

GreenApps: An Off-Grid Cellular Edge Apps Ecosystem

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Cellular Edge Services in Kumawu, Ghana

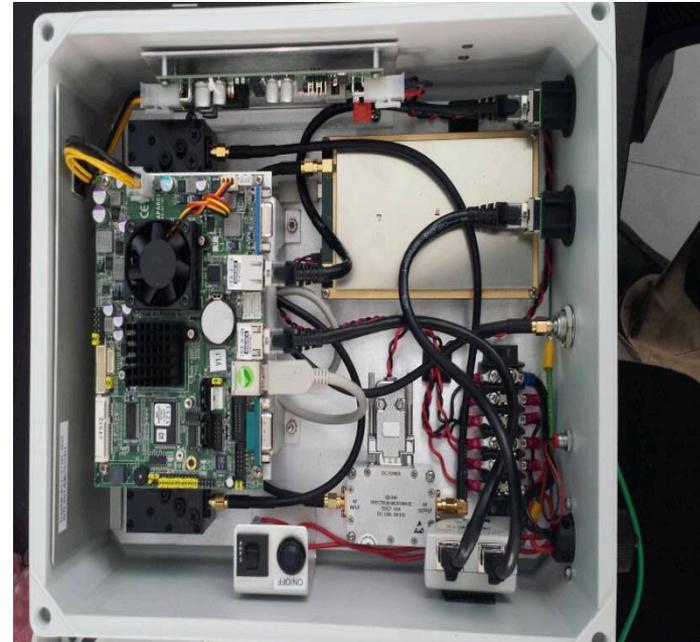


