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 \( \sim \) 300 Watts
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

Data Center

Cloud Infrastructure

Cellular Network

Gateway

Data Center Cloud Infrastructure

CloudNS

Control + Data

EdgeNS

Gateway

EdgeNS

Code

EdgeNS

EdgeNS
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

- Page Analytics Layer
- Extreme Caching
- Flow Management
- Stochastic congestion control (SCC)

Cellular Network

- Delta Pre-Fetching
- Extreme Caching
- Flow Management

INTERNET

- Gateway
- Delta Pre-Fetching
- Extreme Caching
- Flow Management

Data Center Cloud Infrastructure

- HGp://abc.com
- HGp://xyz.com

Http://abc.com

Http://xyz.com
Fishline in Nicaragua

**FISHERMAN Texts** [Fish_line_phone_number]
140 Character Advertisement of Fish

**FISHERMAN Receives text**
Is this the message you want to send: [140 Character Advertisement of Fish]
1. YES
2. NO

**1. YES ALL USERS RECEIVE**
Fisherman just reach with fresh fish! Wanna buy it now?
1. YES
2. NO
3. I NEVER WANT TO RECEIVE A FISH MESSAGE AGAIN

**2. NO FISHERMAN Receives text**
To send a Fish Line text your message to [Fish_line_phone_number]

**2. NO USER Receives text**
Thank you for your interests.

**3. NEVER WANT TO RECEIVE A FISH MESSAGE USER Receives text**
Are you sure you never want Fish messages again?
1. Yes
2. No

**Yes**
You will not receive fish messages again. If you want to subscribe in the future, send “subscribe” to [subscribe phone number]

**No**
You will still get fish line messages. Thank you!