Advanced Lecture on Internet Applications

9. Charged VoIP and Free Internet Phone

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Internet Phone and VoIP

- internet phone
  - a kind of VoIP (same voice quality)
  - internet phone does not assume phone network
- VoIP
  - often assume phone network constructed as private IP network
  - interoperability to other phone network important
    - usage based charging implied

IT Revolution

- disintermediation of information and communication by internet
- internet will be the only information communication infrastructure
  - persistent connectivity with direct internet connection to each house holds necessary
    - communication over the internet is inexpensive, flat rated and high speed

Persistent Connectivity

- persistent connectivity to phone network
  - is available in every office and home
    - can call/called phone anytime
  - slow, expensive, usage based charge
- persistent connectivity to internet
  - is available in every office and home in 2005
    - can send/receive information to/from internet anytime
  - high speed (broadband), inexpensive, flat rate

Phone Business and Broadband

- phone network is
  - network to transfer voice
- phone business is
  - to charge 10 yen for 3 minutes 64kbps local call
- broadband network as phone business
  - must charge 15000 yen for 3 minutes 100Mbps local communication
  - too expensive even with 90% discount
    - broadband network is not necessary!

Internet Business and Broadband

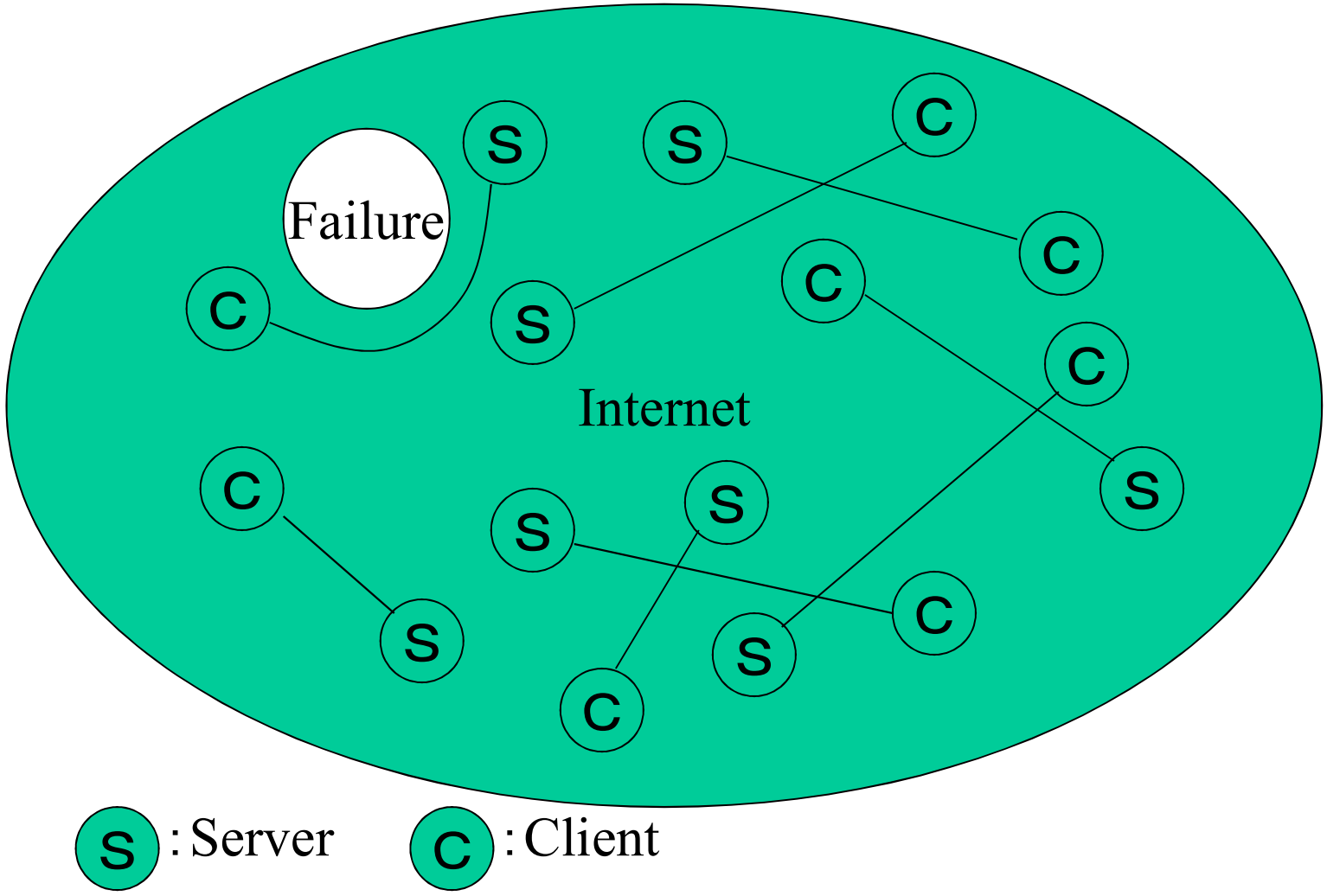
- internet is
  - network to connect computers
    - useful even if slow
    - the faster the more comfortable
- internet business is
  - to collect some (several k yen/month?) money
  - use most inexpensive/fast communication lines and equipment at the time
  - extract maximum capability of lines
    - broadband is inevitable (several Mbps with ADSL)

BTW, What is the Internet?

- Not e-mail
  - seriously thought so 20 years ago
- Not web, either
  - many still misunderstand so
- Is not applications
- The Internet is a network directly connecting terminals based on the principle of the Internet using IP (Internet Protocol)

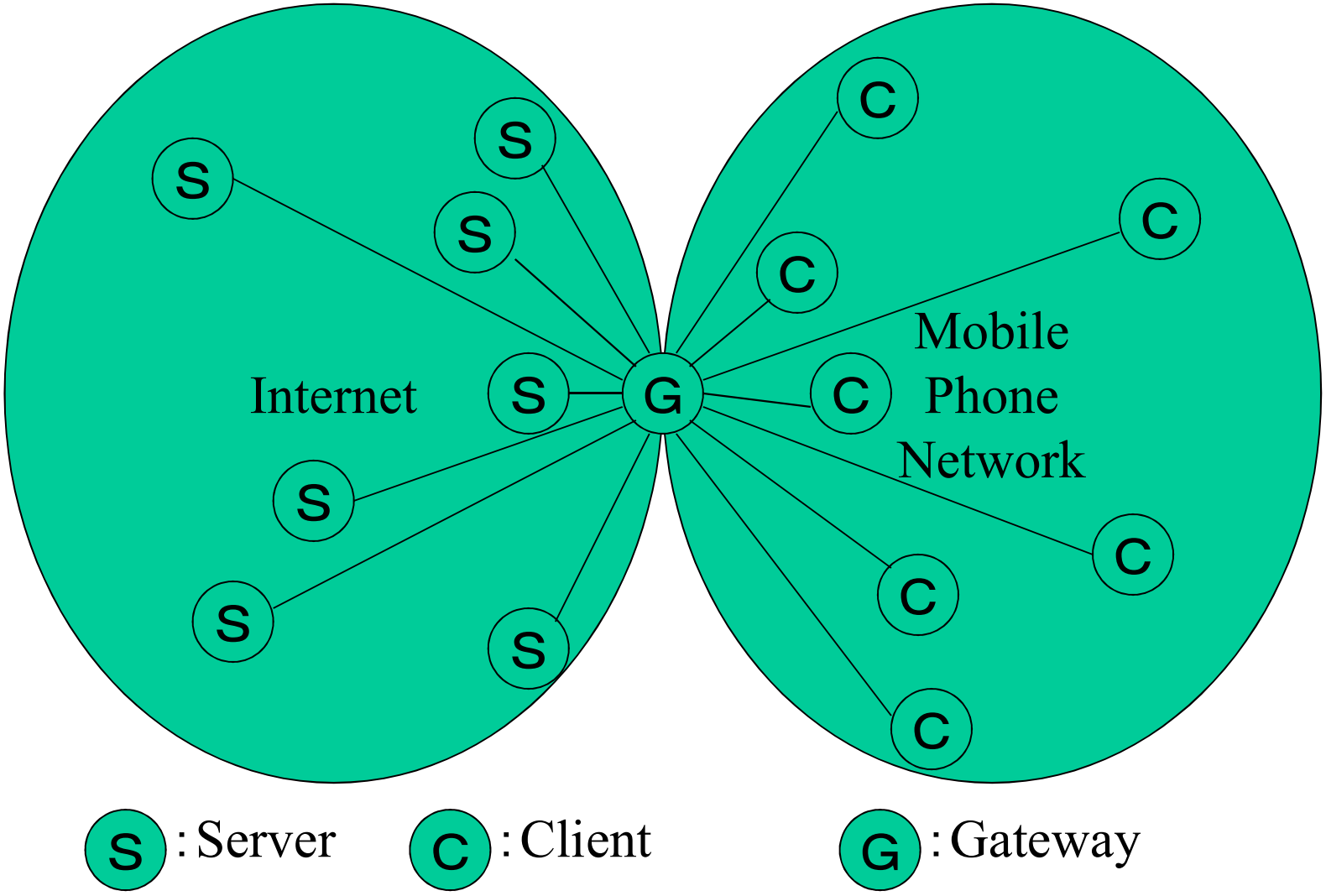
End to End Principle Disintermediated Networking

