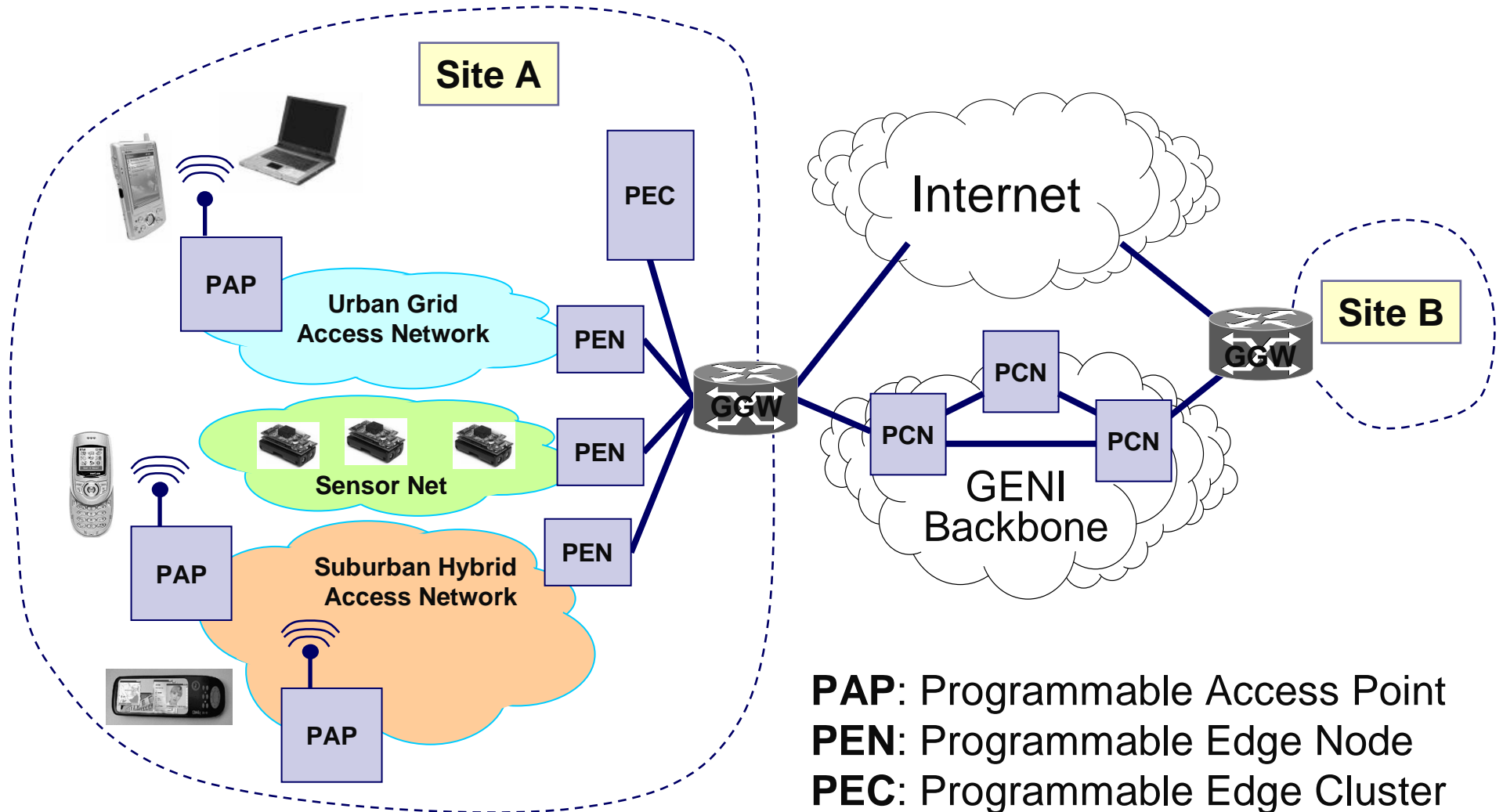




# GENI Wireless Network: Experimental Use Cases

Sanjoy Paul, D. Raychaudhuri  
Wireless Working Group  
[Sanjoy.paul@gmail.com](mailto:Sanjoy.paul@gmail.com)

# GENI Network Architecture



**PAP:** Programmable Access Point  
**PEN:** Programmable Edge Node  
**PEC:** Programmable Edge Cluster  
**PCN:** Programmable Core Node  
**GGW:** GENI Gateway

# Physical Network for Use Case 1: Handoff

Mobile Host (MH)