Cellular Edge Services near Pearl Lagoon, Nicaragua

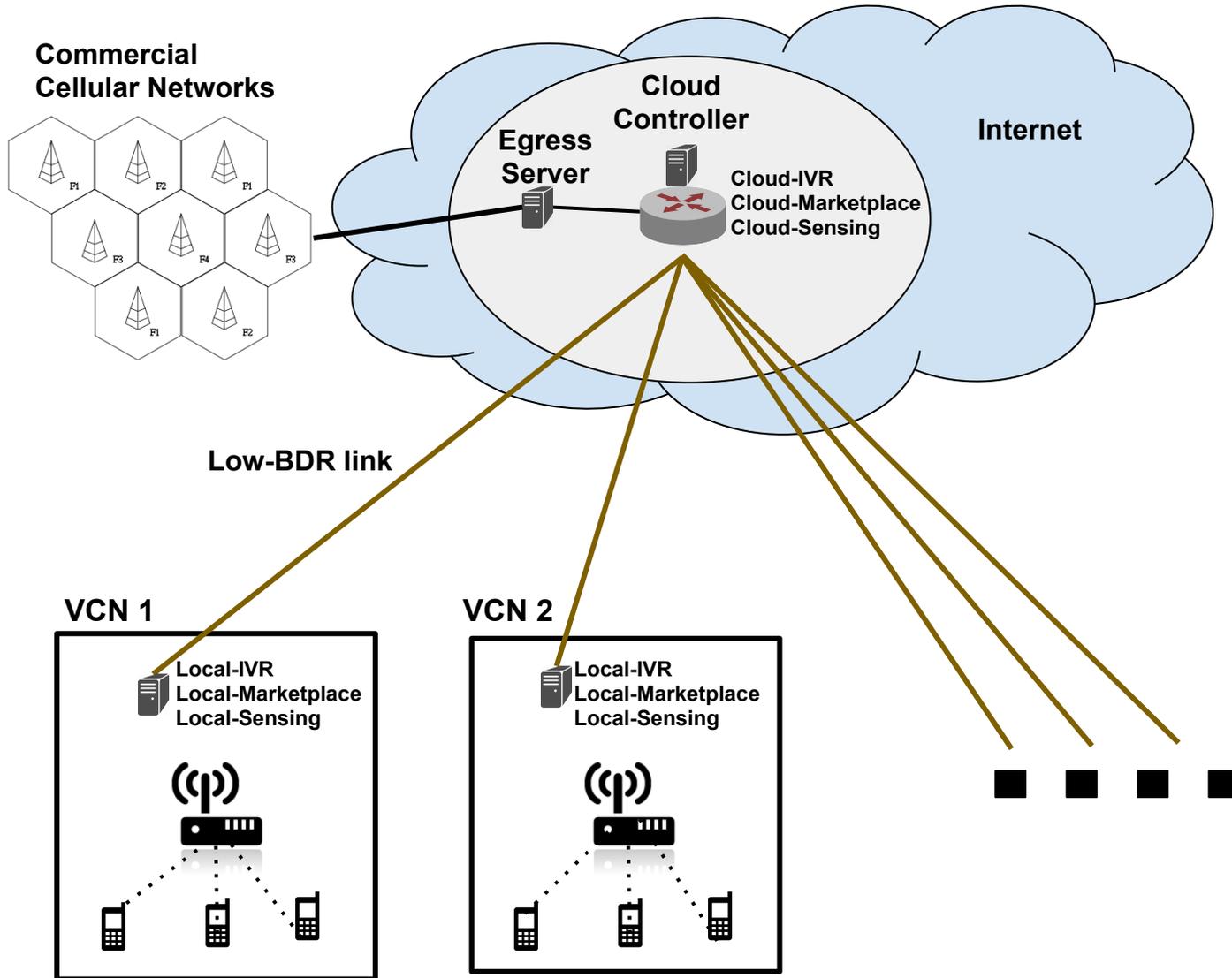


Small Cells

1. Provides basic cellular network functionalities
2. Comparable range
3. Power requirement order of magnitude lower ~ 300 Watts