- implement things by terminals (end) not by the network
  - network equipment has only single function (to connect terminals) and is high speed
- implement things by directly involved terminals without involving other terminals
  - scalable (no load concentration)
  - highly reliable (system works if only terminals are working and can communicate each other over some route)



Internet

Servers and clients are mixed and communicate with shortest pathes

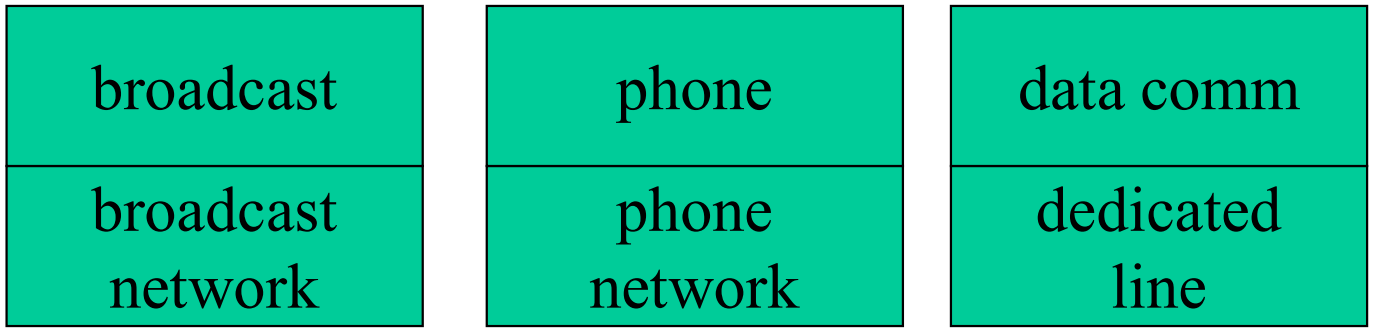


Web Browsing of i-mode from Mobile Phone Network

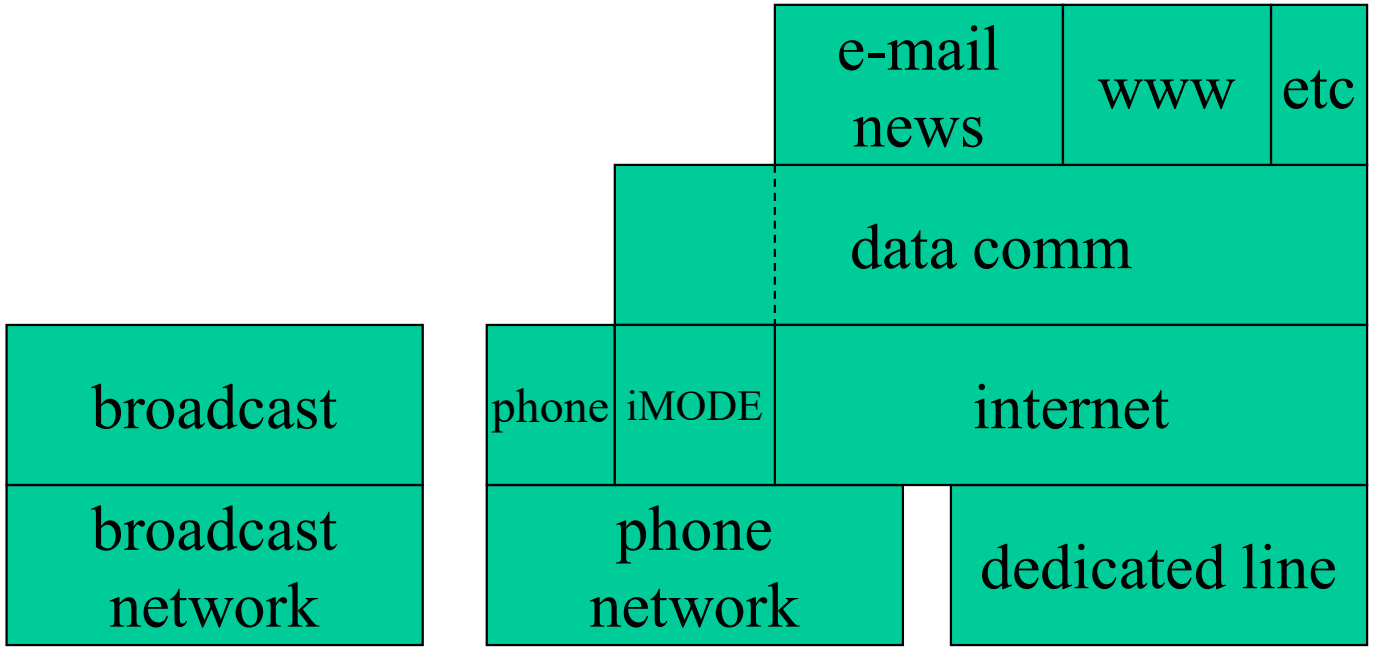
Servers and clients are separated and communicate through the gateway

Networking after IT Revolution

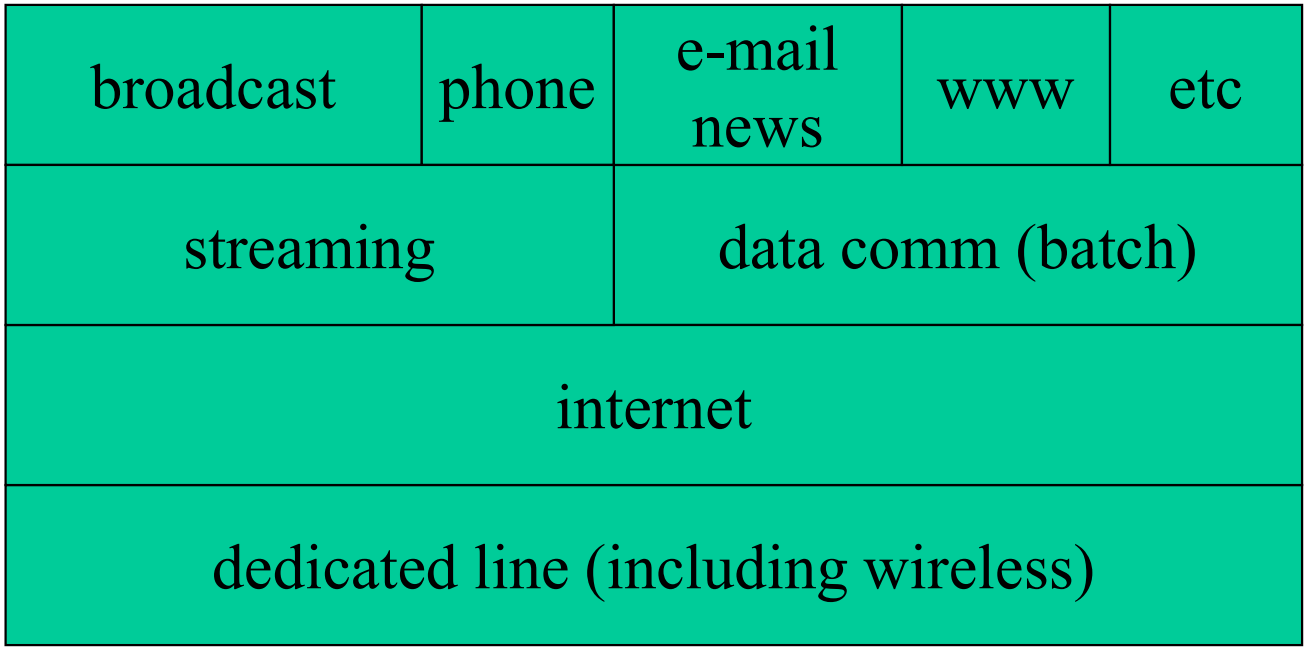
- price destruction of ICN by internet
  - publishing, financial, phone and broadcast networks will disappear
  - IC cost of the society decreased
    - ISP business itself is not so profitable
- publishing, financial, phone and broadcast services will:
  - remain relocated on the Internet
    - may not be profittable
  - social activities increase a lot