PAP1



PAP2

PEN1

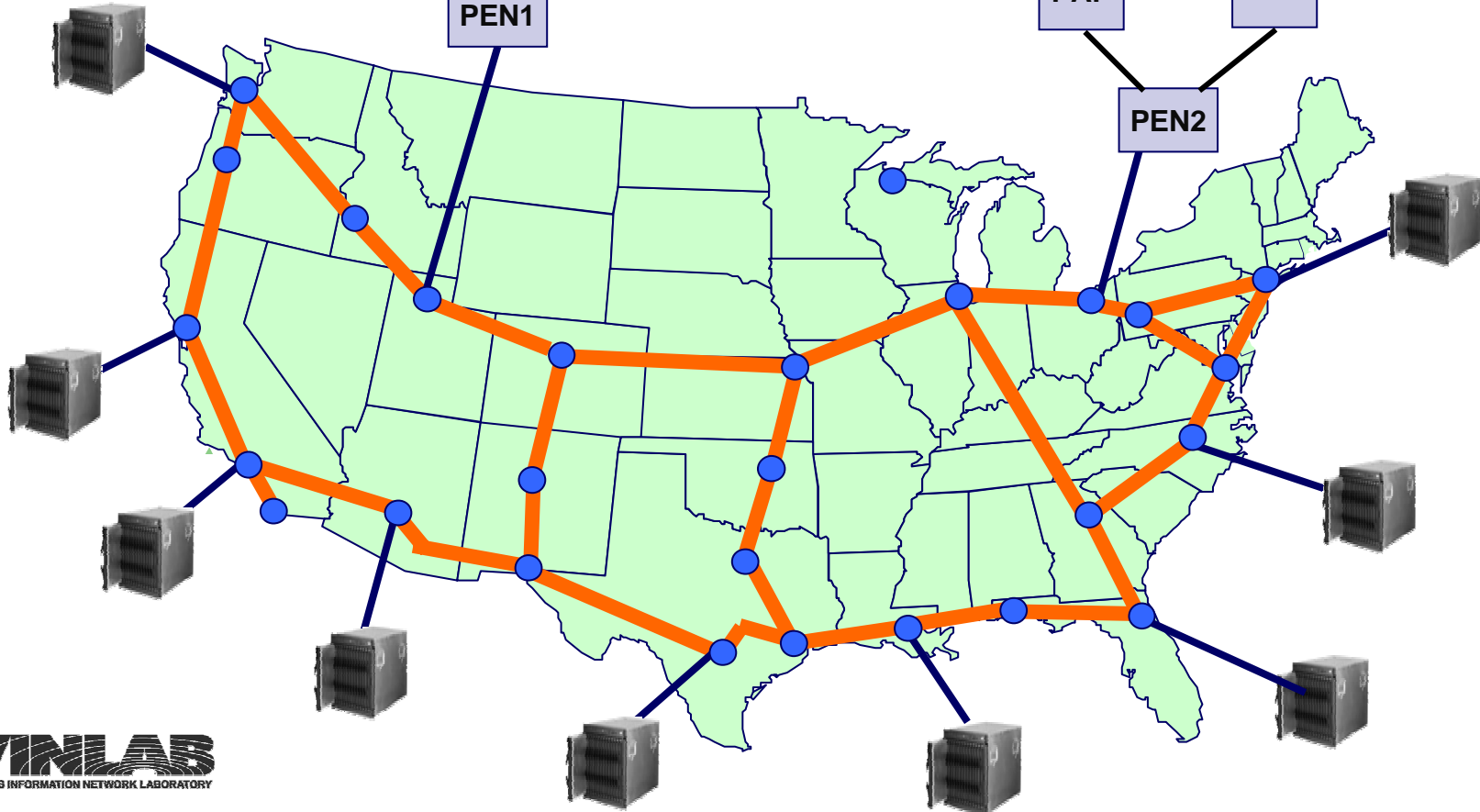


PAPER



PAPER

PEN2



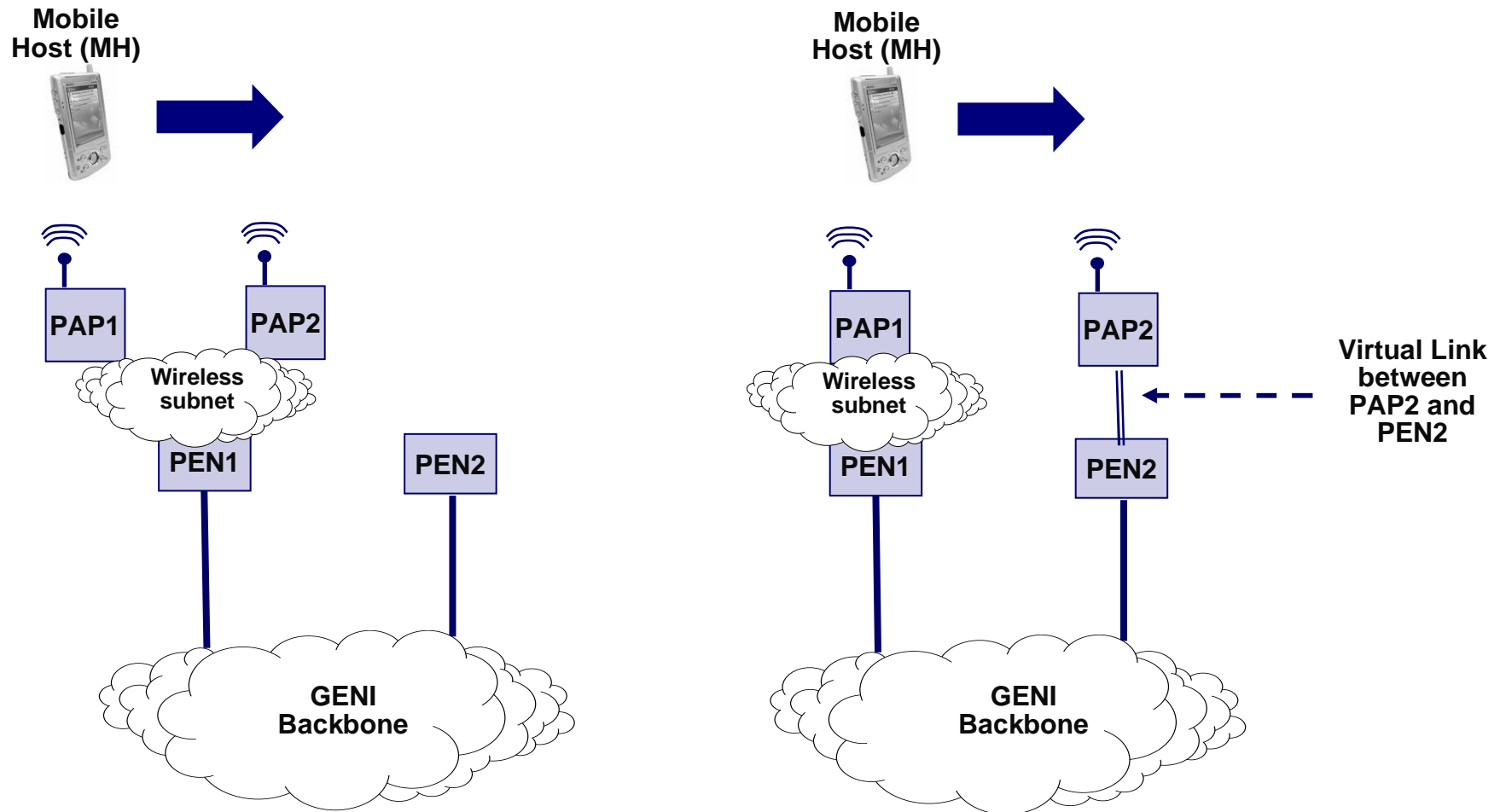
Case-1: Handoff from PAP1 to PAP2 where both PAP1 and PAP2 belong to the same network represented by PEN1.

