Go-Fi or Wi-Go

Photons Everywhere

Jon Crowcroft

December, 2005

Google Cluster + WiFi Access

- A core mesh network directly connecting all major cities in 1 fiber hop

- Access networks in city 1 hop, and around city, 3 hops,

- It's happening anyway & I hate electrons

- The 3 hop limit is not a killer for wireless mesh (hybrid wimax+wifi, directional and omni)

The World is a Mesh

- Core Photonic Mesh
  - Connects virtualised cluster computing resources
  - Scalable Optical Interconnect
- Access Wireless Mesh
  - End users are relays too.
  - Use powered devices in homes/offices
- No routers, no network layer devices
  - Network transparency assured
  - Virtualisation removes threat of vertical monopoly

GoFi threat is to cisco (not microsoft)

- Critical point about this simple architecture is latency
- There might be highish latency through a cluster for an IP packet (although they are motivated to reduce this anyhow even just for web access)
- But the total hopcount is 2 clusters +4 wireless net + 1 fiber hop, globally
- Which would be fine even for interactive apps like video/voice/gaming person-to-person

Resilience and Costs

- Google/Yahoo/Akamai need resilience
  - And need performance guarantees
  - Do not want to share intermediate net
  - But can offer it to others
- Users need affordable net
  - Do not want to pay for DSL or faster deployment
  - Incremental costs of mesh wireless better
  - As speed goes up, scales with number of users
- Need computational-centric net
  - not network centered services.
  - Better for innovation
  - Competition (with voice, TV and other legacy nets)

Software platforms

- Clusters are built from commodity computers in numbers - scales linearly with user demand
- Can implement coding , transcoding
- Can deploy new services
- Already replicate content (Google file system Akamai's distributed caching and application layer multicast)
- Could even do software radio (on wireless and on fiber!)
- Service deployment/innovation rate in these business is massive compared to the network companies (whether telco, isp or cellular or broadcast, all of whom are pretty much moribund)

Wireless access net

- Can easily do better than xDSL
    - Just look at our taxi model as one example
    - Scales with vehicles
- Needs more spectrum
    - Needs it now, so can plan wider band WiFi
    - Need security/share enforcement
    - Same tools for this user multihop radio sharing
    - Also can be used for dynamic spectrum allocation

Real problems in wireless mesh

- 802.11 only 11 (3 orthogonal channels)
- Routing (at AP selection layer and at IP layer) not well understood
- CSMA/CA over 3 hops has TERRIBLE performance
- Plus points - pushing antennae and power to end user exploits their resources transparently and deploys linearly with demand too (or better)
- Note some new discoveries show we can maybe get super-linear capacity out of mesh…maybe
- Yet to be demoed in practice outside a lab…

Future is Wireless

- But notice optical core
- Can also use optical core for fibre radio back haul
- Amortize costs of AP equipment in some cases

- Any questions?

Critical risks

- If we don't fix mesh, people will do fiber to the home

- If we don't fix both, people will do STORE and POST based content distribution, and will be happy with only a few hundred kilobits per second per user (on DSL, since the lower rate packet radio solutions have awful latency)

- Latency is a driver - repeat after me!