networks before the Internet



networks with the Internet

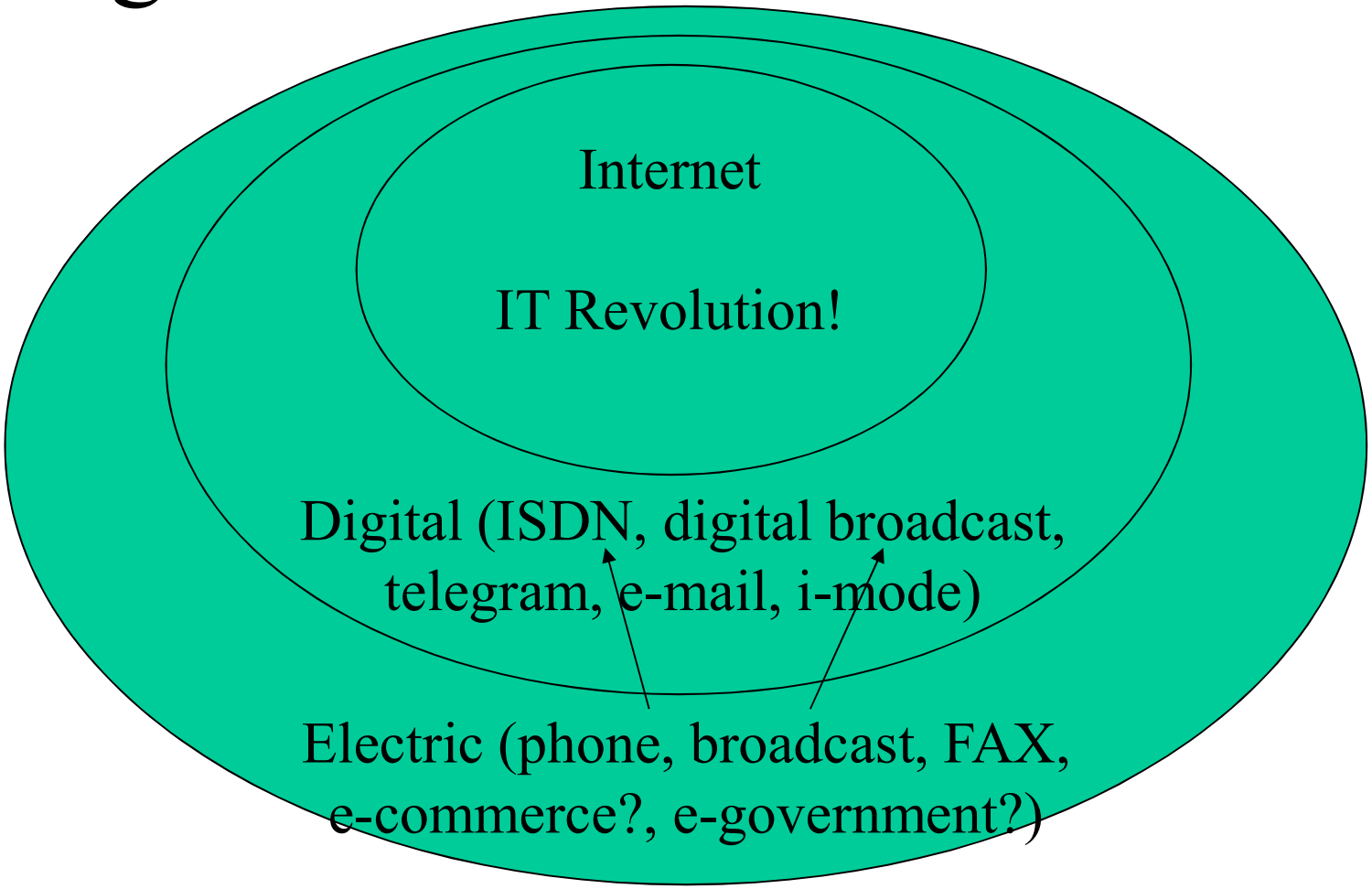


network in the future

Digitization ≠ Internetionalization

- digitization
  - complex processing possible by noise removal
  - signal fire, type, telegram, ATM, ISDN, digital broadcast, ...
- internetionalization
  - use IP end to end
  - unify information/telecommunication networks