Case2: Handoff from PAP1 to PAP2 where PAP1 and PAP2 belong to different networks represented by PEN1 and PEN2 respectively.

In this case, PAP2 will be logically attached to PEN2.

NOTE: PEN1 and PEN2 assign IP addresses to Mobile Host (MH)

# Logical Network for Use Case 1: Handoff

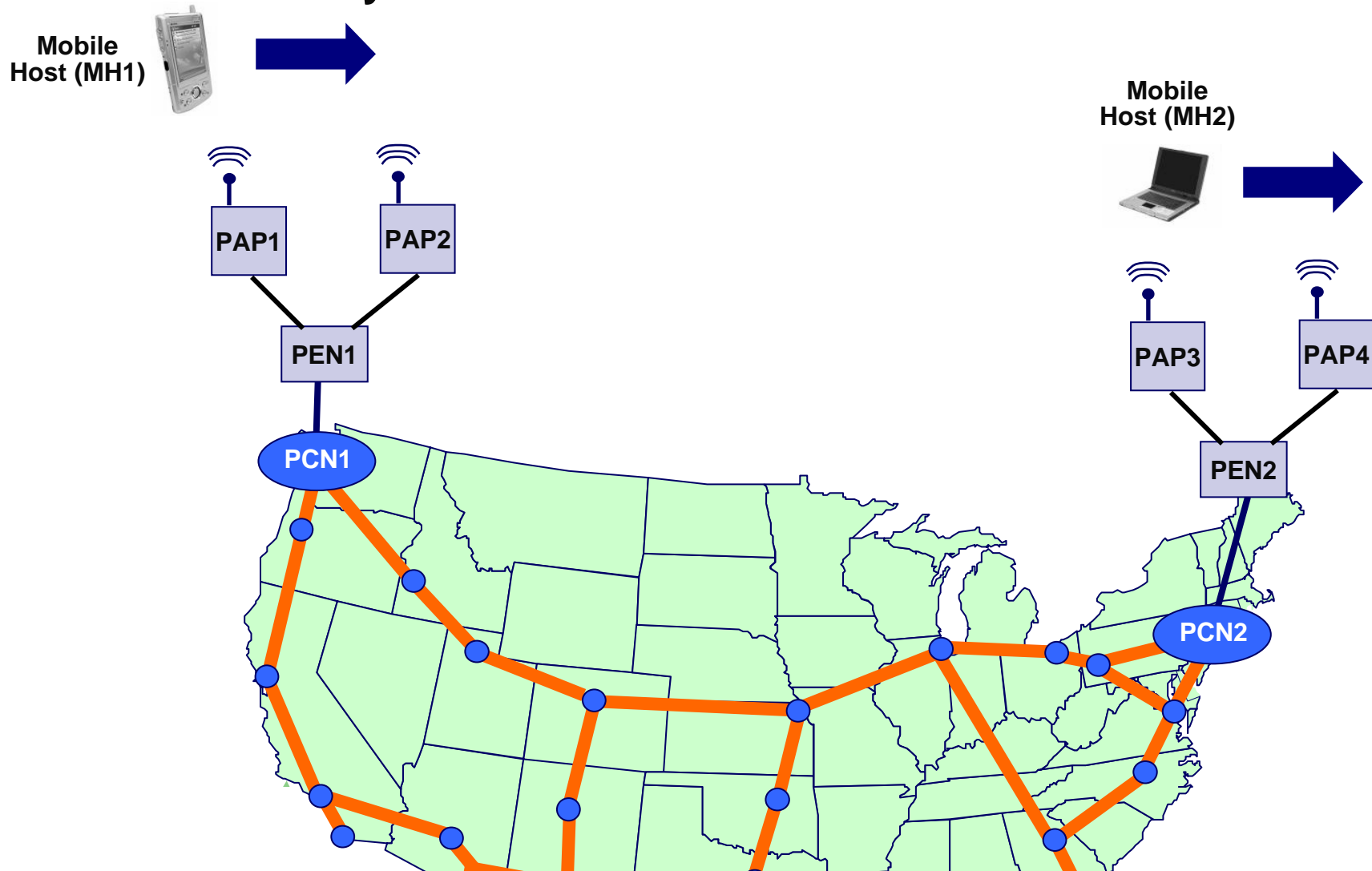


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Case2: Handoff from PAP1 to PAP2 where PAP1 and PAP2 belong to different networks represented by PEN1 and PEN2 respectively.

