Entertainment Content Distribution Networks

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Why is this Important?

Financially

- YouTube worth an estimated 20 Billion by 2020
- Piracy estimated to cost 20 Billion a year now
- Entertainment Industry has lead the way in establishing video storage formats

Day-To-Day Life

- We use Streaming Content Every day
- Youtube cats
- News
- Computers are replacing TVs
Problem Characterization

Users World Wide Want a TV Like Experience Over the Internet

- Establishing a network that allows distribution of content globally
- Ensuring high quality images, synchronized audio are present and consistent frame rate
- Delivering voluminous high quality content cheaply and efficiently
- Videos Distribution is also "small world"
Trade-Off Space

Client Server Model

- **Advantages**
  - User Friendly, Browser Based
  - Runs in Large Datacenters

- **Disadvantages**
  - Must pay for servers/hosting
  - Single point of failure* optimal replication placement is NP hard
  - Single point of litigation

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Peer To Peer Model

- **Advantages**
  - No need for central infrastructure
  - Scalable

- **Disadvantages**
  - Peers and data are transient
  - Requires a Threshold of Peers to work

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A survey on content centric technologies for the current Internet CDN, Passarella

Dominant Approach 1: Youtube

- Uses Google Data Centers Globally and Limelight CDN
- Video Files stored as layers, more layers you have the better video quality
Dominant Approach 2: P2P Systems

- **GnuStream**
  - Build on Gnutella framework and uses its framework to locate peers and distribute files, receiver data collection which reassembles data streams from multiple hosts before sending them to the media player. Each GnuStream streaming session is controlled by the receiver peer and involves a dynamic set of peer senders instead of one.
  - GnuStream relying on a three layer design, Network Abstraction layer, is an interface, the middle layer, or “Streaming Control” layer, incorporates streaming functionality, and the top “Media Playback” layer interfaces to multiple media playback devices.
  - Drawback: GnuStream client may also be hosting P2P files there can be additional performance bottlenecks.

- **PeerCast**
  - PeerCast works the same way as any P2P file sharing applications except instead of downloading files users streams of radio broadcasts. Stream exchanges with a user happen in real time and no data saved or stored on user machines.
  - PeerCast can be divided in 3 levels. The first level contains servers called YellowPage Server so any broadcaster can publish a channel on the YellowPage Server. The second level is a Broadcaster server. It relays streams to the end users. The third level is User which can act as only receiver or as receiver/relayed.
  - Drawback: low robustness of P2P network. When an upper level node leaves a network, the lower nodes can expect starvation.
Insight Gleaned

Technical

- P2P Overlays
  - Structured
  - Unstructured
- P2P Searches
  - Parallel Random Walk
  - Flooding
  - Expanding Ring
- Content Replication
  - Push
  - Pull

Technical-Social Issues

- P2P networks exhibit what economics call tipping points
- Usability > technological prowess
- How quickly content is available, how much content is available
  - Keeping Seeders and Punishing Leachers is hard

Usability

Attaining Content
Future Problem Space

Emerging User Concerns

• Privacy
  • Encryption
  • Steganography (masking P2P traffic)
• Usability
• Access to user generated content
• Protection of own content

How Will Policy Effect the Future?

• CDN Domination of P2P based on Bandwidth restrictions
• Absence of Net Neutrality
• Enforcing IP
• P2P Domination of CDN
• Lack of international IP norms
• Strong Net Neutrality
Future Solution

Homomorphic Encryption Based P2P Networks

- Homomorphic encryption allows processing to be done on data without decryption.
- Caesar Cypher = Homomorphic Concatenation
- Unpadded RSA Cypher = Homomorphic Multiplication
- Emerging research field

Hybrid P2P CDN Networks

- CDN to best Peers, Peers to Other Peers
- Allows Clients To “rent” their excess capacity to the CDN during peak loads
- Work for large software distribution like games