Internetionalization, Digitization and Electronization

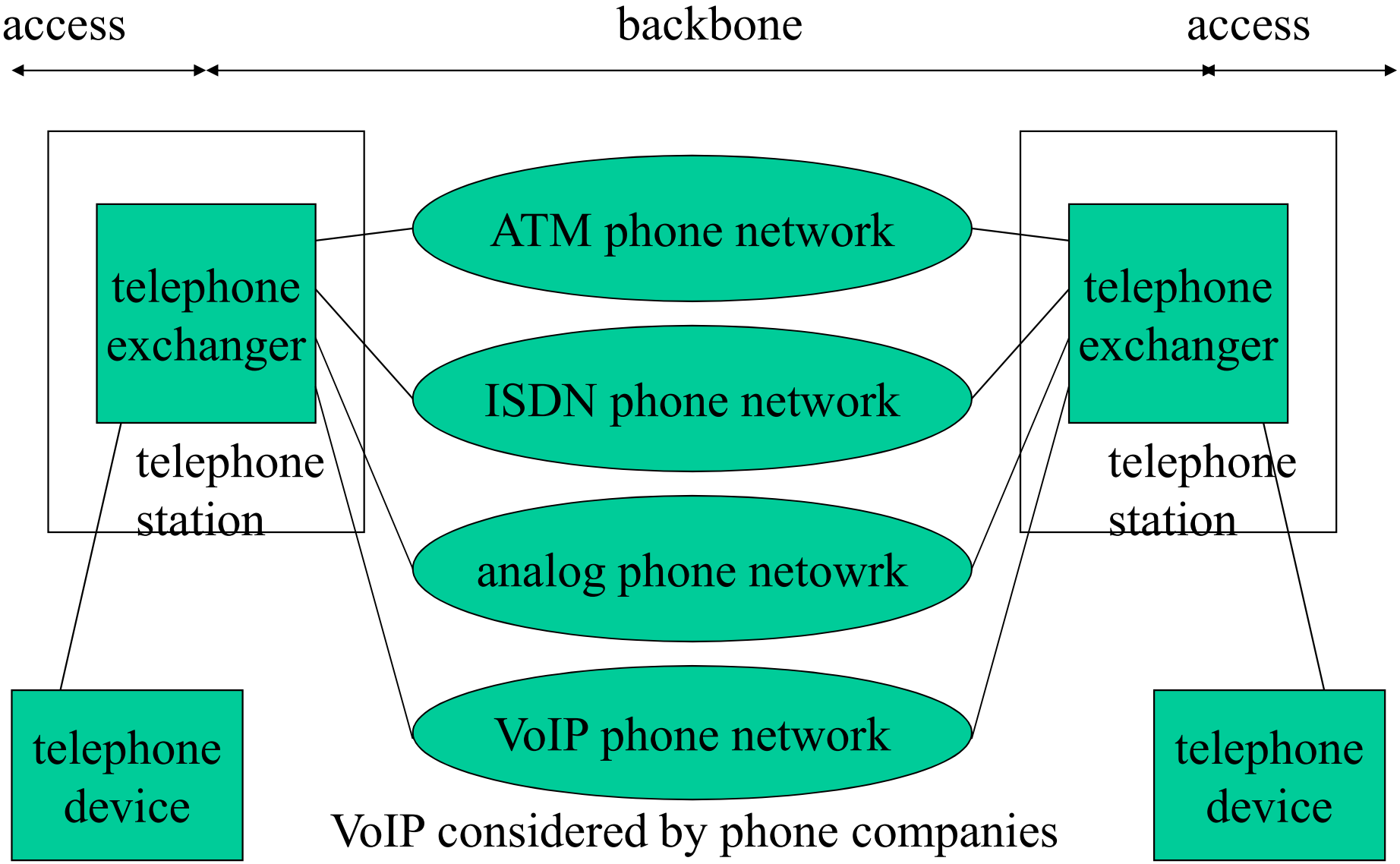


Service (Business?) Model for the Internet Era

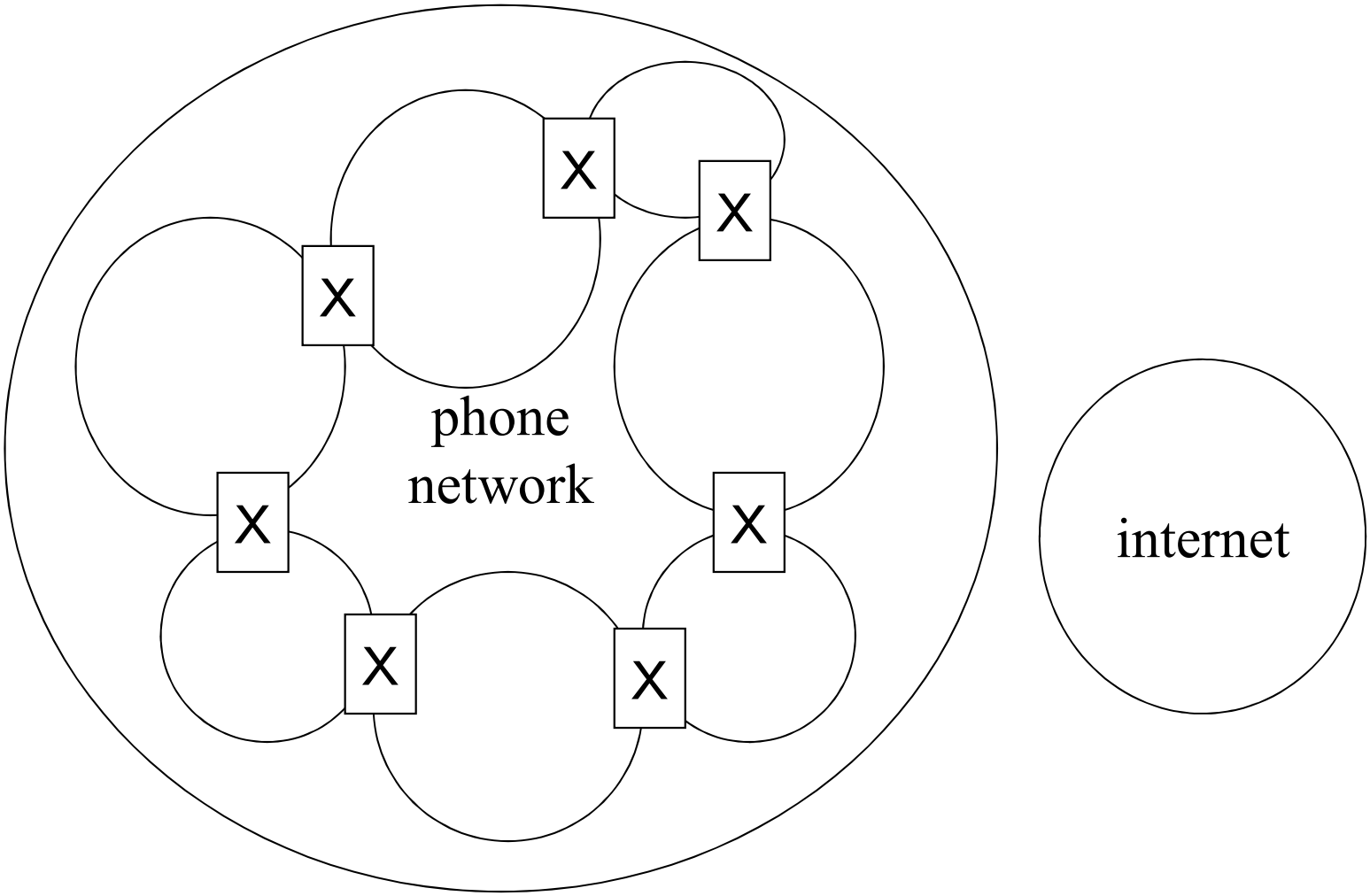
- client server model (BtoB, BtoC)
  - use web browsers on dial-up terminals
  - information provided by servers with persistent connectivity
    - server is maintained by special ISPs
- peer to peer model will be popular
  - anyone can provide information with persistent connectivity
    - ISPs just carry packets
  - cloud?

Disintermediation of IC Networks by IT Revolution

- publishing network is collapsing partly because of P2P file exchanges
- the next target is (was) phone network
  - internet backbone speed exceed that of phone network at around 2000
- with peer to peer model, phone can not be profitable
  - phone will be free (was obvious in 2000)



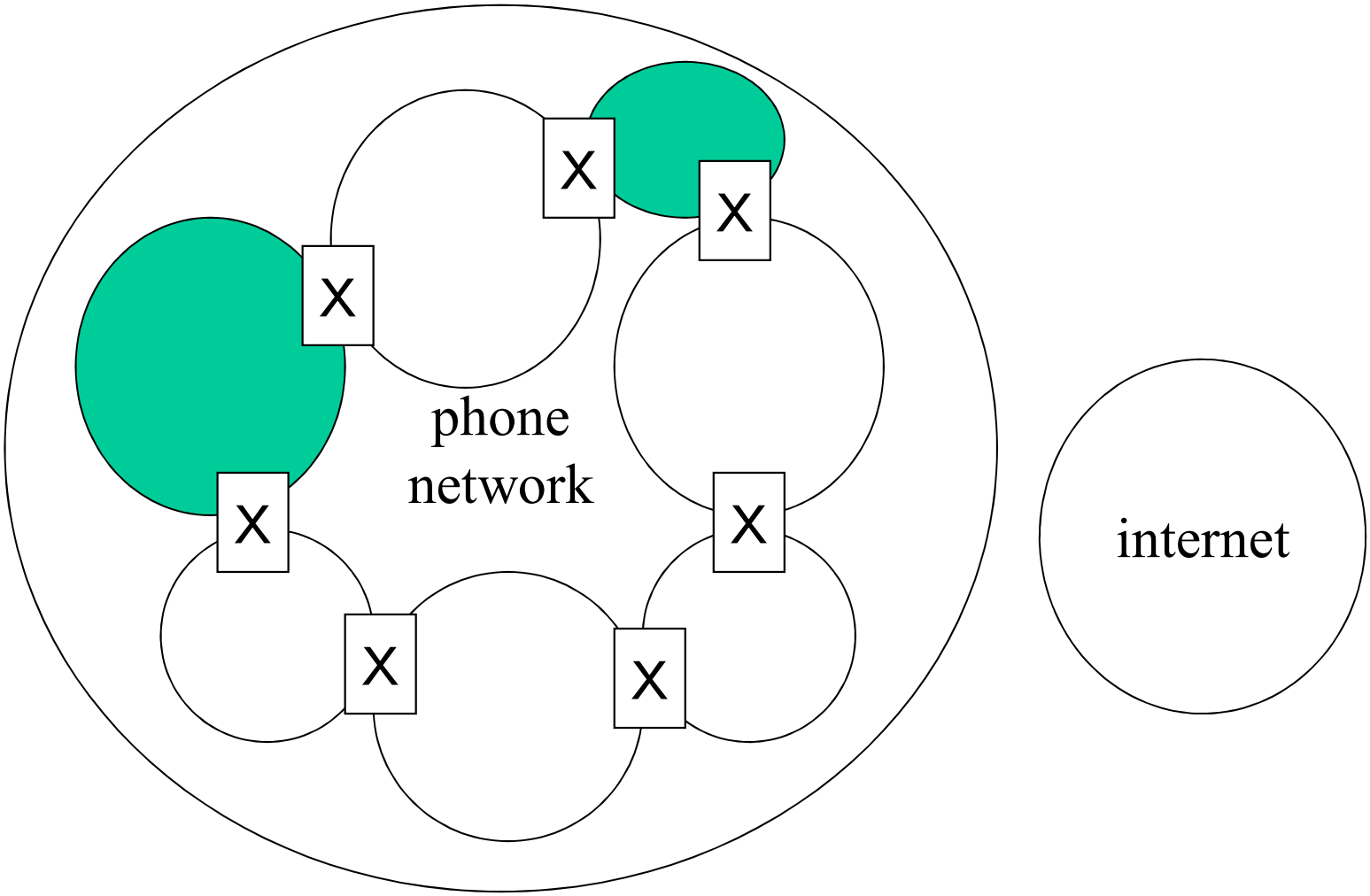
VoIP considered by phone companies
- VoIPize backbone phone -
better than other phone companies with ATM or ISDN