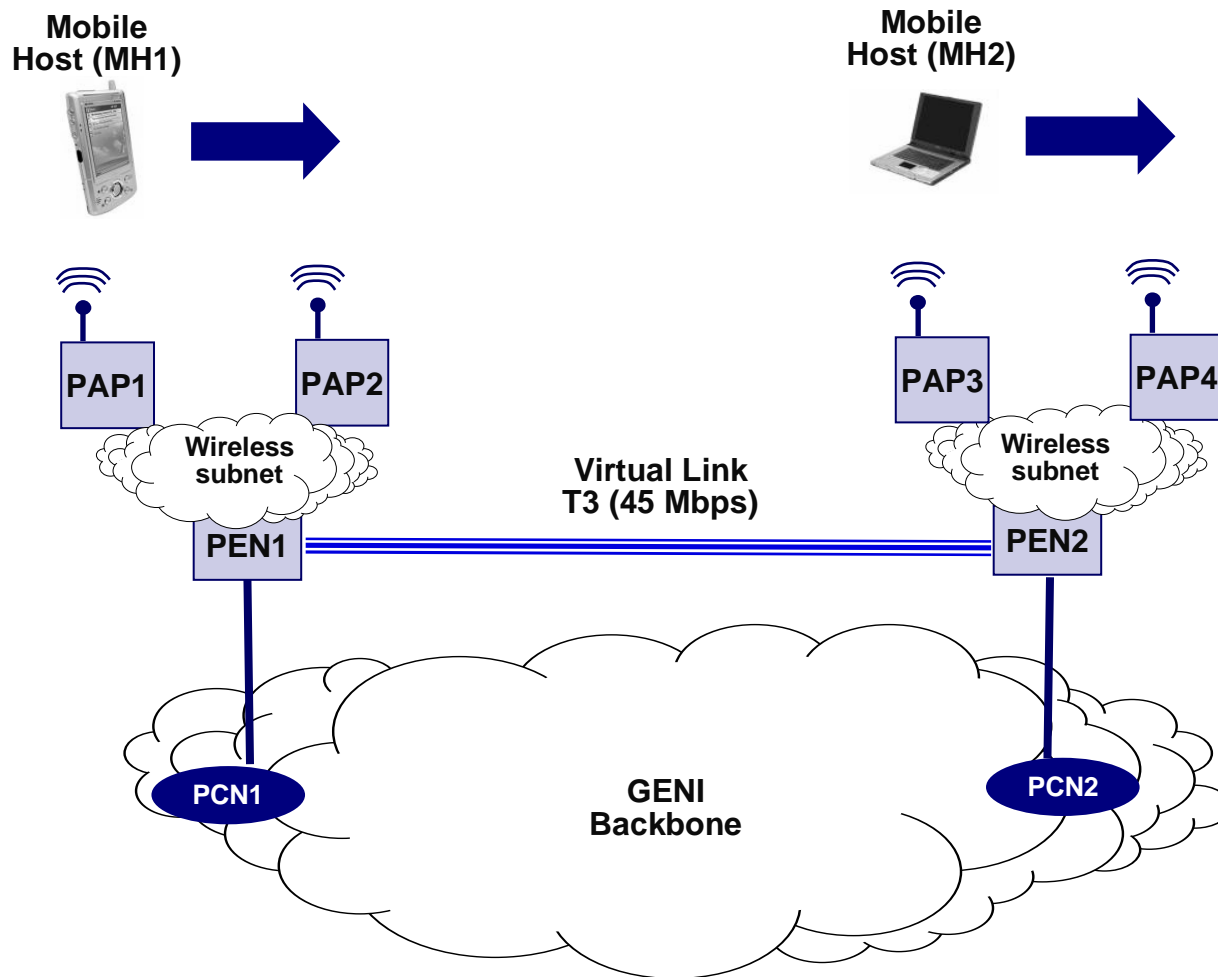
NOTE: PEN1 and PEN2 assign IP addresses to Mobile Host (MH)

# Physical Network for Use Case 2: VoWLAN



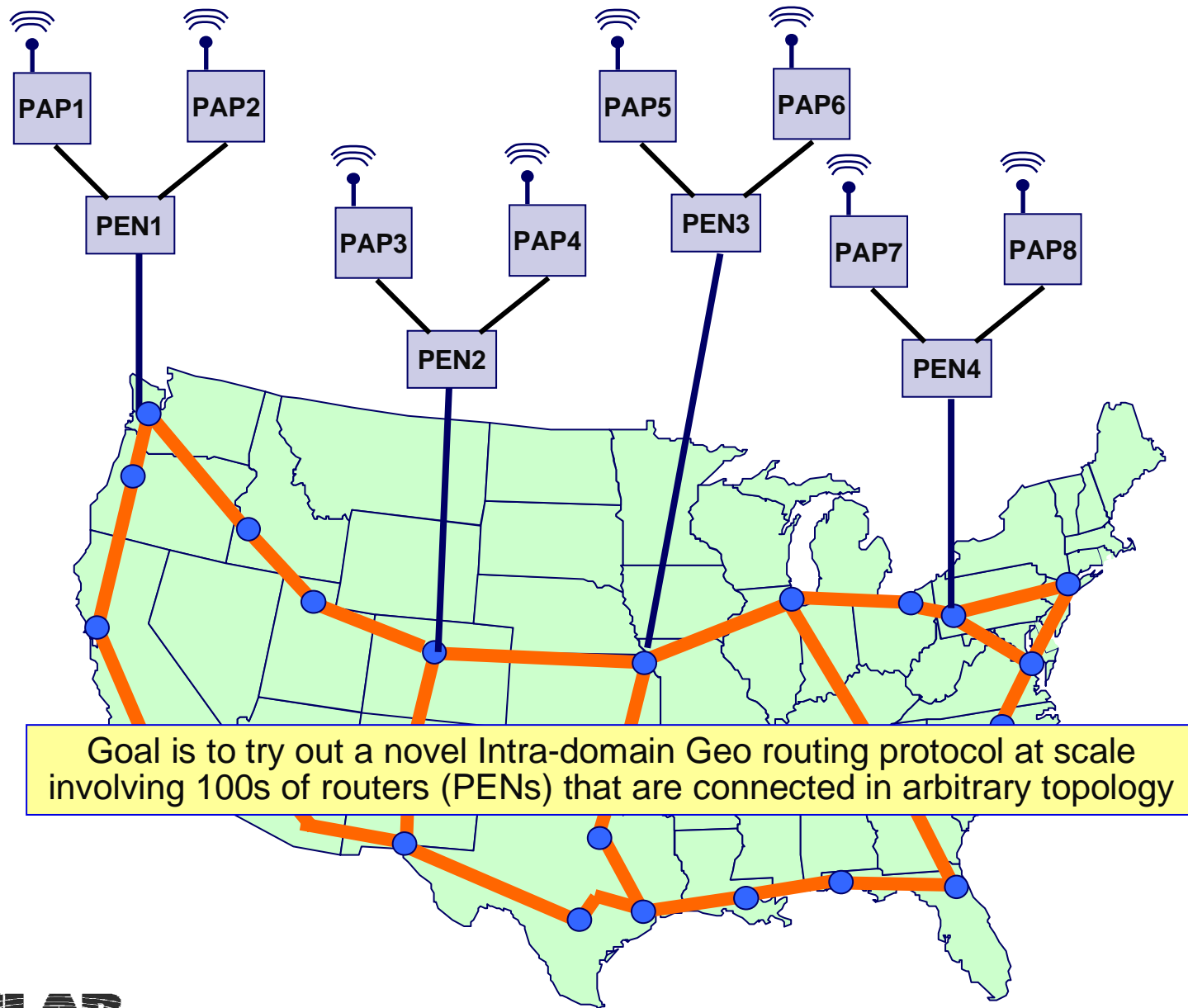
Virtual VoWLAN Service Provider operates only in the East coast and the West coast. The West coast location has edge node PEN1 while East coast location has edge node PEN2. PEN1 and PEN2 are connected respectively to PCN1 and PCN2. VoWLAN's virtual network consists of a logical pipe of bandwidth 45 Mbps between PEN1 and PEN2. Experiment: MH1 talking to MH2 while both are going through handoff in their respective networks.

