NGN
Replacement or Evolution?

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Definition

- for the purposes of this talk, the Next Generation Network (NGN) is the communications infrastructure that will be in general use in 2020

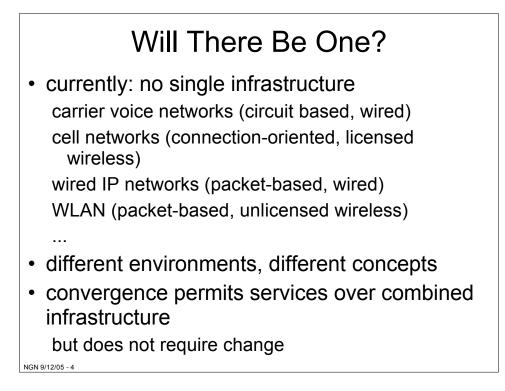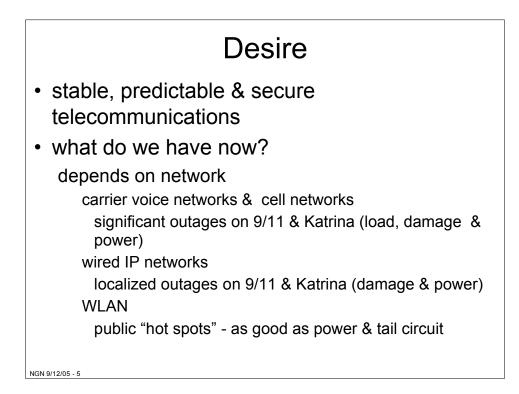- common assumption

    packet-based (I.e., convergence)
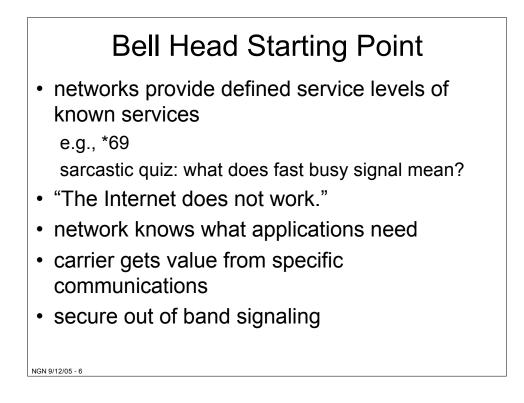
Background IETF/ITU-T

- once very separate with separate interests
- basically different approval concepts
    - IETF - rough consensus of geeks
    - ITU-T - acceptance by goverments
- but IP convergence changed world
    - ITU-T started being interested in IP-based services 8 years ago - maybe seeing little future in circuit-based standards
    - IETF worked on VoIP without knowing it
- evolving working relationship

Will There Be One?

- currently: no single infrastructure
    - carrier voice networks (circuit based, wired)
    - cell networks (connection-oriented, licensed wireless)
    - wired IP networks (packet-based, wired)
    - WLAN (packet-based, unlicensed wireless)
    - ...
- different environments, different concepts
- convergence permits services over combined infrastructure
    - but does not require change

Desire

- stable, predictable & secure telecommunications
- what do we have now?
  - depends on network
    - carrier voice networks & cell networks
      - significant outages on 9/11 & Katrina (load, damage & power)
    - wired IP networks
      - localized outages on 9/11 & Katrina (damage & power)
    - WLAN
      - public "hot spots" - as good as power & tail circuit

Bell Head Starting Point

- networks provide defined service levels of known services
  - e.g., *69
  - sarcastic quiz: what does fast busy signal mean?
- "The Internet does not work."
- network knows what applications need
- carrier gets value from specific communications
- secure out of band signaling

Net Head Starting Point

- network is "transparent", just delivers packets
    - a.k.a., end-to-end argument
- network isolated from applications
    - does not get value from specific applications
- only "ends" know what they want
    - can ask for help from network if they want to
    - note "end" could be a service (e.g., Skype-out)
- security is an "end" responsibility
    - e.g., end-to-end encryption, local firewall