: VoIP phone network

X : telephone exchanger

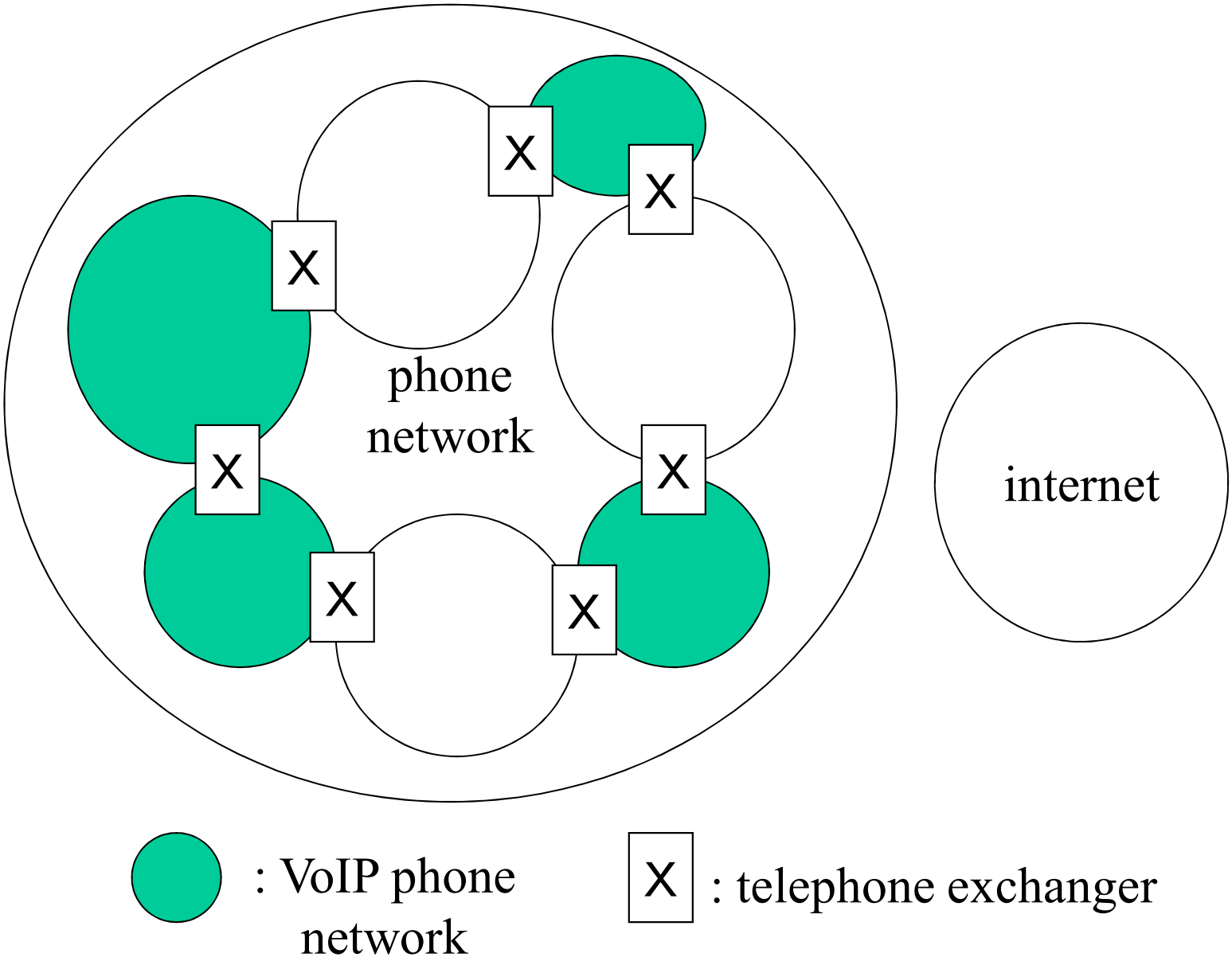
evolution of VoIP network 1 (as expected by phone companies)



