WebPack: A Path to Caching in Remote Edge Networks?

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Background/Context

- We are researchers at the University of Washington
- Focus on Internet access in rural/remote/developing areas

- **Places**: Philippines, Papua, Argentina, Mexico, Arctic Circle
- **Projects**: Endaga, OsmoCom, OAI, NextEPC, CoLTE
- **Friends**: AirWaves Missions, Puspendes, Rhizomatica, AlterMundi, UP VBTS (CoCoMoNets)
We focus on community networks: Networks owned and operated by local actors within the community. These networks are generally small-scale (N < 1000) and do not seek to grow beyond their natural community boundaries [1]. Networks owned collectively or run as a small business, sometimes informally.

Key Point #1: These ISPs are generally too small to have a business relationship with large CDNs, content providers, etc. Also language & cultural barriers.

Key Point #2: These ISPs have local infrastructure close to their users.

Network Characteristics: Backhaul

• Most places we work have **very constrained backhaul**
  - Papua: 3 Mbps / ~150 users
  - Philippines: 2G access only
  - Oaxaca: 2 Mbps / ~300 users

• These metrics are often over-estimated and **flaky**
  - Papua: VSAT has a 10/1 contention ratio and 3000ms pings (from Seattle)
  - Oaxaca: 3+ chained point-to-point long-distance WiFi links induces high jitter/loss
Network Characteristics: RAN

- Local RAN is orders of magnitude faster than backhaul
  - Even at “1 bar” of signal-strength, the bottleneck is still upstream!

- Local LTE: 150 Mbps over a wide area (> 1 mile radius)
- WiFi: even faster speeds (802.11n = 450 Mbps) but less range
Network Characteristics: Traffic

• Observation: Most interactions stay local
  - 91% of tribal Instagram media interactions stay within the tribe [1]
  - Likely applies to other communication methods (phone calls, SMS, …)
  - Not a very surprising result: social networks are driven by social connections

• Observation: Most rural traffic is what you might expect
  - HTTPS sessions to YouTube, FB, Google, CloudFlare et. al. [2]
  - Not a very surprising result in 2019

Our Interest In WebPack

• Key Goal: Optimize local traffic off the backhaul whenever possible!

• Complicated with HTTPS
  – Too small to locally deploy hardware from major CDNs
  – Current *fundamentally unsatisfying* solutions are
    • Mirroring content at a local domain (youtube.{mynetwork}.org)
    • Distributing CA certs to trust a cache and MitM HTTPS connections
  – No good way to separate out sensitive vs. non-sensitive content at the network level
Case #1: Redistribute software updates

• Many users disable updates since they are large and bandwidth is precious
  – Windows, Android Applications, etc.
  – Obvious security risk

• The same binary is downloaded hundreds of times over the backhaul bottleneck via TLS

• WebPack could be used to cache the update transparently in the network, with strong authenticity guarantees
Case #2: Popular media (e.g. videos, articles)

- A multimedia article goes locally viral
- The content producer judges pieces of the content non-sensitive and packages some heavy components of it
- The multimedia is locally cached, leaving the backhaul bandwidth for unique user-specific traffic
- As the article is shared via Facebook, Viber, or email, local users on all platforms benefit from the common cache
Case #3 Breakout local “application functionality”

- WPACK could allow a platform to distribute a large authenticated web application in smaller chunks independent of content
- The application can package more local functionality (more code) while remaining responsive and quick to load
- Locally popular features benefit from in-network caching
Our Major Asks

We work with tiny ISPs who can’t exactly get on the phone with major media outlets, CDNs, or platforms (Google, Facebook, et. al.)

- Driving towards an open standard (and then hoping content producers widely adopt it) is probably the best way forward for us
- WebPack looks like the closest thing to our needs

- **Key Ask #1**: Please keep our use-cases in mind!
- **Key Ask #2**: Work with us and we can meet you in the middle
Thanks for your consideration!

Clarification Questions?

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Backup slides follow…
How We Can Contribute

• Unique position: The ISP consists of its end users, deep trust exists
• We are networking researchers: comfortable with systems hacking, network architecture, protocol design, etc.
• We are also social scientists: interested in usable security and privacy
• Able to explore new trust-models, roll out custom apps, etc.
• We love dogfooding/beta-testing stuff
Coverage expansion by traditional ISPs and MNOs is **slowing** as they reach the economic limits of their deployments...

This population wants to get online and is connecting themselves to the net.