Motion-Triggered Surveillance Camera using MF-IoT

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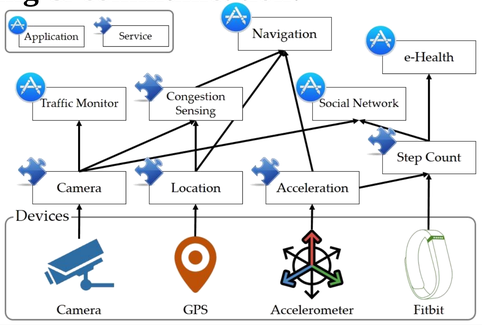
Motivation

Rapid growth in IoT deployment posed unprecedented challenges to the underling network

- **Global reachability:**
  - Allow devices to be identified and located from anywhere
- **Mobility:**
  - Provide seamless connection when devices are mobile
- **Resource heterogeneity:**
  - Support IoT devices with different resource constraints
- **Diverse communication patterns:**
  - Provide efficient support for query/response, publish/subscribe (pub/sub), multicast, anycast, etc.
- **Service-oriented naming & communication:**
  - Allow users/applications address "services" rather than the location of the devices
  - Example:

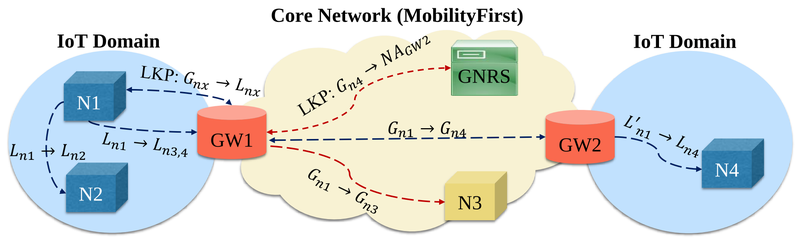
    Devices provide services that can be consumed by applications or other services



MobilityFirst-IoT

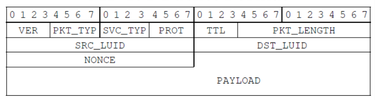
MF-IoT [2] extends MobilityFirst to low-end devices

- **GUID-based communication in the application layer:**
  - Every entity, including (services on) IoT devices, use GUID to address each other



- **Highly efficient communication in IoT domains:**
  - IoT devices form domains which connect to the core network via gateways
  - Use Locally Unique Identifiers (LUIDs) to compress packet headers (10 bytes)
  - Transparent translation between LUIDs & GUIDs in the network layer
  - GUID-LUID mapping managed at gateways
  - Efficient support for diverse communication patterns (unicast, multicast, anycast)

MF-IoT Packet Format



Translation Table on GW1

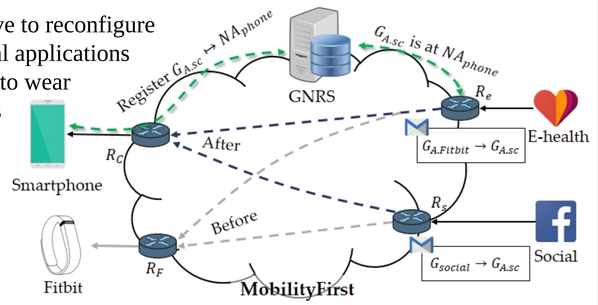
GUID	LUID	Type
G_{n1}	L_{n1}	Local
G_{n2}	L_{n2}	Local
G_{n3}	L_{n3}	Remote
G_{n4}	L_{n4}	Remote

Service-Oriented Communication

MF-IoT treats "services" as first-class citizens

- **Services are seen as network entities:**
  - Each service has a GUID
  - Many-to-many relationship between services and devices
- **Services addressed by their GUIDs:**
  - Applications/services "call" services via their GUIDs
  - Allow multiple instances of a service in the network
- **Benefits:**
  - No need to reconfigure other services when the device that provides a service changes (e.g., service migration)
  - Intrinsic multicast/anycast support
  - Service Chaining: data go through multiple services before consumed
  - Example:

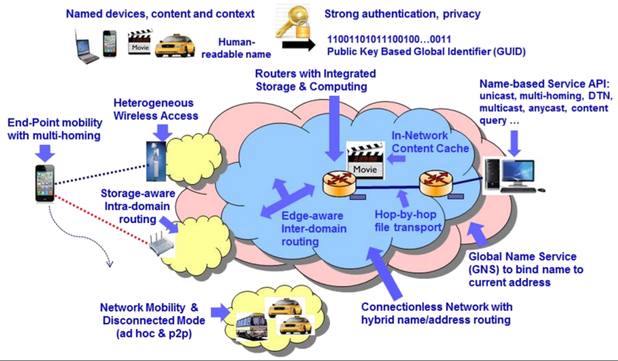
    Alice does not have to reconfigure E-health and social applications when she forgets to wear her Fitbit and uses her smartphone as the step counter



