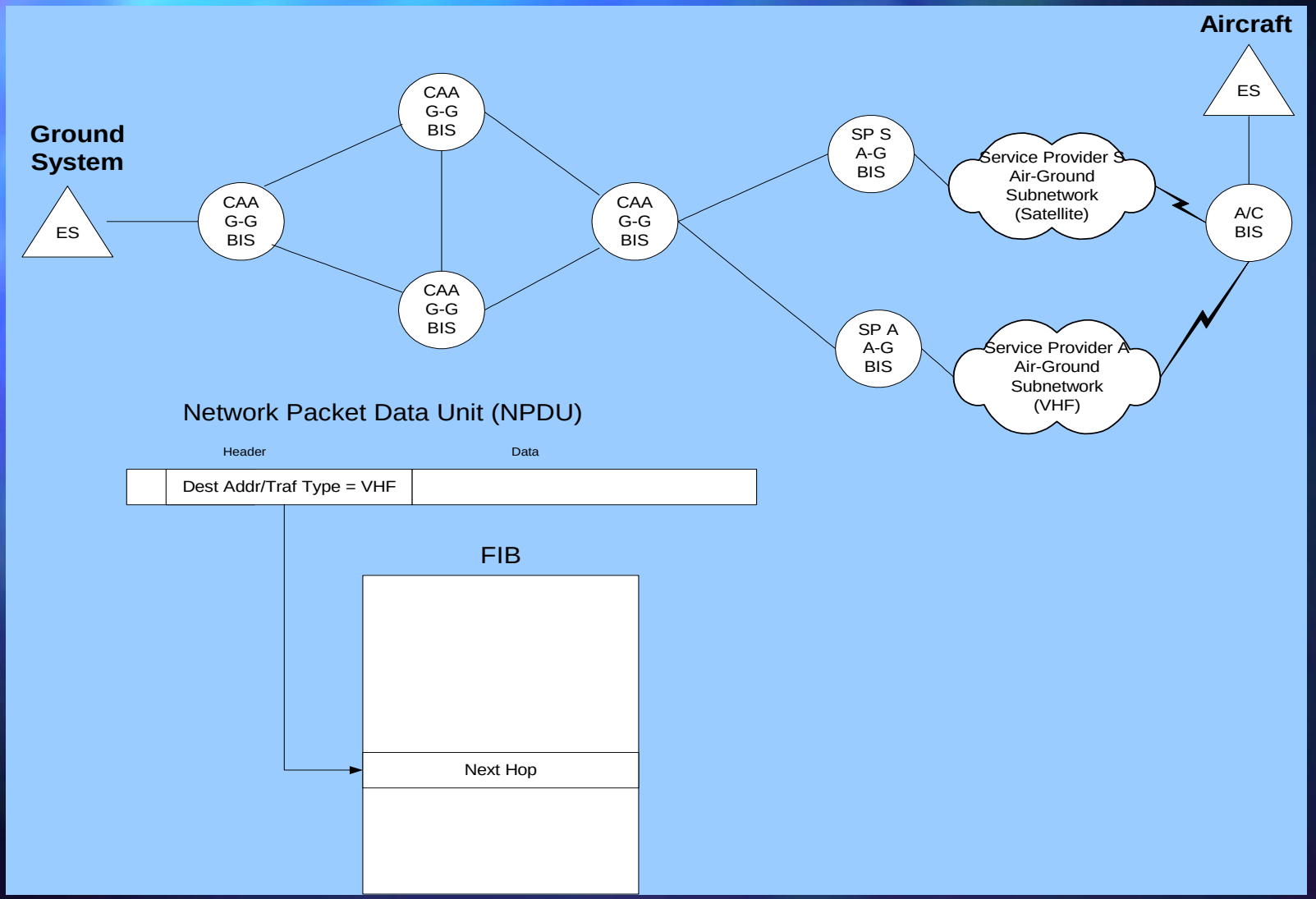
ATN Inter-Domain Routing

- **The ATN used IDRP (ISO/IEC 10747) for Routing**
- **Key Features of ATN Routing**
  - Support for Mobility
  - Support for Policy

