Internet Multimedia: Technology, Standards and Perspectives

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Overview

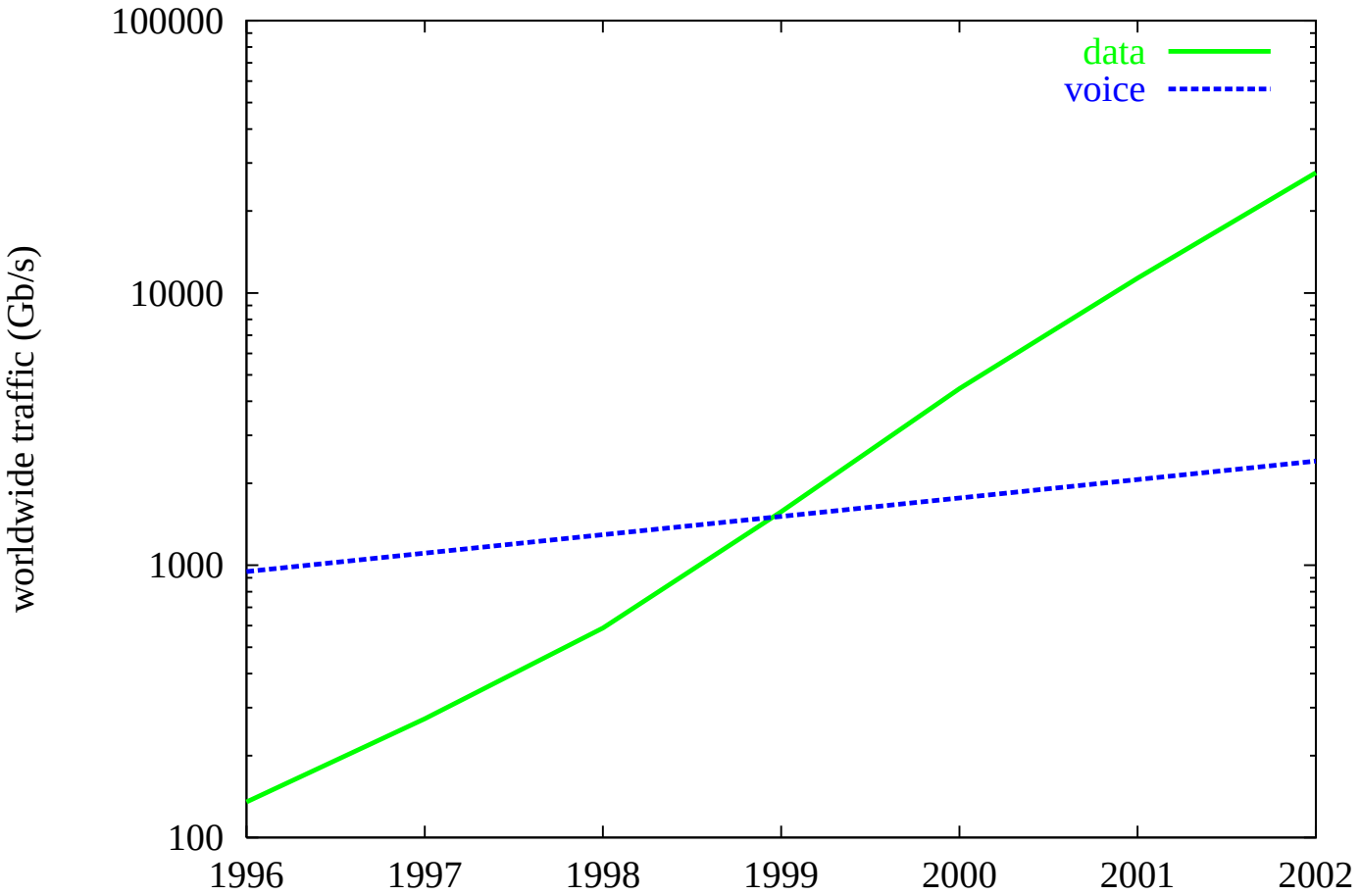
- Internet multimedia applications
- Internet telephony
- media-on-demand
- distribution applications
- multicast
- IPv6

Integration

Vision: the universal, integrated network

- radio, TV, telephone, data (email, web, chat, . . .)
- single network management
- higher redundancy (if done carefully. . .)
- earlier attempts:
  - PBX with data access
  - ISDN
  - Isochronous Ethernet
  - ATM
- all voice-dominated or voice-cognizant $\longrightarrow$ failure

Voice vs. Data Volume



Media Integration

CDs/video tapes + Internet telephony + conferences + radio/TV

- few *technical* differences in protocols: share lower layers
- discreet points $\longrightarrow$ continuum:
  - public vs. private
  - invited vs. announced
  - from one to millions participants
  - symmetric vs. asymmetric
  - delay sensitive vs. distribution
  - media: audio, video, text, but also chat, chess, sensors, ...
- unified terminal, but maybe different emphasis – couch potato vs. office work vs. phone

Internet Telephony

- initially motivated by cost:
  - “borrowed” infrastructure
  - bypass inflated international tariffs
  - no FCC access and universal service charges
  - existing PCs
- now, primarily phone-to-phone
- emphasis now on services, integration

Multimedia

The phone works — why bother with VoIP?