## Logical Network for Use Case 2: VoWLAN

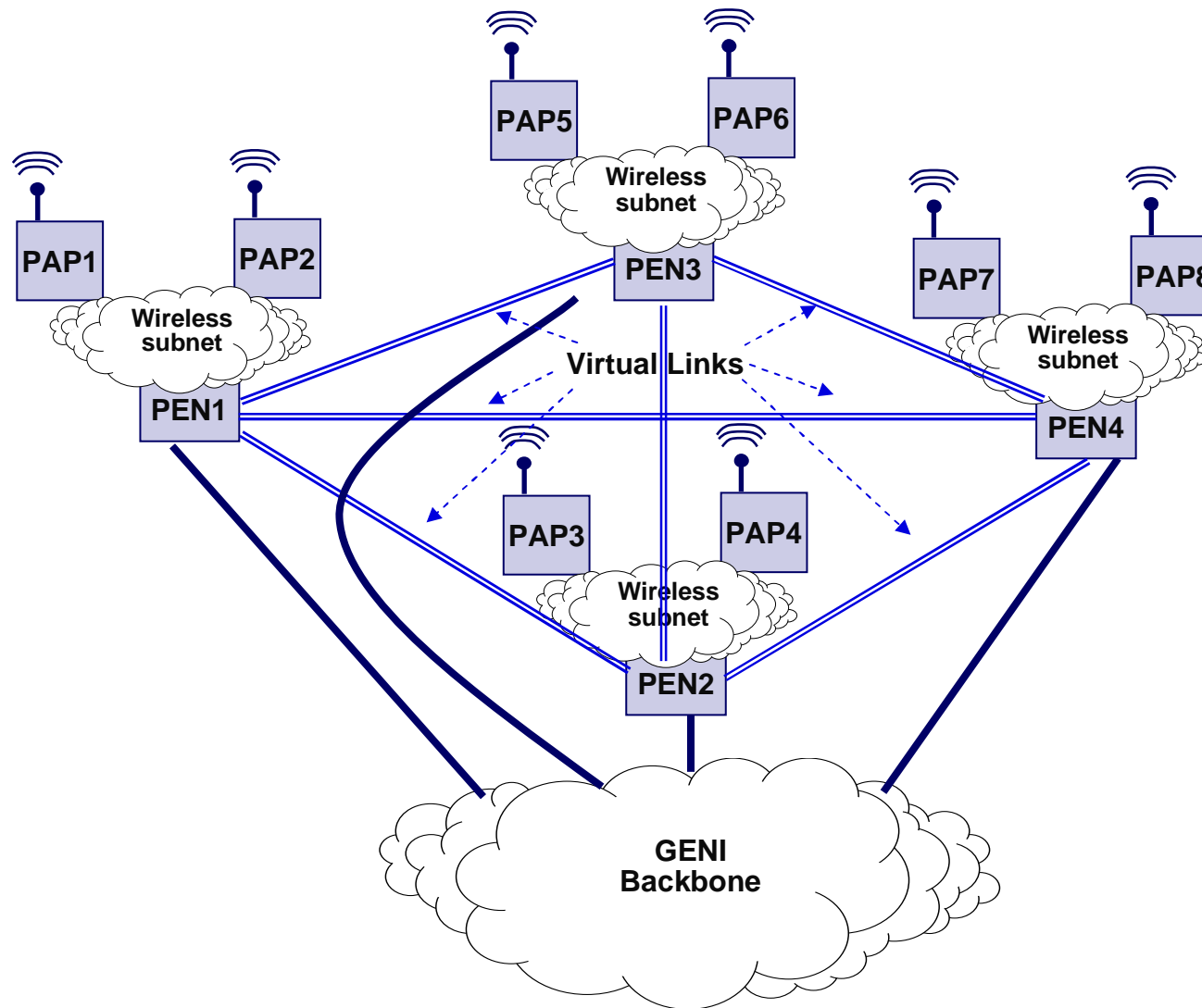


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# Physical Network for Use Case 3: Intra-domain Geo Routing