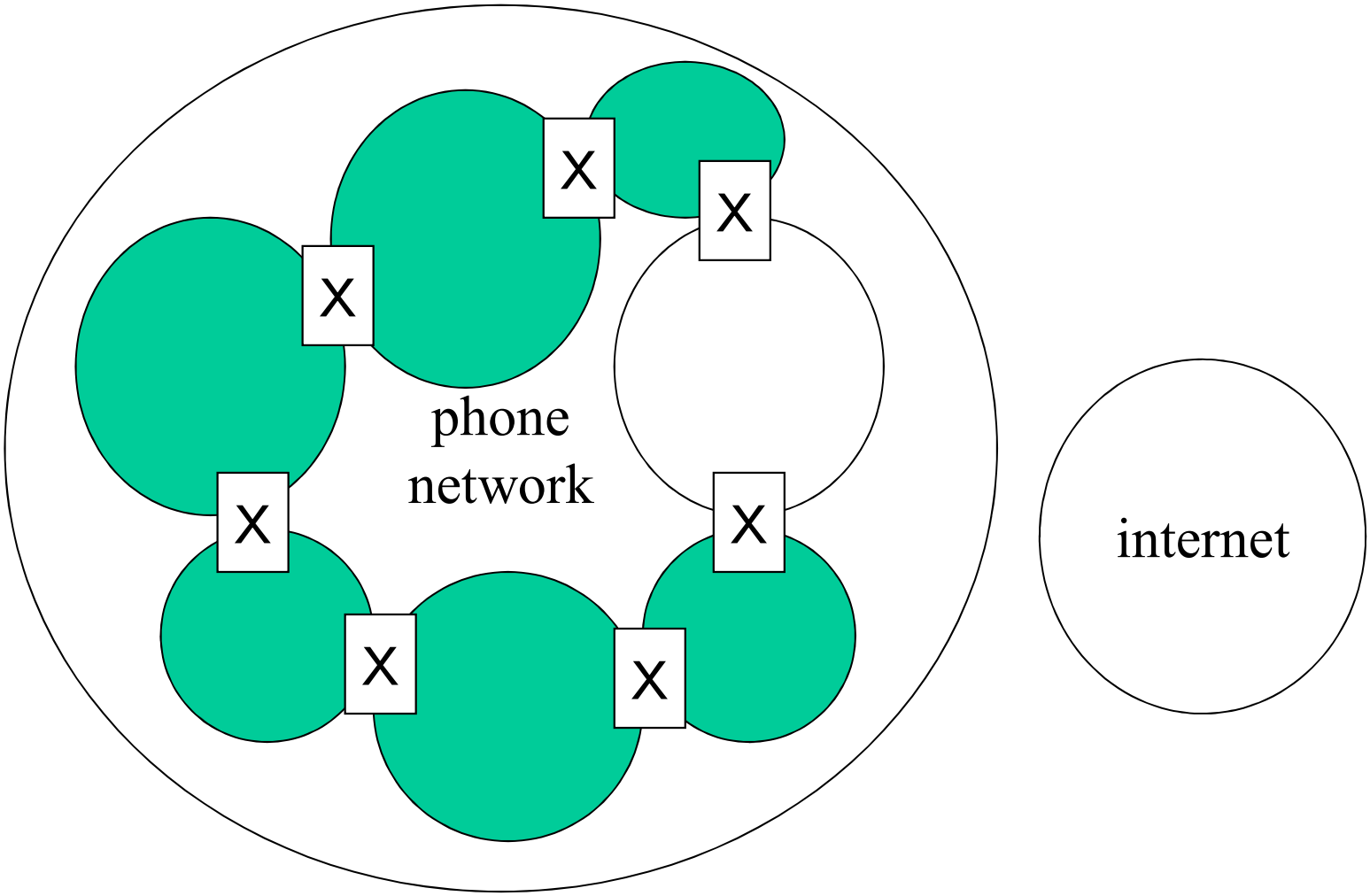
: VoIP phone network

X : telephone exchanger

evolution of VoIP network 2 (as expected by phone companies)



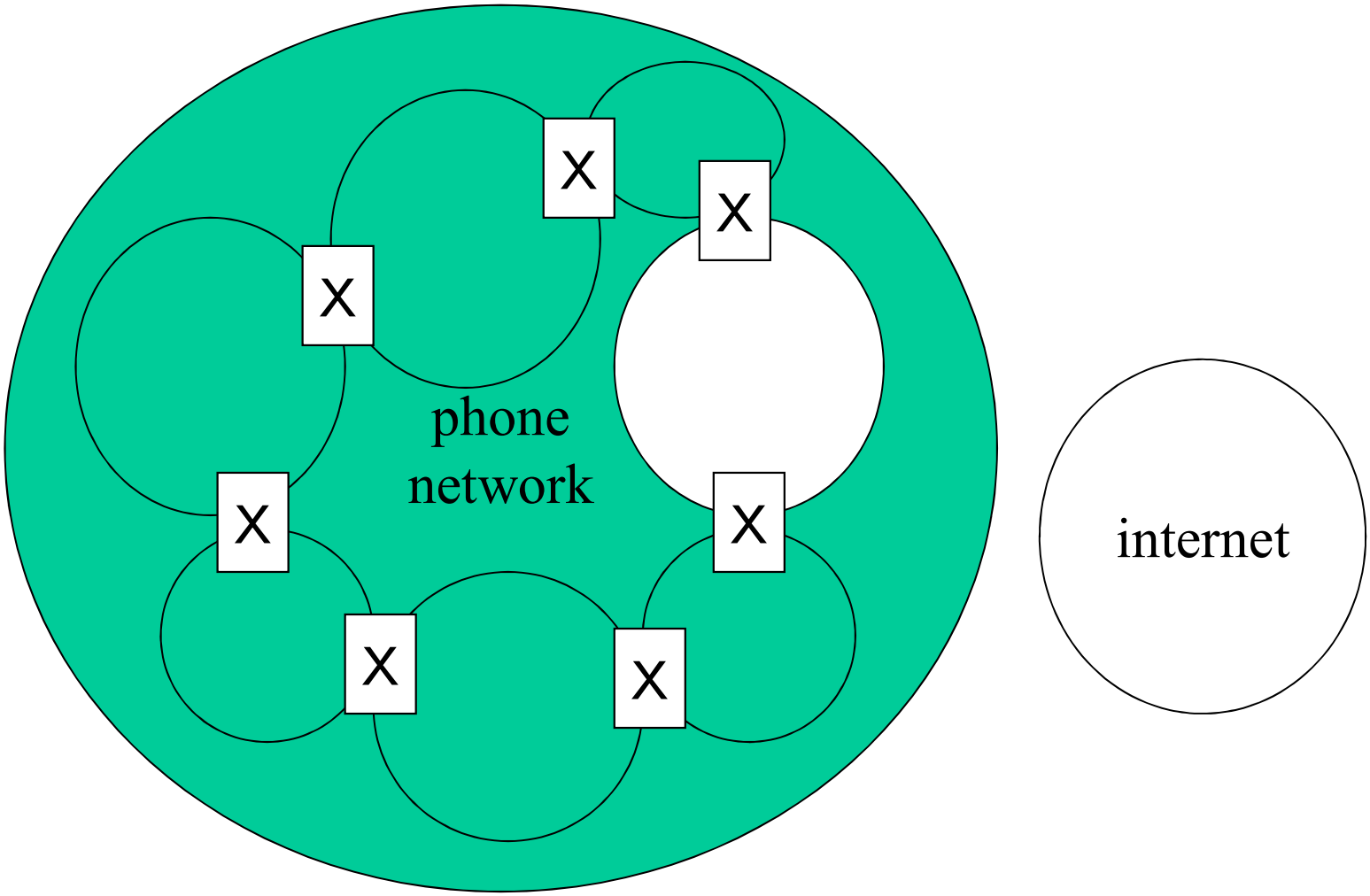
evolution of VoIP network 3 (as expected by phone companies)



: VoIP phone network

X : telephone exchanger

evolution of VoIP network 4 (as expected by phone companies)