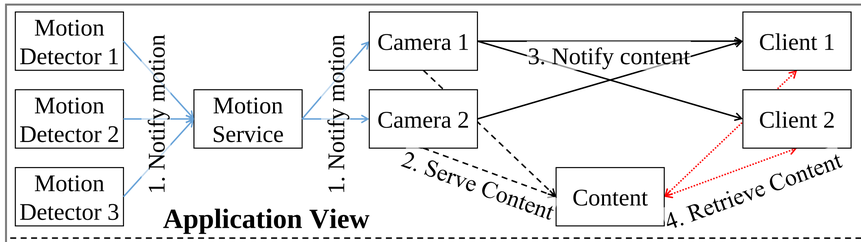
MobilityFirst

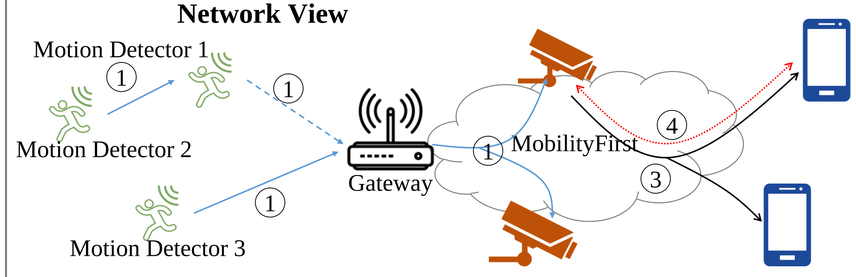
MobilityFirst [1] is a future Internet architecture that supports device mobility & ID-based communication

- **Globally Unique Identifier (GUID):**
  - Public-key-based self-certifying flat names for every entity in the network (e.g., device, service, content, etc.)
- **Global Name Resolution Service (GNRS):**
  - Stores the mapping between GUIDs and network addresses (NAs)
  - Logically-centralized *network layer* function
- **Mobility support:**
  - Routers re-perform GNRS lookup on device move (late-binding)
  - Storage-aware delay tolerant routing based on NAs (GSTAR)



Service-Oriented Comm. in Motion-Triggered Surveillance Camera





Scenario 1: Baseline

- Motion sensors are triggered by movements
- Sensors send notifications to "motion service" which has subscribers Cam 1 & Cam 2
- Cameras prepare video, assign GUID to chunks and notify the new GUID to respective services
- Clients query the video using the content GUID (supports on-demand retrieval)
- MF network forwards the requests to the best source and retrieves the content

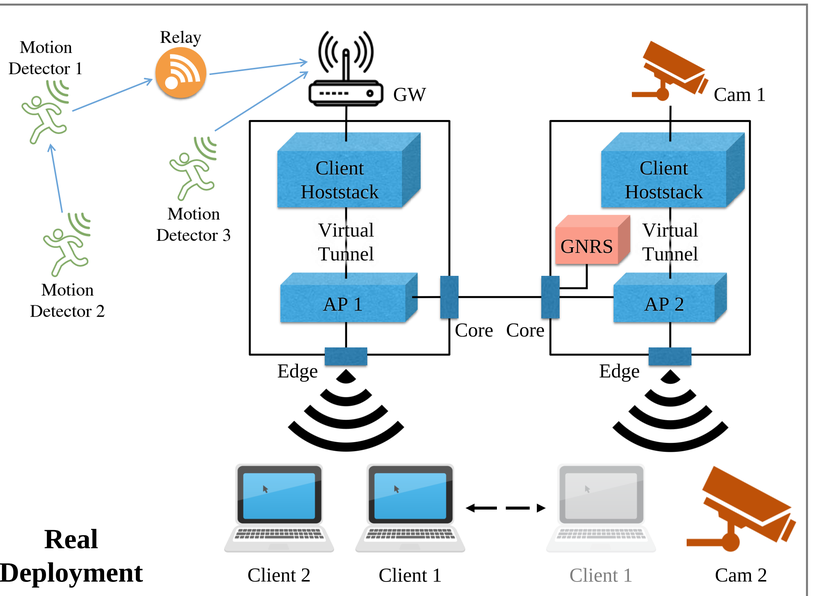
Scenario 2: Mobility

- Client 1 moves between AP1 and AP2
- MF performs late-binding & store-and-forward to ensure reliable delivery

Scenario 3: Service Migration

- Sensors can be added / removed dynamically
- Since applications communicate using service GUIDs, no extra configuration is needed in the whole process

Real Deployment



References:

[1] D. Raychaudhuri, *et al.*, "Mobilityfirst: A Robust and Trustworthy Mobility-Centric Architecture for The Future Internet." SIGMOBILE, pp. 2–13. 2012.

[2] S. Li, *et al.* "MF-IoT: A MobilityFirst-Based Internet of Things Architecture with Global Reach-ability and Communication Diversity." IoTDI. 2016.