# Logical Network for Use Case 3: Intra-domain Geo Routing

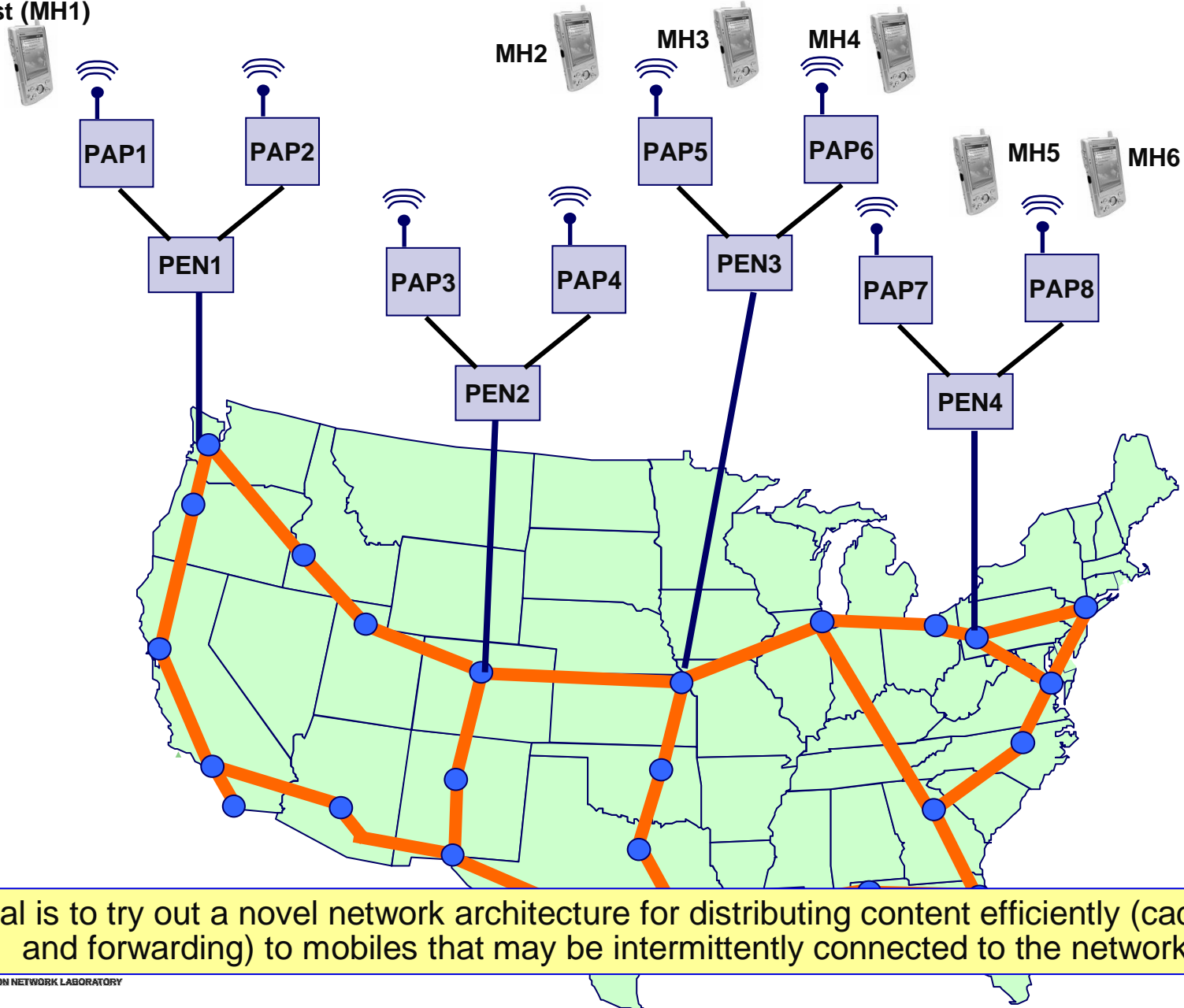


Goal is to try out a novel Intra-domain Geo routing protocol at scale involving 100s of routers (PENs) that are connected in arbitrary topology