Example of Mobile Routing



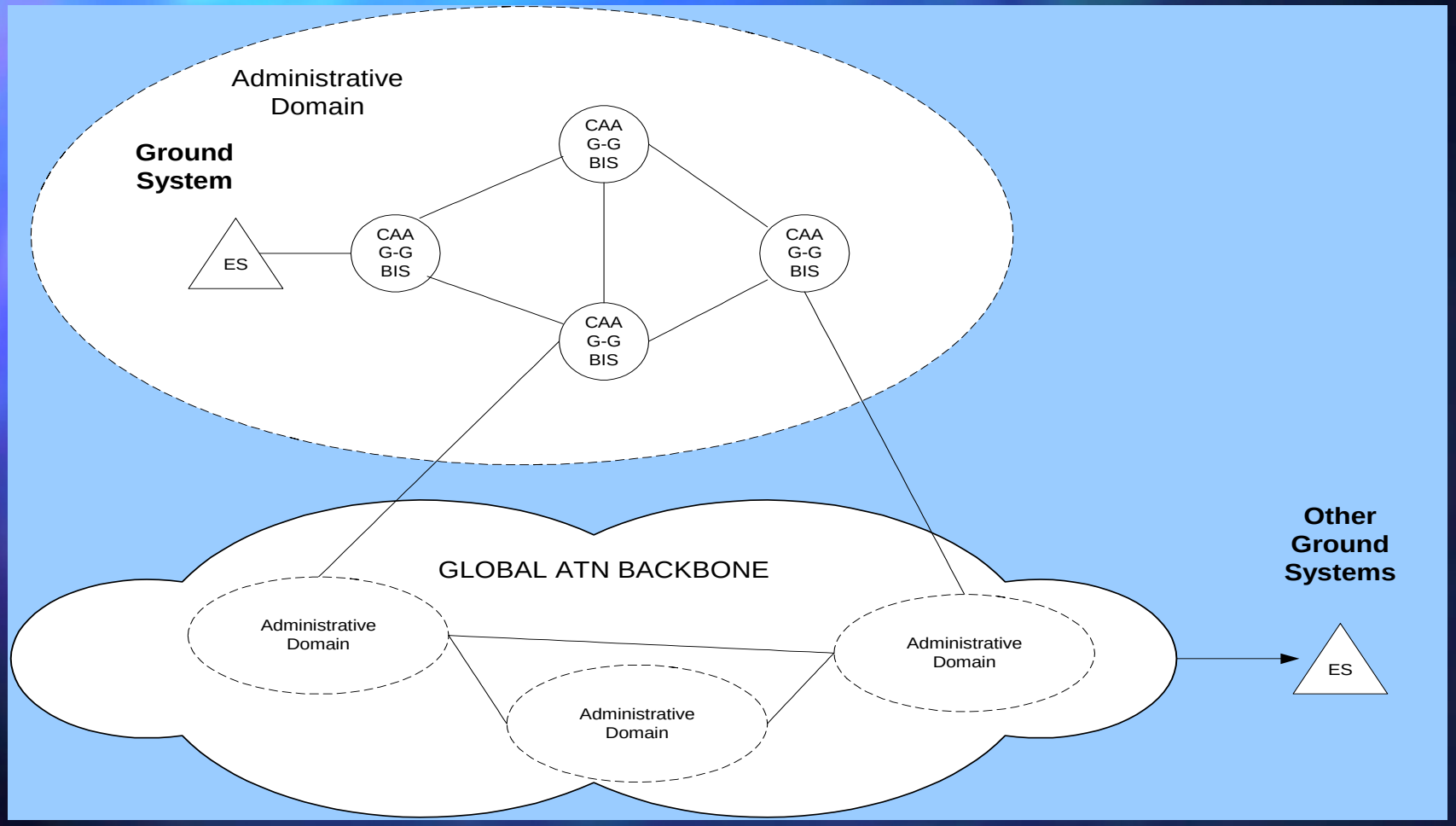
Example of Mobile Routing



Policy-Based Routing

- **IDRP supports policy-based routing**
  - IDRP routers selectively advertise routes which they wish to support
    - The flow of NPDUs in a network is opposite the flow of routing information (RPDUs); thus, controlling the distribution of routing information provides a technique for supporting transit policies
  - From ISO/IEC TR 9795
    - "Routing procedures between Administrative Domains should maintain an "arms-length" relationship"
    - "Organizations operating administrative domains should be able to control the amount and kind of information which enters or leaves their administrative boundaries while still providing and receiving some minimum routing capability

Example of Policy Routing



NSAP Addressing

General ATN Address Format

- Route aggregation is supported by advertising “NSAP address prefixes”
  - Routing policy across administrations is accomplished by advertising prefixes through the ADM field
  - Routing policy with domains is accomplished by advertising prefixes through the ARS field
- The Asia-Pacific Addressing Plan provides options within the ADM and ARS fields to segregate Administrative and Routing Domains and to form Confederations across these domains

Summary

- **ATN Routing uses the IDRP Routing Protocol**
  - IDRP is a distributive adaptive routing protocol which is based the the distance vector technique
    - termed “path vector” because it support multiple metrics
  - IDRP supports mobility by permitting route aggregation and selection of paths to aircraft based on Traffic Type
  - IDRP supports policy-based routing without the attendant requirement for a homogenous policy which must be applied to all routers in the network
    - as would otherwise be required with static or link state adaptive routing