Virtual Cellular Networks



Solar power – Good for 5kms

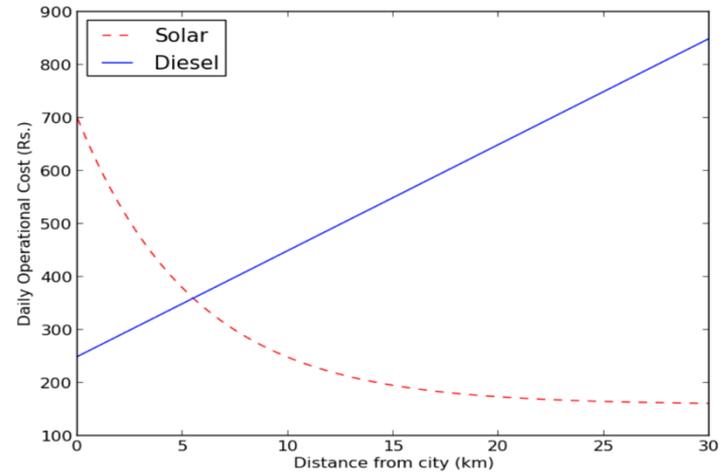
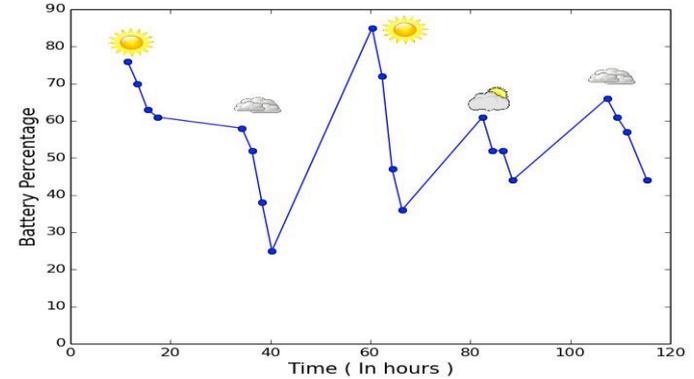
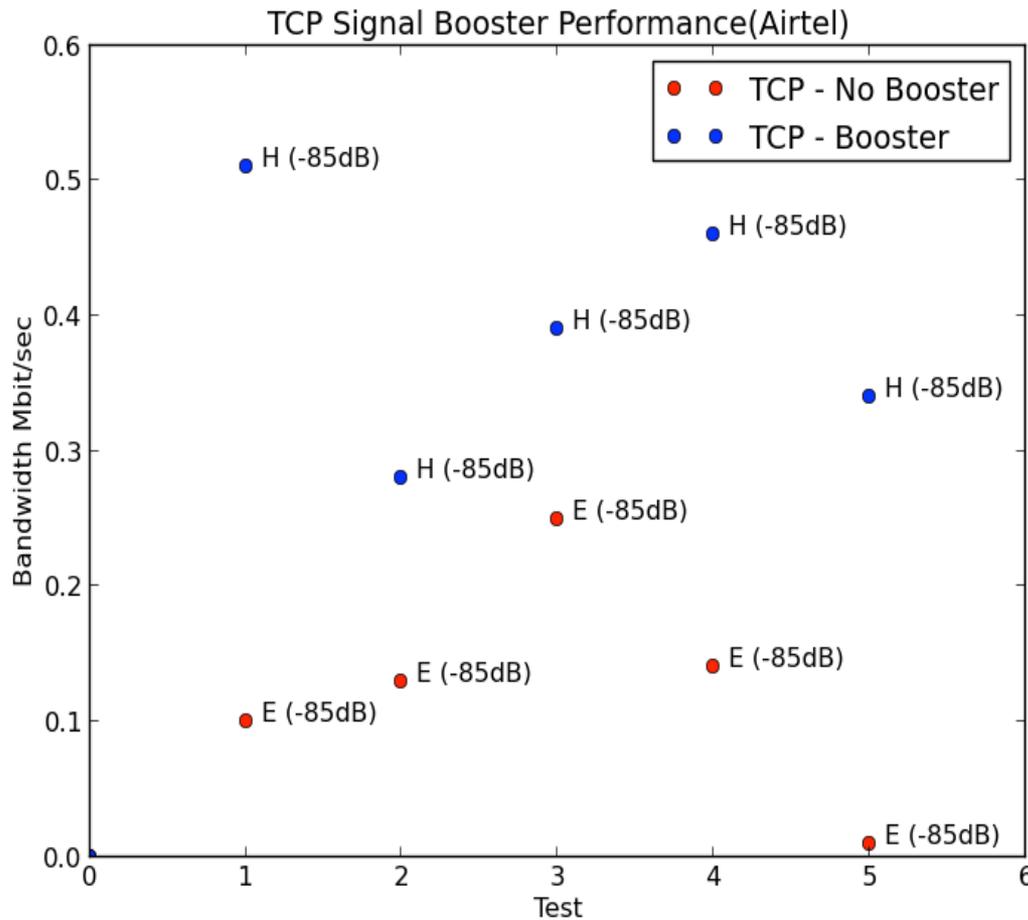