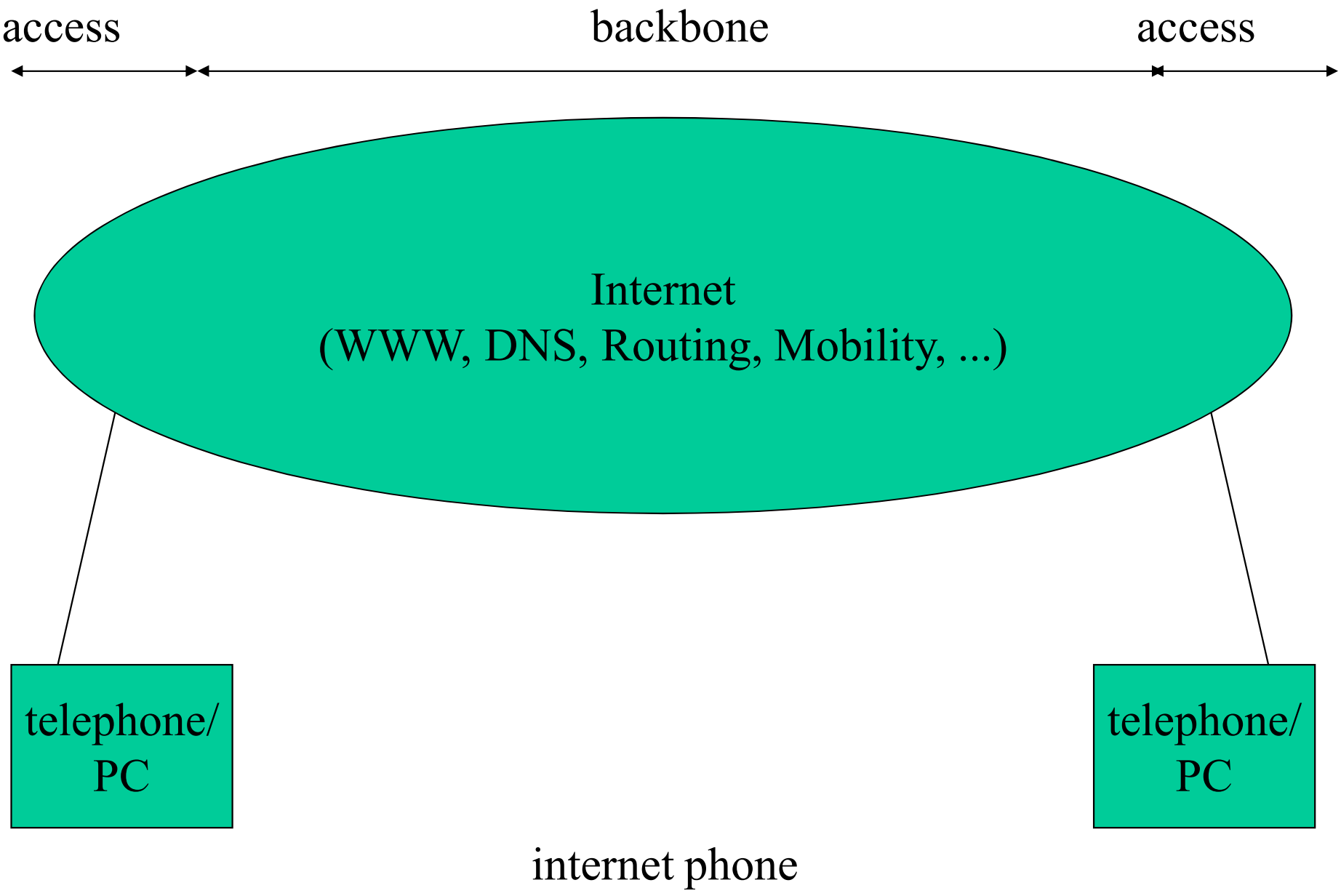
: VoIP phone network

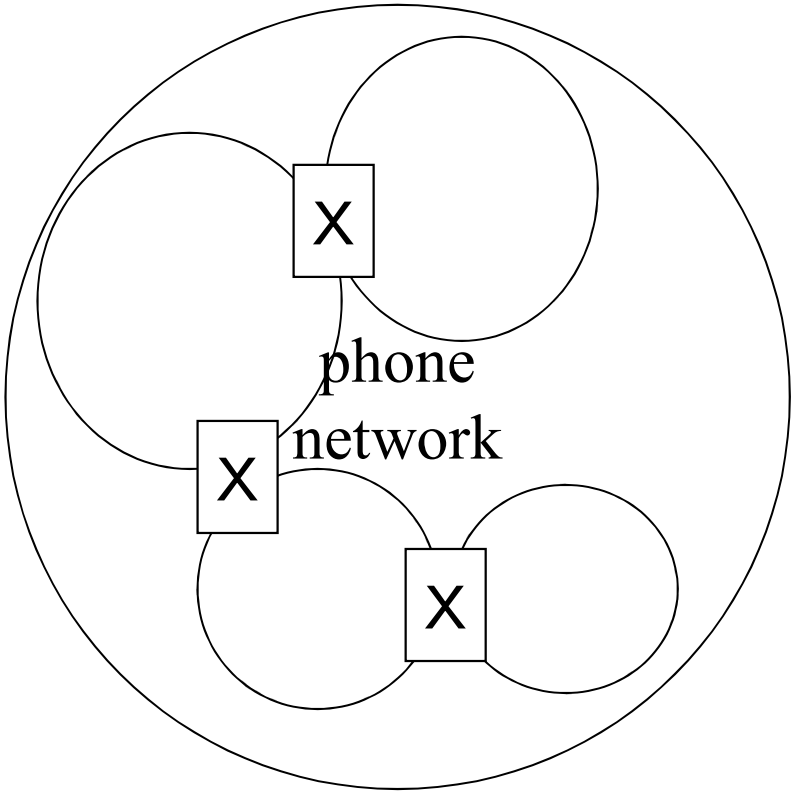
X : telephone exchanger

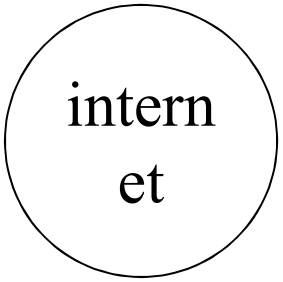
evolution of VoIP network 5 (as expected by phone companies)

Internet Phone Shock

- directly communicate between internet users
  - ISPs are not, can not be, involved
- practical as broadband internet evolves
- with persistent internet connectivity
  - completely free regardless of length of talk
    - phone business is meaningless
- can not be regulated
  - unless internet itself is strongly regulated


access
backbone
access
Internet
(WWW, DNS, Routing, Mobility, ...)
telephone/
PC
telephone/
PC
internet phone



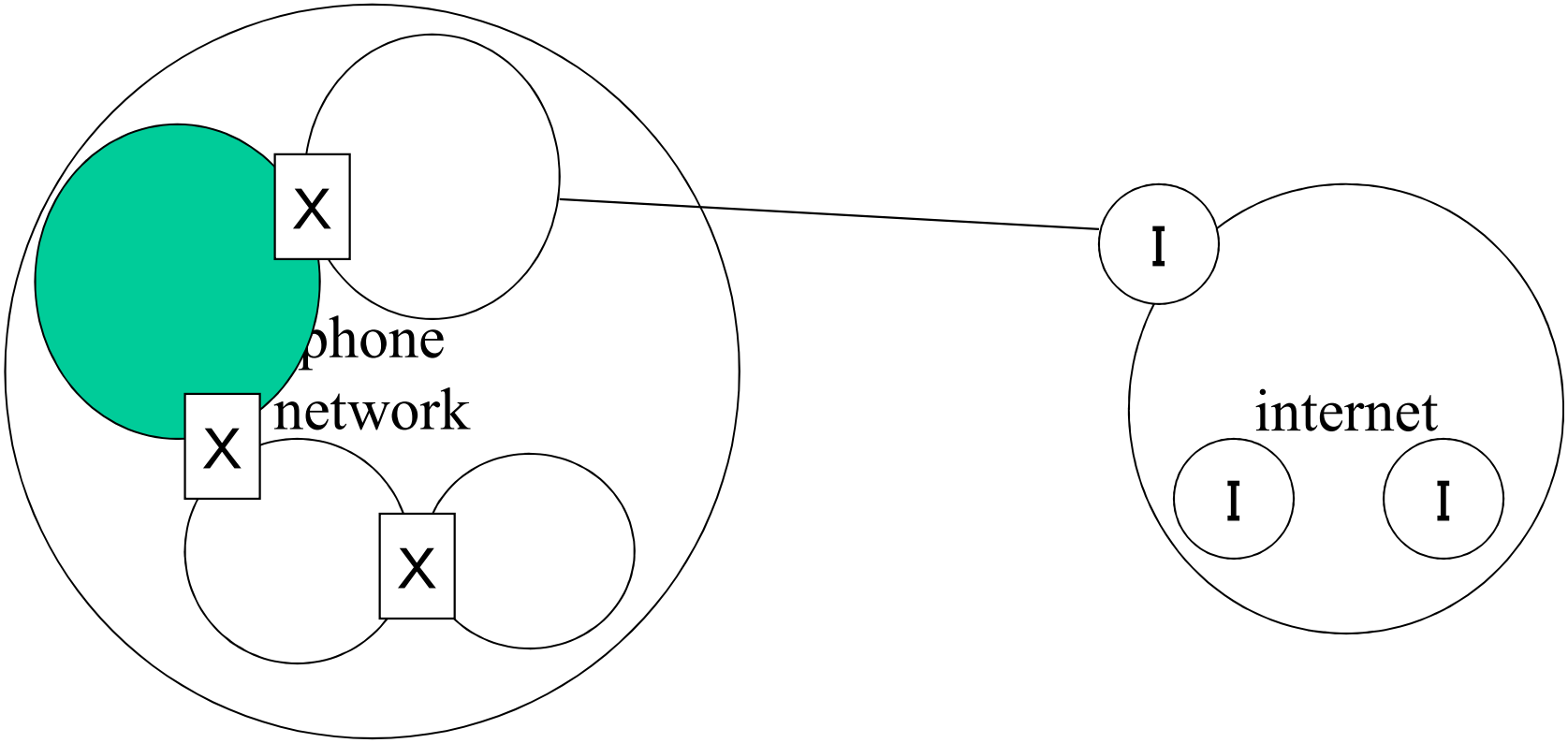


: VoIP phone network

X : telephone exchanger

I : internet phone device

evolution of the internet (1)

