Scalable Mobility Management using Global Name Resolution Service (GNRS) in MobilityFirst FIA

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Mobility Challenges in Future Internet

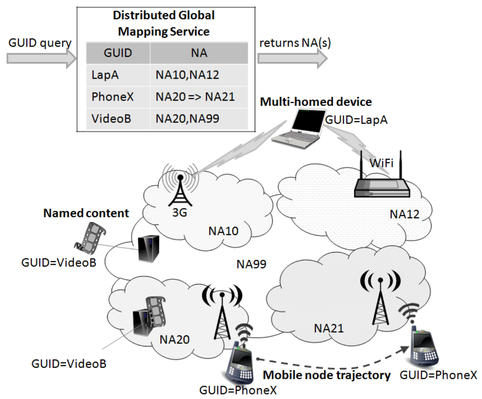
Mobility is a defining characteristic of future Internet

Historic shift in devices connected to Internet from wireline to wireless/mobile

Challenges: Address changes, variable link quality, intermittent disconnections

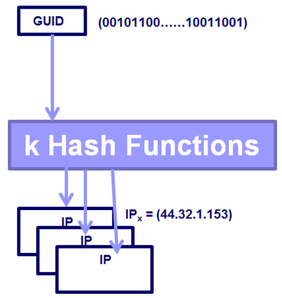
Approach

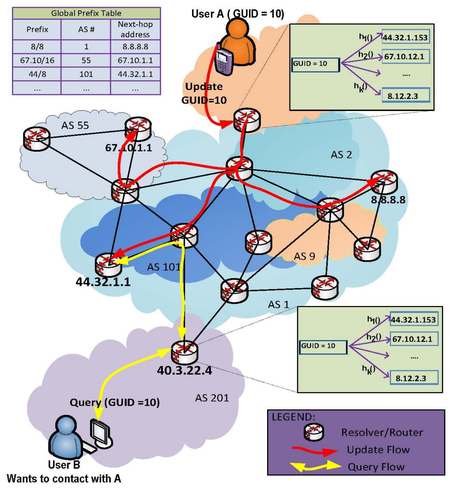
- MobilityFirst employs a clean separation of name and address by assigning a Globally Unique Identifier (GUID) to each network attached object
  - PCs, phones, laptops, content, service, etc., all have a GUID.
- Global directory (GNRS) maintains mapping between GUID and latest Network Address (NA) of object
- Communications target GUIDs and not end-point addresses
  - Dynamic address resolution and storage support within routers effectively handle end-point mobility



DMap: Direct In-Network GUID-to-NA Resolution

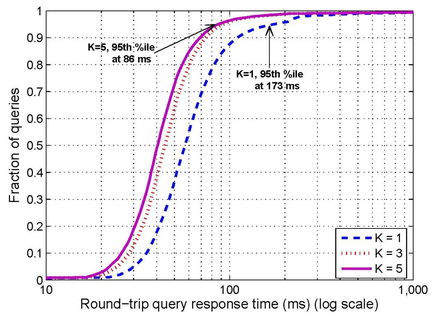
- Resolution servers are co-located with routing elements
- GUID is hashed to network address space (example the IPv4, IPv6 space)
- The <GUID, NA> mapping is stored at server hosted by network that owns the particular portion of address space the GUID hashes to
- Every mapping is replicated at K random Locations
- Queries are serviced from nearest replica





DMap Simulation Results

We are aiming for query response latencies in the range 50-100 ms to be able to handle delay sensitive applications during high mobility



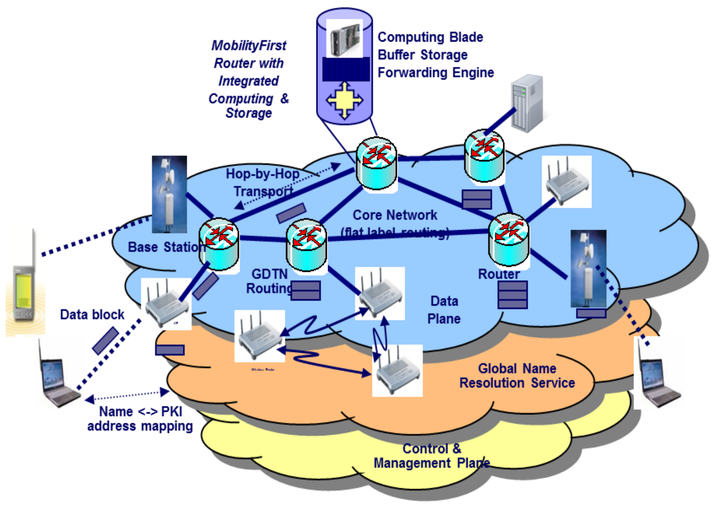
Simulation details:

- DIMES AS-level Internet topology data: 26,424 ASs, 90,267 links
- Routing: Shortest path
- K - number of hash functions, 1-5

K	Round Trip Query Latency (ms)		
	Mean	Median	95th percentile
1	74.5	57.1	172.8
5	49.1	40.5	86.1

Reference:
T. Vu, A. Baid, Y. Zhang, T. D. Nguyen, J. Fukuyama, R. P. Martin, D. Raychaudhuri, "DMap: A Shared Hosting Scheme for Dynamic Identifier to Locator Mappings in the Global Internet ", *Proceedings of IEEE ICDCS 2012*, Macau, June 2012.