Figure 3: SSC cost vs. diesel

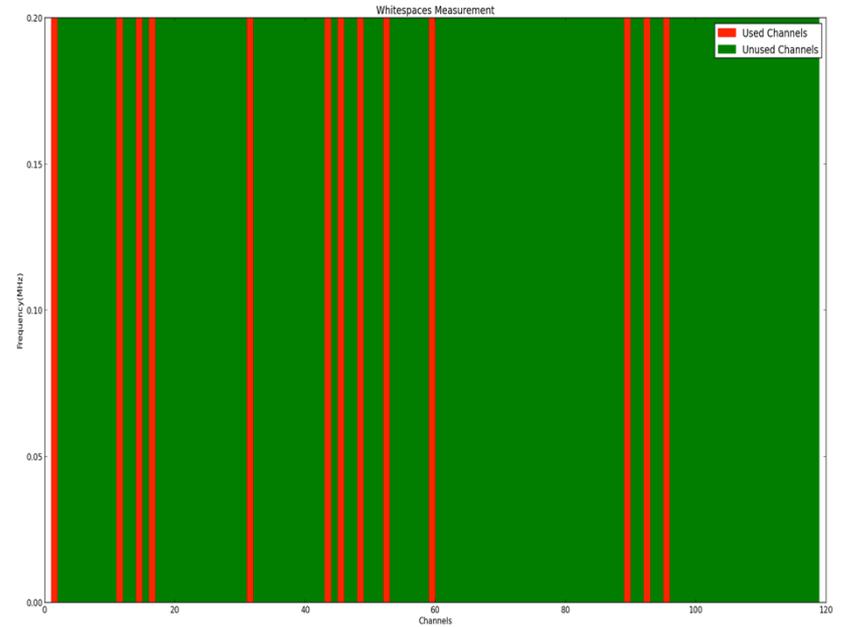
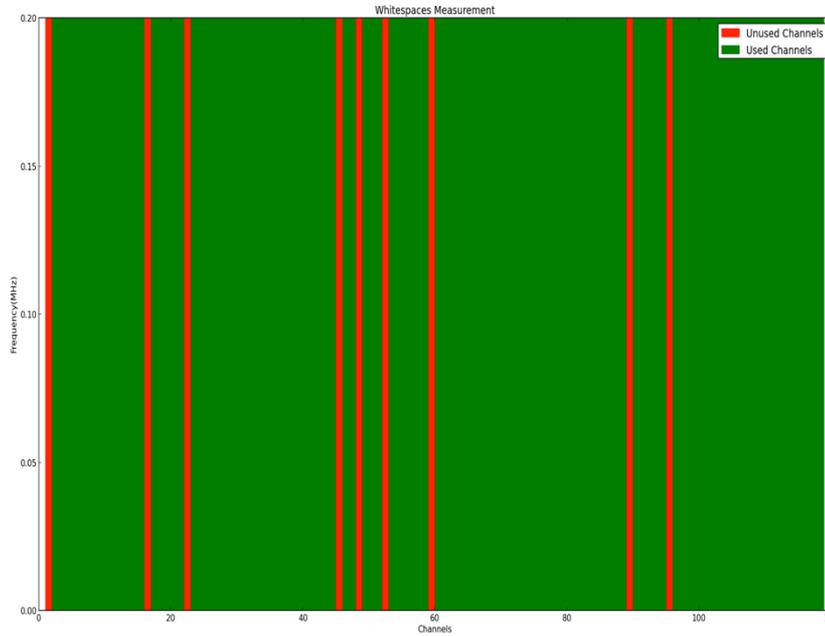
Signal Boosted Backhauls – Kumawu, Ghana



TCP bandwidth increases by up to 5 times while using a booster.

