Internet Access, Challenges and Applications

Henning Schulzrinne
Dept. of Computer Science
Columbia University
New York, New York
schulzrinne@cs.columbia.edu

September, 2000

Overview

- New Internet services
  - Structured data
  - Event notification
- Internet technical challenges
- Internet access alternatives
- Internet access devices
- New Internet applications

New Internet services

- streaming services (radio, movie clips?)
- event notification and presence
- peer-to-peer object distribution (e.g., Napster)
- Internet telephony (10% of international long distance)
- mobility

Internet challenges

- address exhaustion $\longrightarrow$ NAT kludges, IPv6
- traffic growth: doubling/yearly
- availability (99.9% $\longrightarrow$ 99.999%)
- wireless and mobile access
- security for infrastructure and access

Structured information delivery

- traditionally, information delivered for presentation
  - ASCII for email
  - HTML for web presentation
  - Word, PDF for documents
- loses meaning of data items
- “screen scraping”
- early attempt: EDI

XML

- XML (extended markup language): text description of data objects, marked up with “tags”
- XML just describes data, not processes
- can be delivered via HTTP (web), email, . . .
- is text, but not meant to be read by humans
- verbose, but can be compressed via standard text compression
- rendered by separate set of rules (XSL)

XML example

```
<?xml version="1.0" standalone="yes"?>
<library>
  <book>
    <title>The Grapes of Wrath</title>
    <author>John Steinbeck</author>
    <publisher>Viking Press</publisher>
    <pub_year>1939</pub_year>
    <call_no>PZ3.S8195Gr6<call_no>
  </book>
</library>
```

Event notification

- notify subscriber when designated events occur
- example: “presence” (buddy lists)
- generalizable to physical measurements, news events, financial data, . . .
- currently proprietary (AOL, MSN, Yahoo), presence only
- on-going work in Internet Engineering Task Force (IETF)

Consumer Internet access alternatives

Modem ISP	$20
Cable modem	$40
DSL	$40+
Wireless	$30 + volume or $60
Satellite	$20

Business rates depend on local access

Modem

- modem speed limited to about 33.6 kb/s upstream and 56 kb/s downstream
- no major advances in modems on horizon
- 52% of US households have Internet connectivity

(A)DSL

- asymmetric for consumers: e.g., 640 kb/s downstream, 96 kb/s upstream
- practically, up to 1.5 Mb/s
- now, can be self-installed
- probably will largely replace T-1 lines for business (about $250 - $400/month)
- both DSL and cable modems oversubscribe trunks
- projected at 7.7m by 2002, 9.6m by 2003

”Among the nation’s 30,000 central phone offices, 4,300 were equipped for DSL as of the end of September [1999], according to TeleChoice, a consulting firm in Boston. ... there were 300,000 residential DSL subscribers and 1.1 million cable modem subscribers at the end of 1999. The number of residential DSL subscribers is expected to grow to 900,000 by the end of 2000.” [actually, total of 1.2M by 6/00, with 12% business]

DSL varieties

Service	up (Mb/s)	down	application
Asymmetric DSL (ADSL)	0.8	8.0	residential
Symmetric DSL (SDSL)	1.5	1.5	small business
High Speed DSL (HDSL)	2.3	2.3	T1 replacement
Very High Speed DSL (VDSL)	12.0	52.0	limited distance
Universal ADSL	0.1	1.5	G.lite, splitterless

Only ADSL and U-ADSL widely available.

Cable modems

- standardization in progress (DOCSIS)
- theory, 30 Mb/s downstream, but shared
- RoadRunner advertises 1.5 Mb/s downstream, 300 kb/s upstream

Current wireless data access

- packet data or modem (circuit)
- almost no packet data coverage outside metropolitan areas
- indoor coverage depends on service

Service	max.	min.	type
Ardis	19.2	4.8	packet
CDPD	19.2		packet
Cellular	14.4	9.6	dial up
GSM	9.6		dial up
Metricom	33.6		dial up/packet
RAM Mobile Data	8.0		packet

- expensive: $0.10 to $0.30/kB packet, $0.002/kB circuit
- also: GSM short message service (SMS), limited to 160 bytes

Near-term wireless access: Ricochet (Metricom)

- 128 kb/s IP data, from lamp posts
- San Diego and Atlanta now
- Baltimore, Boston, Chicago, Dallas/Ft Worth, Denver, Detroit, Houston, Kansas City, Los Angeles, Miami, Minneapolis, New York City, Philadelphia, Phoenix, San Francisco/San Jose, Salt Lake City, Seattle, St Louis, Washington, D.C. in progress

WAP (Wireless Access Protocol)

- average web page contains 18 objects, 3.8 kB each = 68.4 kB, but only 2 kB is text
- average email (mine. . .): 8 kB
- 100-pixel phones
- separate protocol stack, similar to IP, operates over SMS, GSM, . . .
- need to create separate content for WAP, often for each phone
- usability? interoperability?
- “walled garden”
- see also NTT DoCoMo