Reality

- neither starting point is correct
    - both are simplistic but useful characterizations
- telco net has e2e signaling where carrier is uninvolved in application
    - e.g., touch tone controlled voicemail
- Internet not actually transparent
    - e.g., firewalls & NATs
- telco services: not always defined quality
    - e.g., cell phones
- telco security questionable
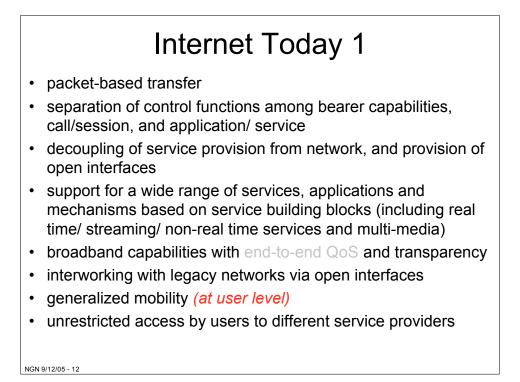   - dependent on walled garden
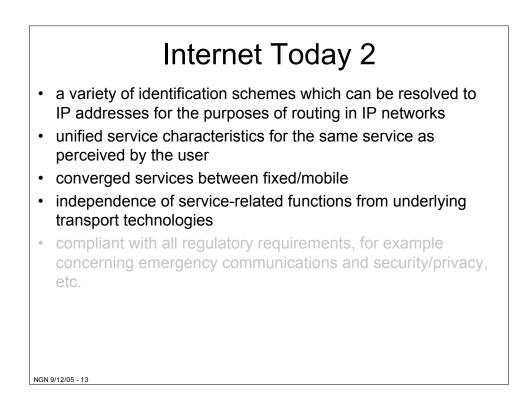
Description
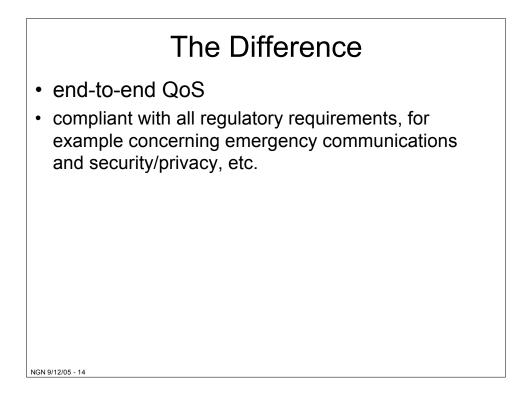
- I'll use the ITU-T NGN bullets as a view of the NGN

ITU-T NGN 1

- packet-based transfer
- separation of control functions among bearer capabilities, call/session, and application/ service
- decoupling of service provision from network, and provision of open interfaces
- support for a wide range of services, applications and mechanisms based on service building blocks (including real time/ streaming/ non-real time services and multi-media)
- broadband capabilities with end-to-end QoS and transparency
- interworking with legacy networks via open interfaces
- generalized mobility
- unrestricted access by users to different service providers

ITU-T NGN 2

- a variety of identification schemes which can be resolved to IP addresses for the purposes of routing in IP networks
- unified service characteristics for the same service as perceived by the user
- converged services between fixed/mobile
- independence of service-related functions from underlying transport technologies
- compliant with all regulatory requirements, for example concerning emergency communications and security/privacy, etc.
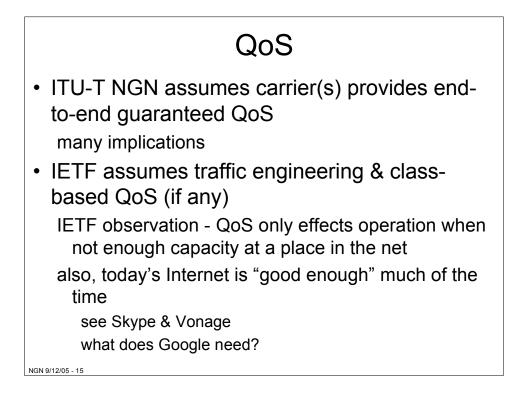
Internet Today 1

- packet-based transfer
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- broadband capabilities with end-to-end QoS and transparency
- interworking with legacy networks via open interfaces
- generalized mobility *(at user level)*
- unrestricted access by users to different service providers

Internet Today 2

- a variety of identification schemes which can be resolved to IP addresses for the purposes of routing in IP networks
- unified service characteristics for the same service as perceived by the user
- converged services between fixed/mobile
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The Difference

- end-to-end QoS
- compliant with all regulatory requirements, for example concerning emergency communications and security/privacy, etc.

QoS

- ITU-T NGN assumes carrier(s) provides end-to-end guaranteed QoS
  - many implications
- IETF assumes traffic engineering & class-based QoS (if any)
  - IETF observation - QoS only effects operation when not enough capacity at a place in the net
  - also, today's Internet is "good enough" much of the time
    - see Skype & Vonage
    - what does Google need?

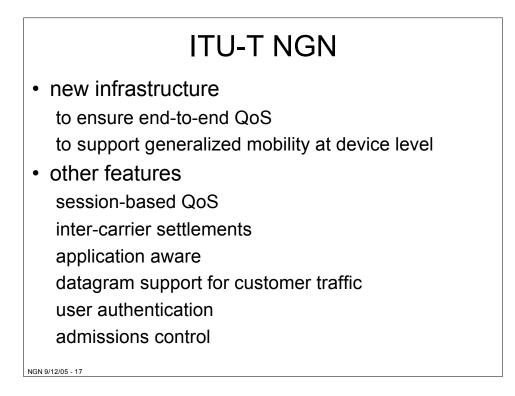# ISP Infrastructure

- basic
  - routers & links
  - billing,ticket & management/monitoring systems
  - links to customers & peers
  - DNS servers
- optional
  - applications servers (email, web, ...)
  - managed customer services (firewalls, VPN, ...)
  - user authentication (RADIUS)

ITU-T NGN

- new infrastructure
  - to ensure end-to-end QoS
  - to support generalized mobility at device level
- other features
  - session-based QoS
  - inter-carrier settlements
  - application aware
  - datagram support for customer traffic
  - user authentication
  - admissions control

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ITU-T NGN

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ITU-T NGN, Implementation 1

PSTN

"Carrier Grade"
IP-based
Networks

ISP

"The Internet"
(best-endeavours
network)

ACI

ITU-T NGN, Implementation 2

Internet

Legacy
Networks
(ISDN/PSTN
etc.)