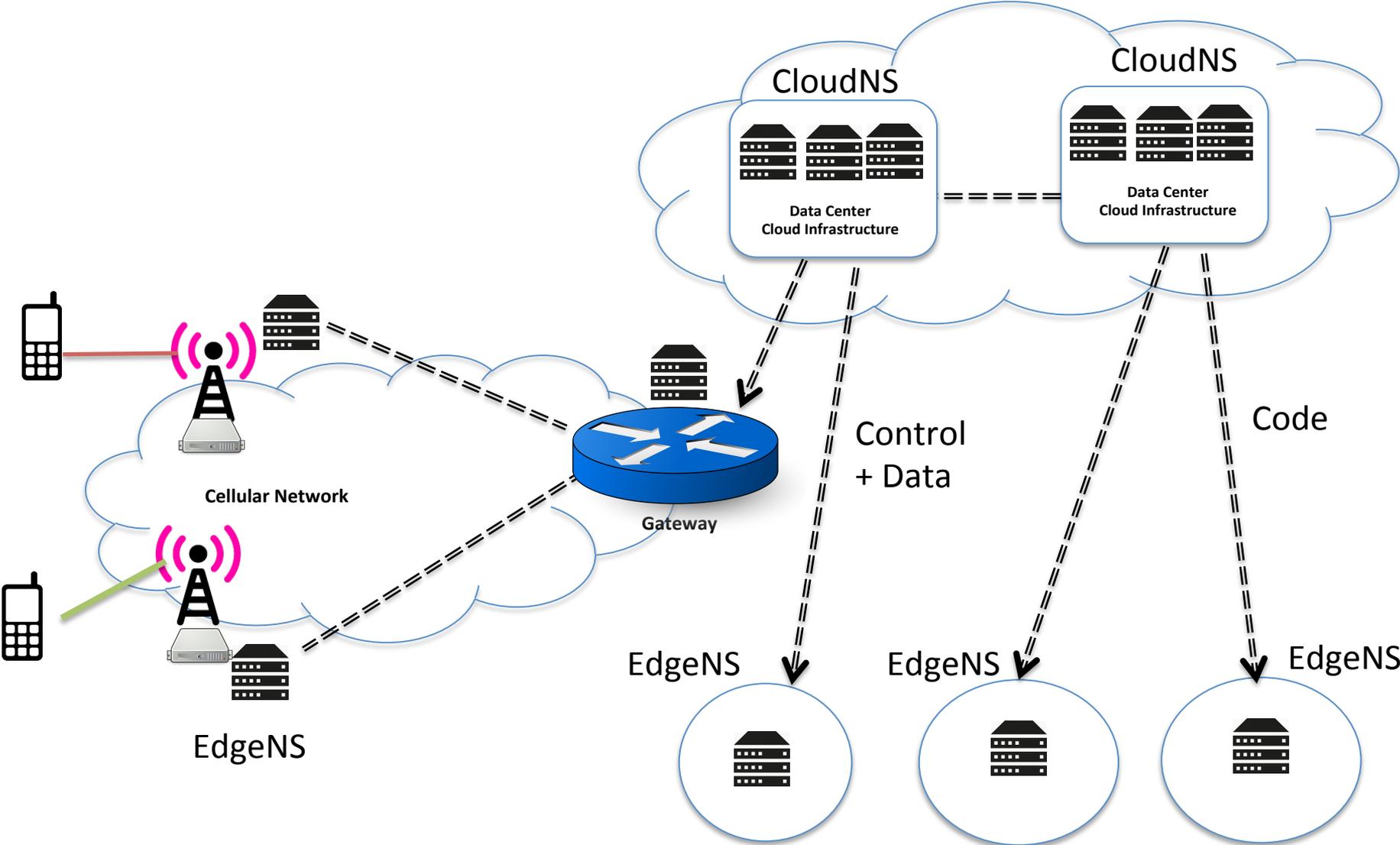
There is still significant variability

Participatory Whitespaces



There is a constant need for scanning.

Distributed Network Services Model



Distributed Network Services

- Cloud NS – Cloud Controller Network Service
 - Controls several EdgeNS
 - Operates over same App-state space as EdgeNS
 - Can install App-Code on the fly in EdgeNS
- Edge NS – Edge Network Service Instance
 - Middlebox in the data path to the client
 - Loose synchronization of state with CloudNS
 - Runs App-Code in isolated VM environments
 - Can run several Apps at the Edge

Identity Primitives and Management

- Network Identities (network layer - easy!)
- Device Identities
 - EdgeNS maintains ownership of device identities
 - Liveness vs Consistency tradeoff
 - EdgeNS gives us ownership in the face of failures
 - Ownership controlled by CloudNS
 - Mobility
- Application Identities
 - Assign identities to each State
 - Specify CAP tradeoffs as a function of state
 - CAP tradeoffs determine synchronization primitives