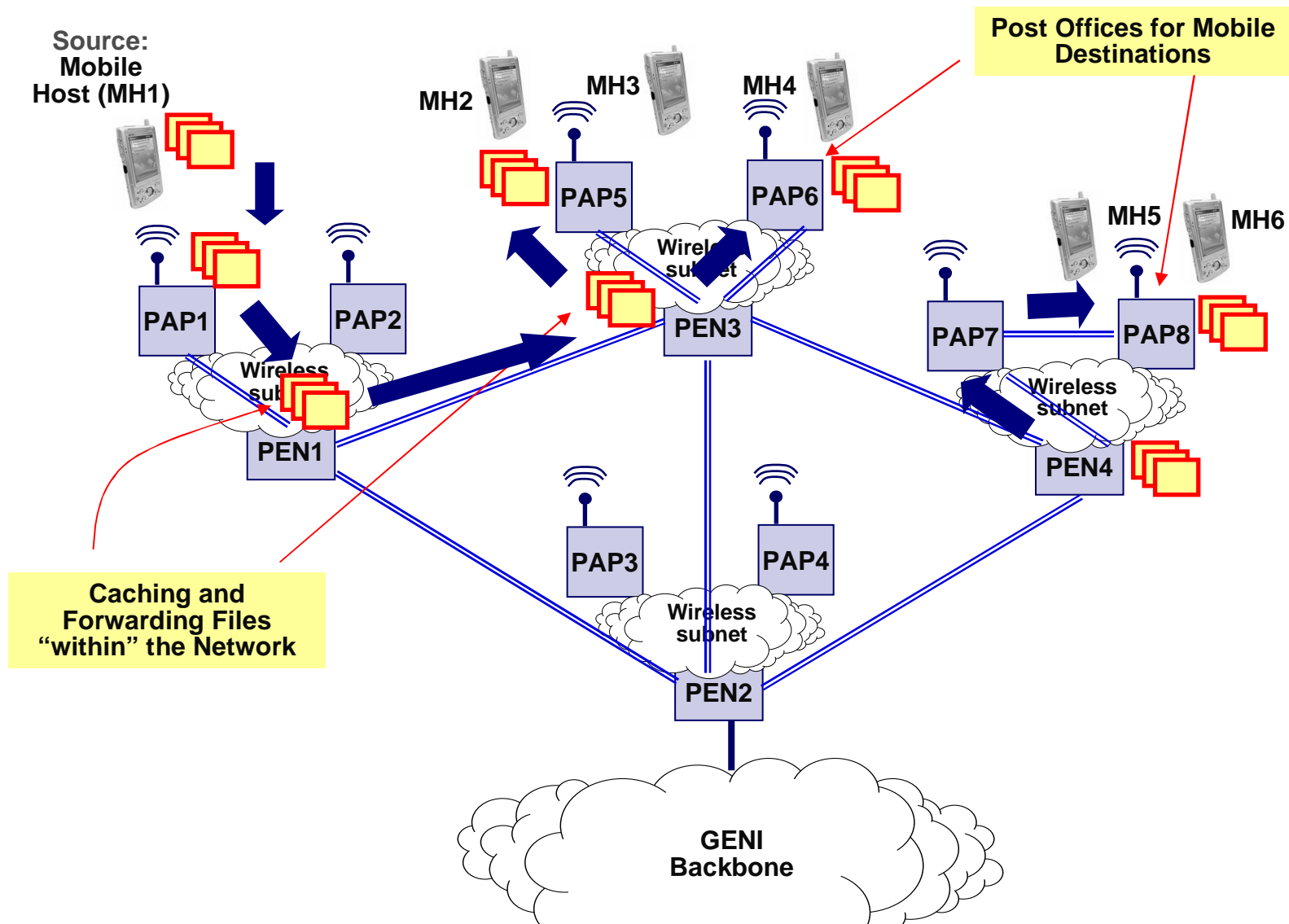


# Physical Network for Use Case 4: Hop-by-Hop Transport

Source:  
Mobile  
Host (MH1)