user perspective

- variable compression: tin can to broadcast quality
- security through encryption
- caller, talker identification
- better user interface (browser)
- internat. calls: TAT transatlantic cable = $0.03/hr
- no local access fees (3.4c)
- easy: video, whiteboard, ...

carrier perspective

- silence suppression ➠ traffic ↓
- shared facilities ➠ management, redundancy
- advanced services (email/web integration)
- cheaper switching ($0.005 vs. $5/kb/s)
- 9.6 kb/s fax as data

Internet Telephony Services

- interactive web response
- integration email + voice mail
- visual caller id
- location-transparent features
- PBX features at home
- …

Internet Telephony Architecture

Transport media: RTP, with extensions for DTMF

Set up calls: H.323 and SIP

Find gateways: TRIP

Map phone number to IP addresses: DNS “enum”

Voice mail: RTSP + email

Internet Telephony: Challenges

- delay: need < 150 ms
- packet loss: $< 5\%$
- reliability: “5 nines”
- cheap, non-Windows end systems

Internet Telephony – as Part of Internet

- email address = SIP address
- SIP URLs in web pages
- forward to email, web page, chat session, . . .
- include web page in invitation response (“web IVR”)
- RTSP: choose your own music-on-hold
- include vCard, photo URL in invitation

SIP Standardization Status

- Feb. 2, 1999: IETF Proposed Standard
- March 17, 1999: IETF RFC 2543
- eligible for Draft Standard: 6 months, 2 implementations $\surd$
- new SIP working group (move from mmusic)
- working on updated draft based on implementation experience
- mostly clarifications + optional headers, no new version

SIP Bake-Off

- 3 bake-offs: April, August, December
- from 15 to 33 groups
- hardware, PSTN gateways, proxy/redirect servers, clients, test instrument, . . .

SIP Bake-Off Participants

3Com
8x8
Agilent
Alcatel
Broadsoft
British Telecom
Catapult
Cisco
Columbia University
Dialogic
dynamicsoft
Ellemtel
Ericsson
Facet
Helsinki Univ.
Hewlett-Packard
Indigo
IPcell
Lucent
MCI Worldcom
Mediatrix
Mitel
Netspeak
Nortel
Nuera
OZ.com
Pingtel
Radcom
Telogy
Vovida
VTEL

Integrating Signaling and Instant Messaging: Some Ideas

- "reverse" signaling: callee indicates availability
- buddy lists = special case of *event notification*
- other events: "sensor 17 smells smoke", "Beanie Babies are on sale", "(voice) mail has arrived", . . .
- subscribe – notify – set up call
- useful for call parking
- many SIP mechanisms apply: security, redirection, proxying, content negotiation, . . .

SIP for Event Notification

- add two methods: SUBSCRIBE and NOTIFY
- proxy server may intercept SUBSCRIBE
- use message body for event description
- default: presence, indicated by REGISTER
- one of *many* proposals for presence (IETF WG!)

Media-on-Demand Services

true on demand vs. (e.g.,) netradio.com

- RealNetworks, Windows MediaPlayer
- mostly proprietary, moving towards standards
- RTSP for controlling delivery, RTP for streaming audio and video
- SMIL (W3C) for content description
- major problem: scaling

Distribution Services

- current architecture:
  - unicast streams $\longrightarrow$ only hundreds of listeners, needs lots of servers
  - ISP-based replication (Akamai)
  - satellite-based replication (SkyCache)
- multicast

Radio Infrastructure

Internet radio “networks”:

- station discovery: SAP, SDP
- content tagging
- local content (e.g., MarconiNet experiments)
- ad insertion

Multicast: Applications

- send only *one* copy
- replicate as late as possible
- applications:
  - data distribution (stock quotes, news, . . .)
  - audio/video distribution (Internet radio, TV)
  - near-video on demand: align to nearest station
  - audio/video conferencing
  - resource discovery (“what the nearest foo service?”)
  - redundancy and synchronization

Multicast: Technology

- roughly equivalent to radio: just tune to multicast IP address (e.g., 224.2.0.1, IETF-1-VIDEO.mcast.net)
- don’t need to know sender
- receive-only or send-only possible
- zero to any number of senders
- subscribe to multicast group if sending

Multicast: Pieces

- multicast routing via flood-and-prune: DVMRP $\longrightarrow$ PIM-DM
- local groups: MOSPF = extension of OSPF to multicast
- sparse groups: PIM-SM, CBT
- PIM-SM: high protocol complexity
- multicast address allocation: MADCAP (just published) to get address, multicast Address Set Claim (MASC) across domains, Multicast Address Allocation Protocol (AAP) within domain

Multicast: Status

- available in all modern operating systems
- mostly available in Ethernet switches and other LANs
- ATM very iffy
- router support for IGMP, DVMRP available; PIM-SM/DM for Cisco and few others
- operational issues prevent widespread deployment
  - billing?
  - fault location?
  - denial-of-service amplifier
  - most users want on-demand
- overlay network: Mbone

IPv6

- solve address scarcity problem ($\longrightarrow$ NATs with private address spaces) by increasing address from 4 to 16 bytes
- add better support for multicast, security, mobility
- remove little-used features from IP header
- need to run both IPv4 and IPv6 for *looong* time