Intermittent File System Primitives

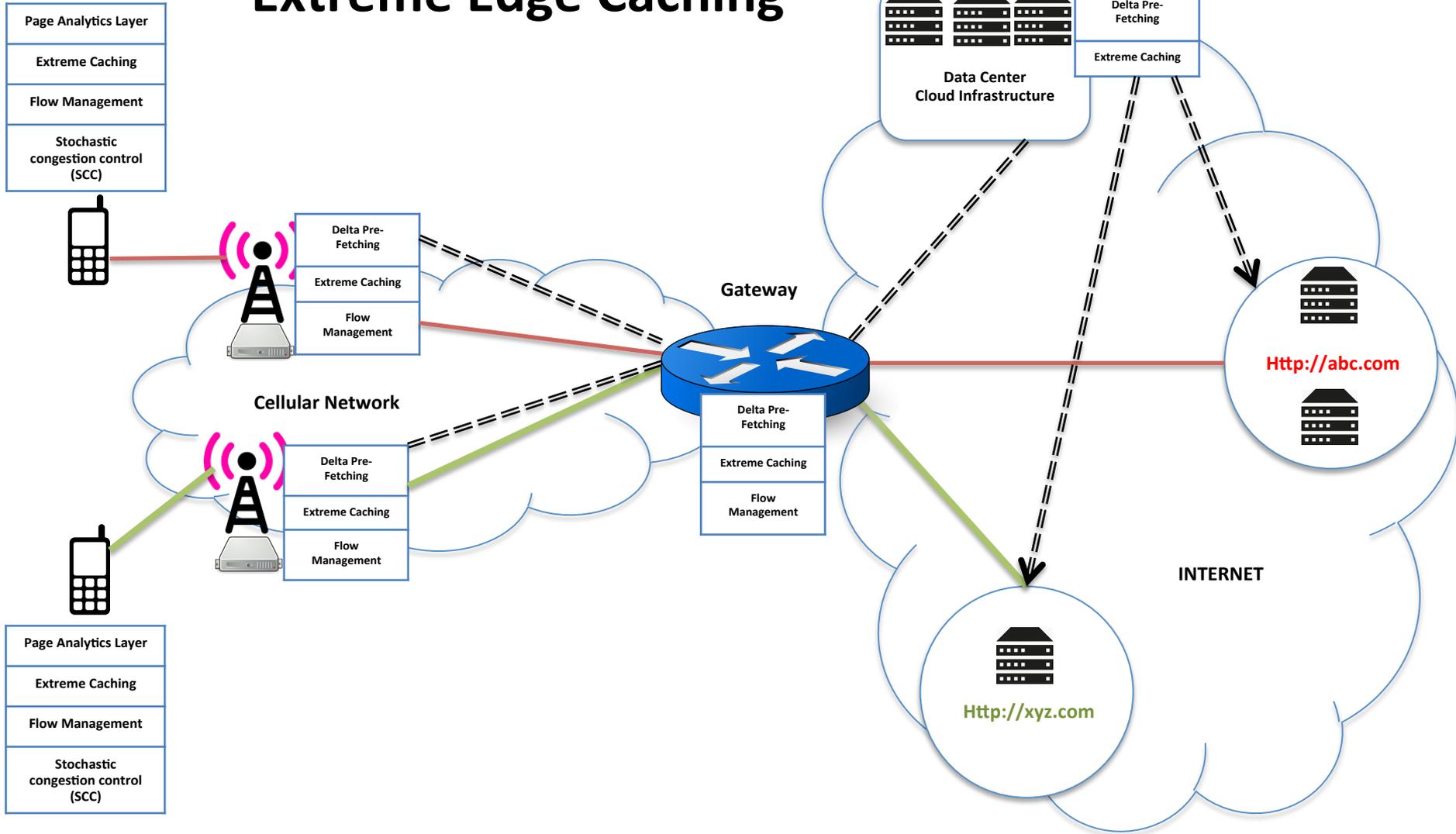
Application independent primitives.

- POST - Helps applications send data to the cloud in a lazy manner
- GET - Helps applications fetch data from the cloud instantly
- SEARCH - Helps applications search data in the cloud instantly

Extreme Edge Applications

- Marketplace – Distributed Buy/Sell Bidding
- Mapping – Distributed GPS mapping
- Intermittency-Aware Distributed Voicemail
- Intermittency-Aware Distributed Messaging

Extreme Edge Caching



Fishline in Nicaragua