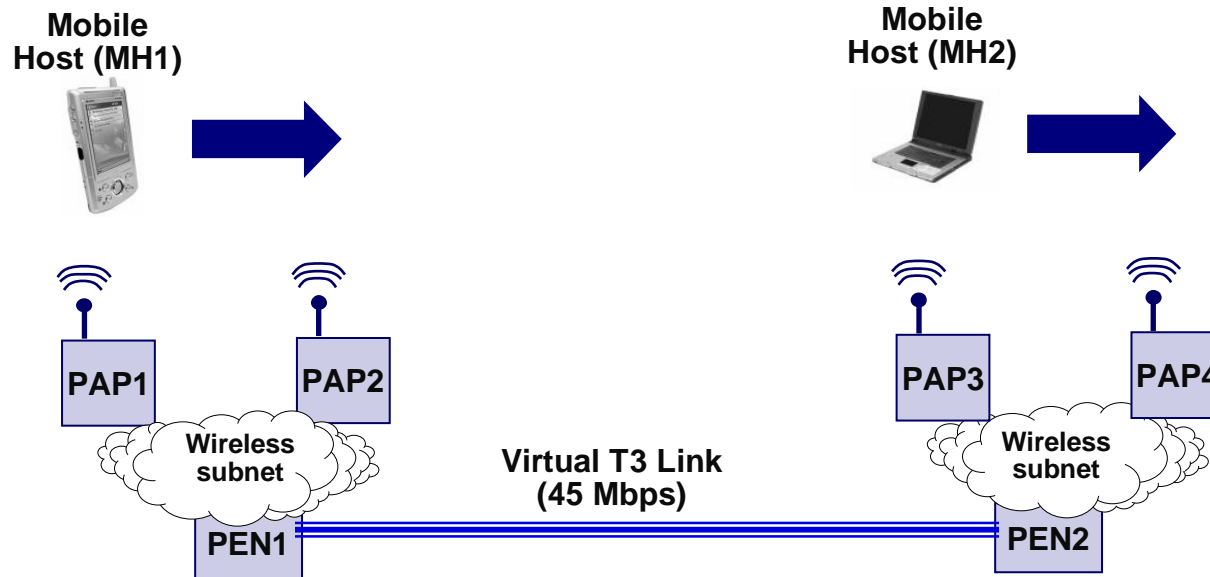


# Logical Network for Use Case 4: Hop-by-Hop Transport



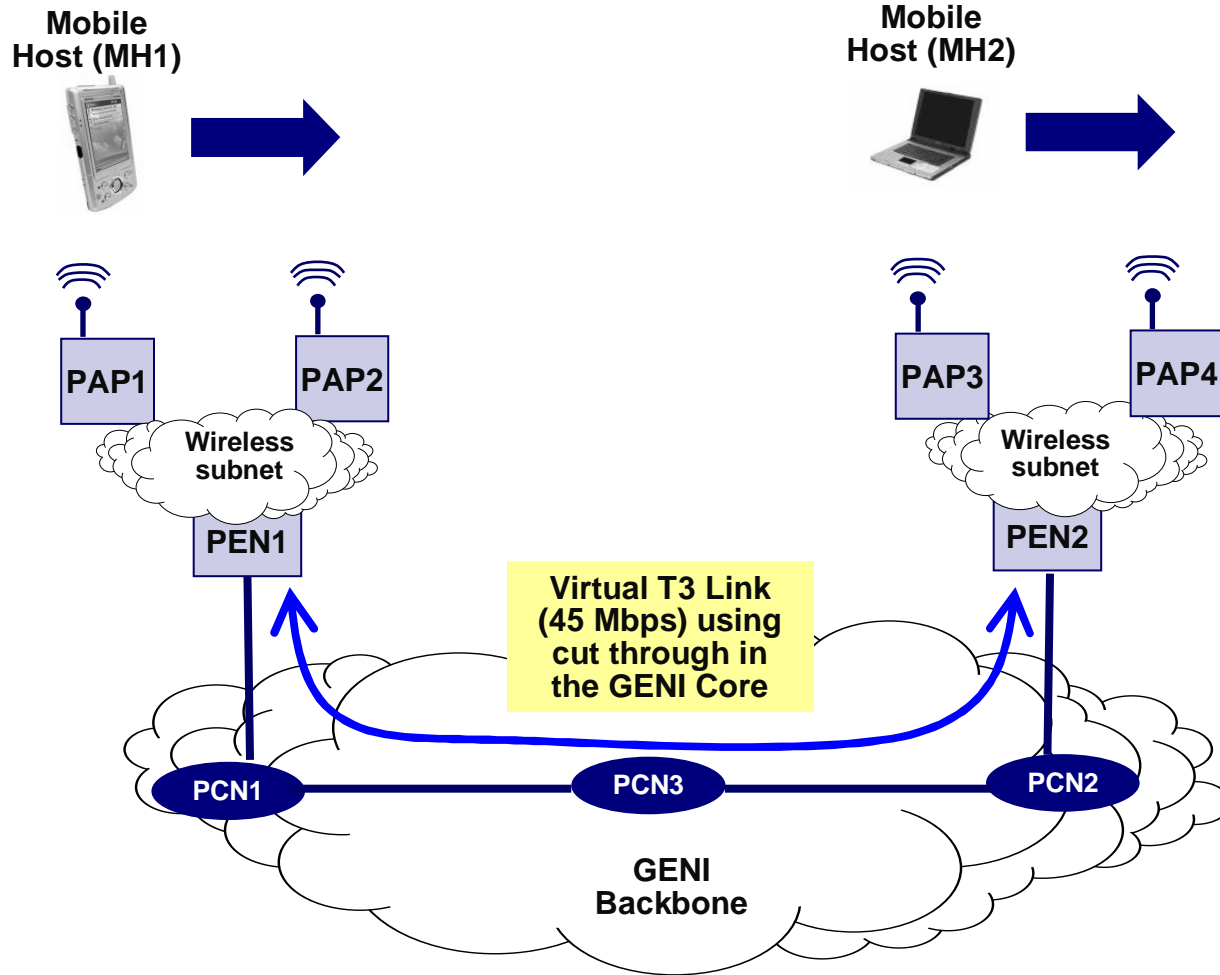
Goal is to try out a novel network architecture for distributing content efficiently (caching and forwarding) to mobiles that may be intermittently connected to the network

# Focus on One Example: VoWLAN



**Virtual link between Programmable Edge Nodes actually traverses a path through the GENI backbone.**

# VoWLAN: Need to set up a Virtual T3 between two PENs



**GENI-created cut-through – no experimenter code on PCNs (?).**

# Steps in Embedding a User-specified Logical Network in the GENI Physical Network

- Experimenter specifies general requirements
  - E.g., nodes, links, bandwidth (logical elements and topology)
  - But not specific node and link choices (logical but not physical)
  
- GENI computes an embedding
  - Identifies suitable physical nodes and links
  - Identifies the right cut-through paths
  
- The GENI elements involved in the embedding need to be configured
  - Admission control
  - Setting up the Forwarding table entries (label switching tables for MPLS, VLAN tag to MPLS labels mapping)
  - Reserving resources (bandwidth, spectrum, time slots, memory, disk, CPU etc.)
  
- GENI management system would have to do monitoring
  - Ensure that the slice does not pump more traffic than it asked for and does not encroach on other slices
  - Monitor for extraneous elements encroaching on the resources of the slice under consideration
  
- GENI would need to collect and process performance metrics
  - Experiment-independent measurements
  - Experiment-specific measurements

# Questions (1 of 2)

- How does experimenter specify Topology for
  - Slices with long-running services (e.g., VoWLAN service provider)
  - Experiments within slices (handoff between PAPs within a wireless subnet, handoff between PAPs between wireless subnets)
  - Experiments outside long-running service slices
- Who computes the embedding and how?
  - And do the admission-control book-keeping?
  - Across all components in the system?
- Who configures resources and how?
  - E.g., setting link-scheduling weights, CPU schedules...
  - E.g., allocating a Network Processor or FPGA
  - Challenges
    - Resources in a graph, not just a path
    - Diverse resources, like CPU, not just link bandwidth
  - Done “top down” by Root GENI Management?
    - Configuring each scheduler?
    - Stitching the pieces together? Creating cut-throughs?
    - When, if ever, does it become “signaling”
    - What kind of encapsulation of the packets

# Questions (2 of 2)

- Isolation (Service Level Agreement) for
  - Slices with long-running services
  - Experiments within slices
  - Experiments outside long-running service slices
- Admission control for
  - Slices with long-running services
  - Experiments within slices
  - Experiments outside long-running service slices
- Discovery for
  - Slices with long-running services
  - Experiments within slices
  - Experiments outside long-running service slices
- Measurements and Monitoring
  - Architecture
  - Storage per node or Centralized storage or Hybrid
  - Monitoring for intrusion
  - GENI-wide service vs. Per-experiment measurement