MobilityFirst Architecture Overview



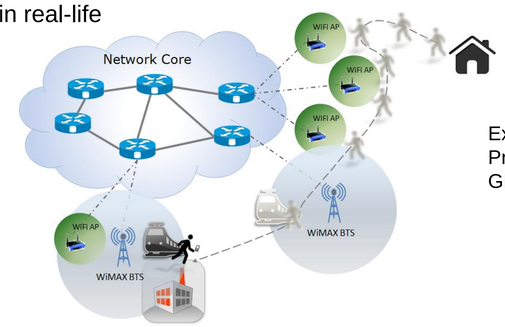
Architecture Highlights:

- Separation of naming & addressing
- Public-key globally unique identifier (GUID) and flat network address (NA)
- Generalized Storage-aware (GSTAR) routing
- Multicast, multipath, anycast services
- Flexible inter-domain boundaries and aggregation level
- Early binding/late binding options
- Hop-by-hop (segmented) transport
- Support for content & context
- Strong security and privacy model
- Separate mgmt & computing layers

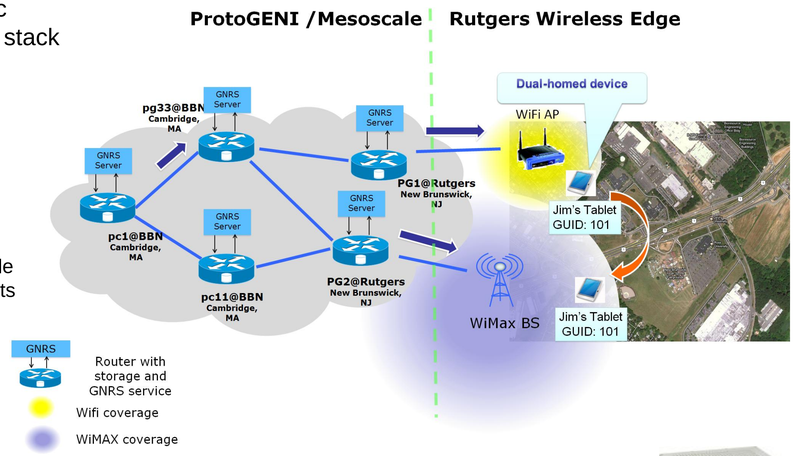
GNRS/MobilityFirst Evaluation on GENI with Device Mobility

Aside from mapping GNRS server instances to physical hosts on GENI, realistic evaluation require modeling end-user/client-device mobility with entire software stack

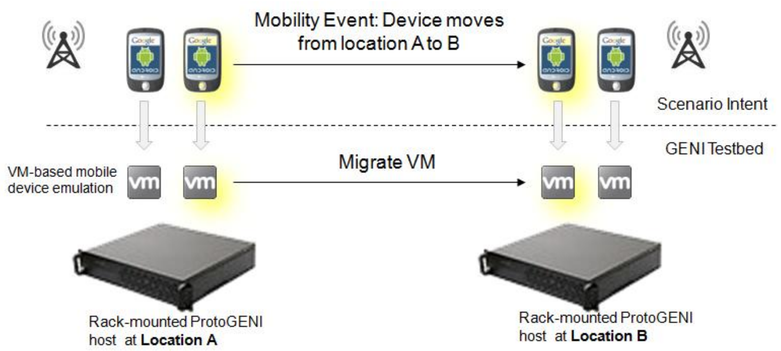
Scenario below shows multiple and varied network associations a mobile user encounters in real-life



Example mapping onto ProtoGENI and Mesoscale GENI testbed deployments



Wide-area Mobility Emulation



Local Mobility Emulation

Image courtesy: JFW Industries

Signal strength attenuation - using a RF Transceiver Test System, for example.

Our demonstration uses a 9-port RF test matrix, connecting 8 nodes on SB4 testbed of ORBIT that allows for attenuation between 0-63dB between each port pair

Empirical traces of signal strength variation between device and access points and BTSs can be captured and replayed by varying attenuation levels on the testbed.

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