Mobile
Networks
(2G, 3G
etc)

Other NGN
Networks

NGN Core

Fixed Access
(e.g DSL)
Network

Cellular radio
Access
Network

WLAN Access
Network

Mobile
Object

Internet QoS Data Point

- Steve Casner et al, NANOG presentation

    http://www.nanog.org/mtg-0105/casner.html

- experiment on active ISP backbone

    San Francisco to Washington DC

    POP to POP

    1Mbps average data rate

    15 5 to 7 day trials

- results:

    99.99% availability

    jitter < 1ms for 99.99% of packets <u>sent</u>

Argument for no Control

- is adding bandwidth all that's needed?
- Andrew Odlyzko of U. Minnesota

    may be cheaper to just throw bandwidth at QoS
        problem

        1 - only a few points of congestion

        2 - 80% of data com costs non-transmission

        3 - adding QoS complexity will add to other costs

            labor, management & billing systems etc

        4 - local part of data communications dominate overall
            cost

        5 - cost of transmission coming down

    upgrade congested points, cheaper than QoS
        complexity

Is There a Business Driver for QoS?

- Internet is "good enough" for lots of things much of the time
    - except for tail circuits, servers and (sometimes) inter-ISP links (CNN 9/11 lesson)
- QoS-based services mean asking customer to pay more money all of the time to get better service some of the time
    - and some of the down time is routing outages
- sarcastic quiz: what is IAD?

Device Level Mobility

- ability of a device to 'connect in' via different networks (e.g., cellular, WLAN & LAN)
- ability to move between nets while maintaining session
- if there is IP connectivity the first can be done in the Internet
    - e.g., mobile IP
- session handoff between nets is being worked on
    - not an easy problem

Regulations

- if QoS & device mobility are not drivers for NGN complexity that leaves regulations
    - "compliant with all regulatory requirements, for example concerning emergency communications and security/privacy, etc."
- security/privacy best done end-to-end
    - (bad guys will do so)
- legal intercept?
    - multiple options

Legal Intercept Options

- require redesigned infrastructure
    - to forward traffic through central device
    - very expensive & long lead time
        - e.g., fiber paths wrong, too much traffic
- require packet cloning
    - have ISP forward traffic meeting pattern to law enforcement
    - maybe through 3rd party to parse application
- use application service providers (e.g. VoIP)
    - tell application service providers to monitor
        - what's a service? what if service provider non-US?

Legal Intercept, contd.

- note that e2e encryption is a fact of life
    - i.e., a legal intercept will often get gibberish
    - Clipper Chip v2 not in current cards
- service provider will often not have keys
    - most applications use their own keys
        - e.g., enterprise & personal VPNs, secure web, pgp
    - bad guys will use their own keys even if illegal

Emergency Communications

- in circuit-based world
    - per-call priority placement (preemption some places)
        - quality is defined if call gets through
    - authentication by GETs card knowledge
        - maybe SIM card in cell phones
- no equivalent in Internet
    - packet-based priority does not do same thing
        - all equal-priority application sessions share fate
        - no concept of sessions in network core
    - major DoS risk if no user authentication
        - network-edge based policing possible

IEPREP

- IETF working group on use of IP networks (including Internet) in times of emergency
- major conflict with NCS folk
    - NCS - mandate priority for emergency traffic
    - ISPs - no need, will not work, costs lots & makes net vulnerable
- IETF producing RFC to describe a way to do authentication & special handling
    - note - not simple prioritization, ISP needs to run and ISP customers need to communicate in emergencies

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Detail

- note an ITU-T NGN would co-exist with the Internet for a very long time
- will generally only cover enterprises
    - what about at-home employees?
- customers of most enterprise web sites will not be on NGN for a very long time (if ever)
    - so NGN features will be of no use in consumer world
- services will have to work in mixed NGN/Internet environment
    - i.e., NGN cannot be assumed for many applications

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ITU-T NGN Needed?

- can create value for carrier
  - by forcing carrier into application value chain
    - e.g., poor QoS unless carrier gives OK
    - impediment to innovation
- QoS support may not be a killer app
  - Internet is not reliably crappy enough
- device level mobility & legal intercept
  - can be done without infrastructure changes
- security best done e2e
- emergency use - priority only works on closed networks

Non-Transparent Internet

- worry that carriers will try to control what runs over their links
- restrict applications unless carrier gets cut
- "4 freedoms" addresses issue (in theory)
  - but too many caveats
- argument is that carriers can not survive as bit pipes - need application revenue
  - a real worry, but cure worse than disease
  - fear of non-self-supporting Internet is a big threat
  - potential of muni-owned infrastructure

Last Word

IP Telephony or Internet Telephony?

innovation or replication?

$$\frac{voice}{IP}$$

or

$$\frac{voice}{IP}$$

"make sure it stays good"   "it is good enough"

some regulators want to "define" voice over IP

but no way to know what it *will* be