License-free wireless

- 2.4 GHz spread spectrum (“ISM band”)
- IEEE 802.11b: up to 11 Mb/s, downgrades to 1 Mb/s depending on distance to base station
- 100 mW power, limited to 100 to 300 ft
- e.g., WaveLAN (Orinoco), Apple AirPort, Compaq, 3Com, . . .
- needs access points ($300) with Ethernet interface
- e.g., Wayport service in hotels and some airports

BlueTooth

- short-range wireless (30’)
- inexpensive transmitters: goal of $5
- 1 Mb/s in 2.4 GHz
- long-delayed
- initial products: wire replacements (headset – cell phone)

Vertical Blanking Interval (VBI) and HDTV

Use existing TV channels for *shared*, *one-way* data distribution

- VBI: space between TV images, about 150 kb/s
  - VBI used by PBS, but apparently discontinued
- HDTV
  - each channel about 27 Mb/s
  - legality of HDTV channel use questionable
- DirecPC satellite: theoretically, 400 kb/s

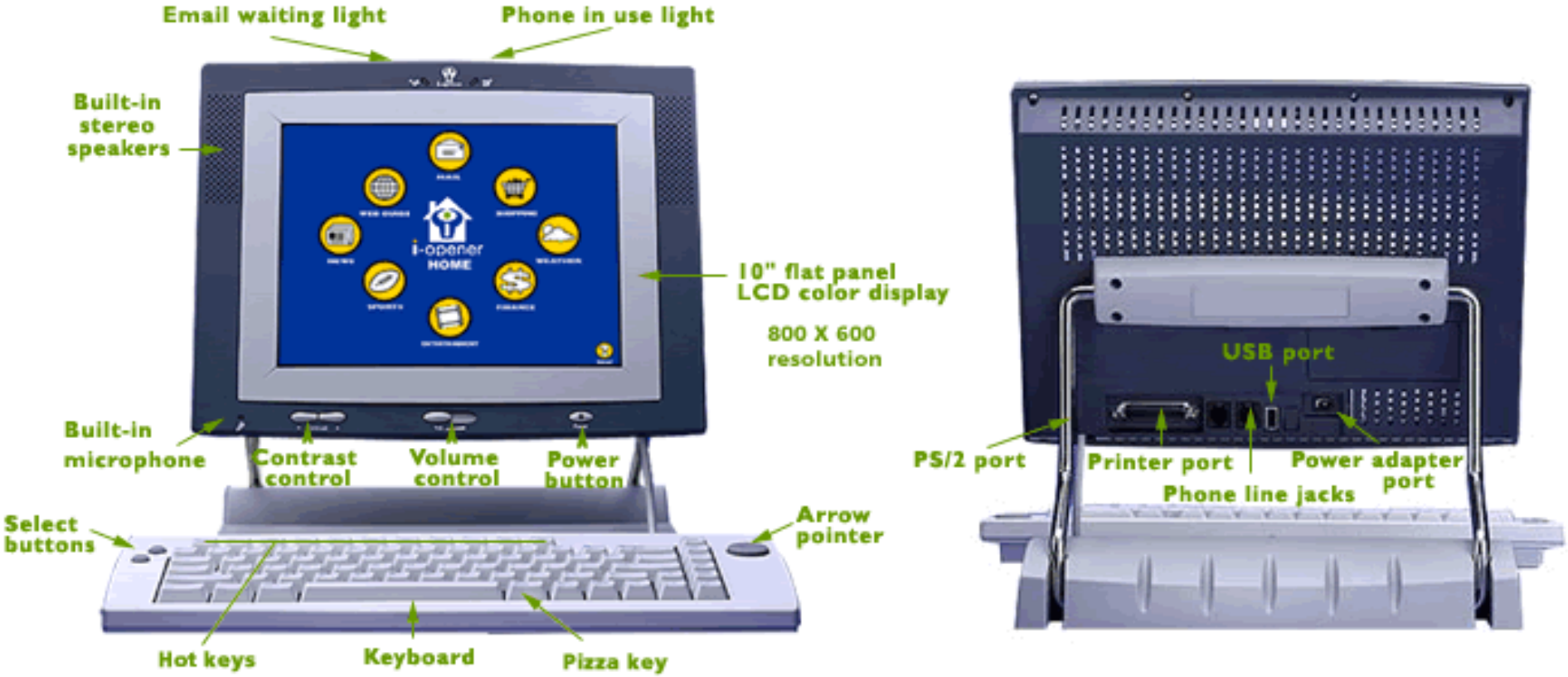
Third-Generation wireless (3G)

- often referred to as UMTS
- operates between 1.8 and 2.1 GHz
- in flux, with goal of IP to handset
- multiple standards organizations, such as 3GPP, MWIF, 3GPP2
- theoretically, 2 Mb/s, practically $<$144 kb/s for mobile users
- very expensive spectrum (UK: $35b)
- first deployments in 2001?

Non-PC Internet access

- PalmPilot (AvantGo), WinCE
- WAP (limited content)
- Internet appliances (e.g., i-opener)
- Internet telephones (e.g., i.Picasso, Pingtel)

i-Opener Internet appliance



Pingtel Internet phone

Summary

- add content-based delivery to presentation delivery
- slow transition to DSL and cable modems
- wide-area wireless data still mostly hype
- local wireless data access spreading fast
- many new ways to access Internet beyond the PC