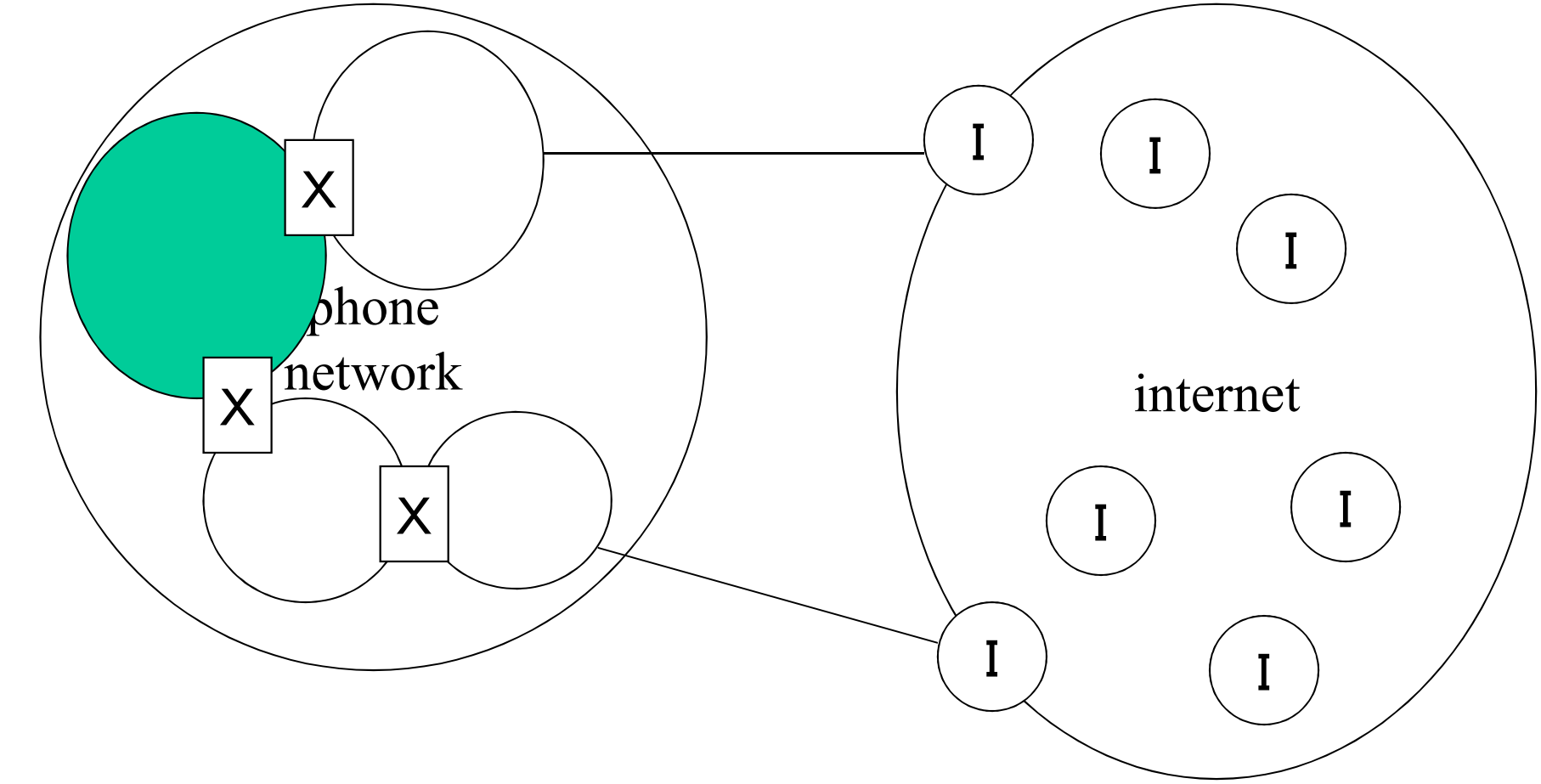


: VoIP phone network

X : telephone exchanger

I : internet phone device

evolution of the internet (2)

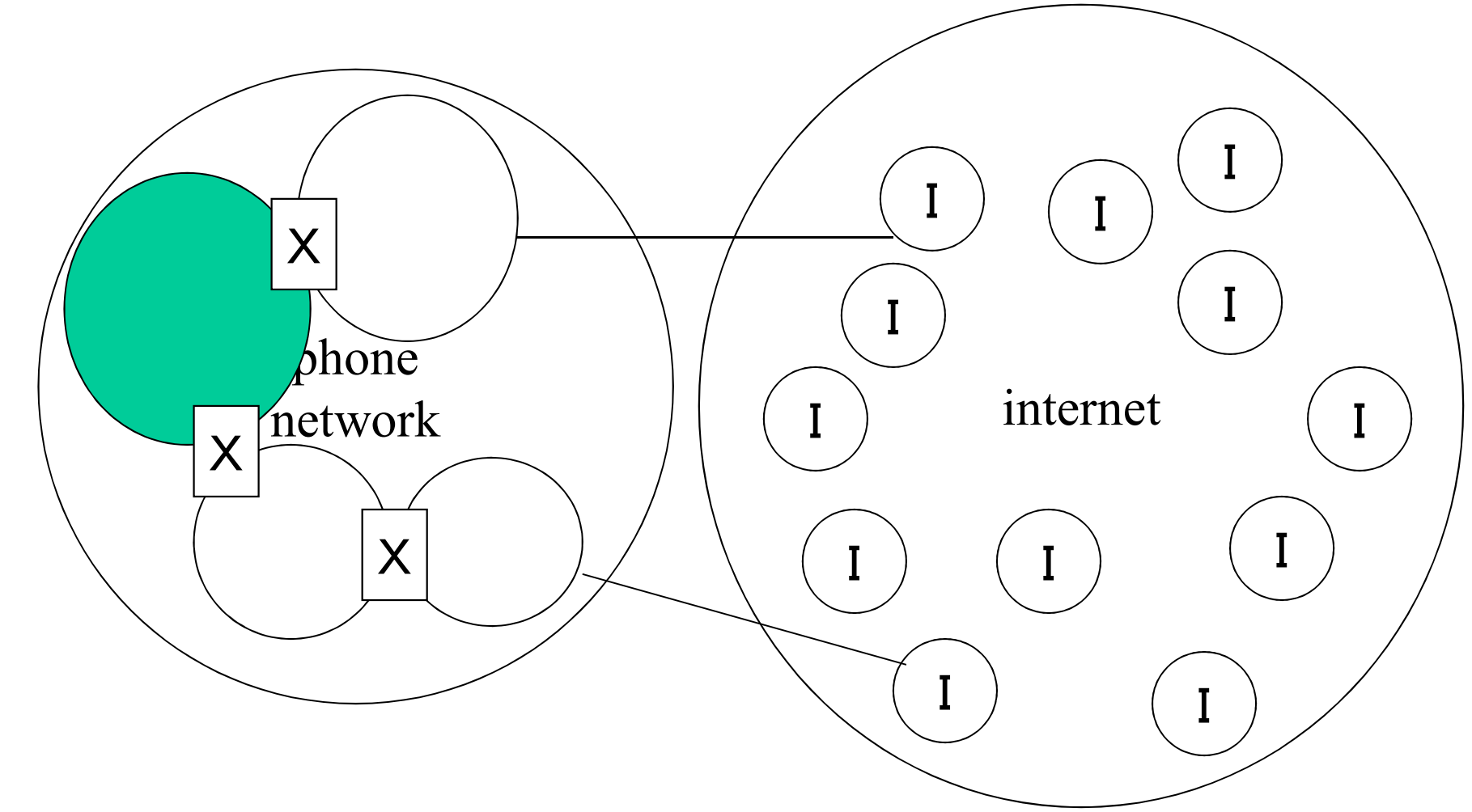


: VoIP phone network

X : telephone exchanger

I : internet phone device

evolution of the internet (3)

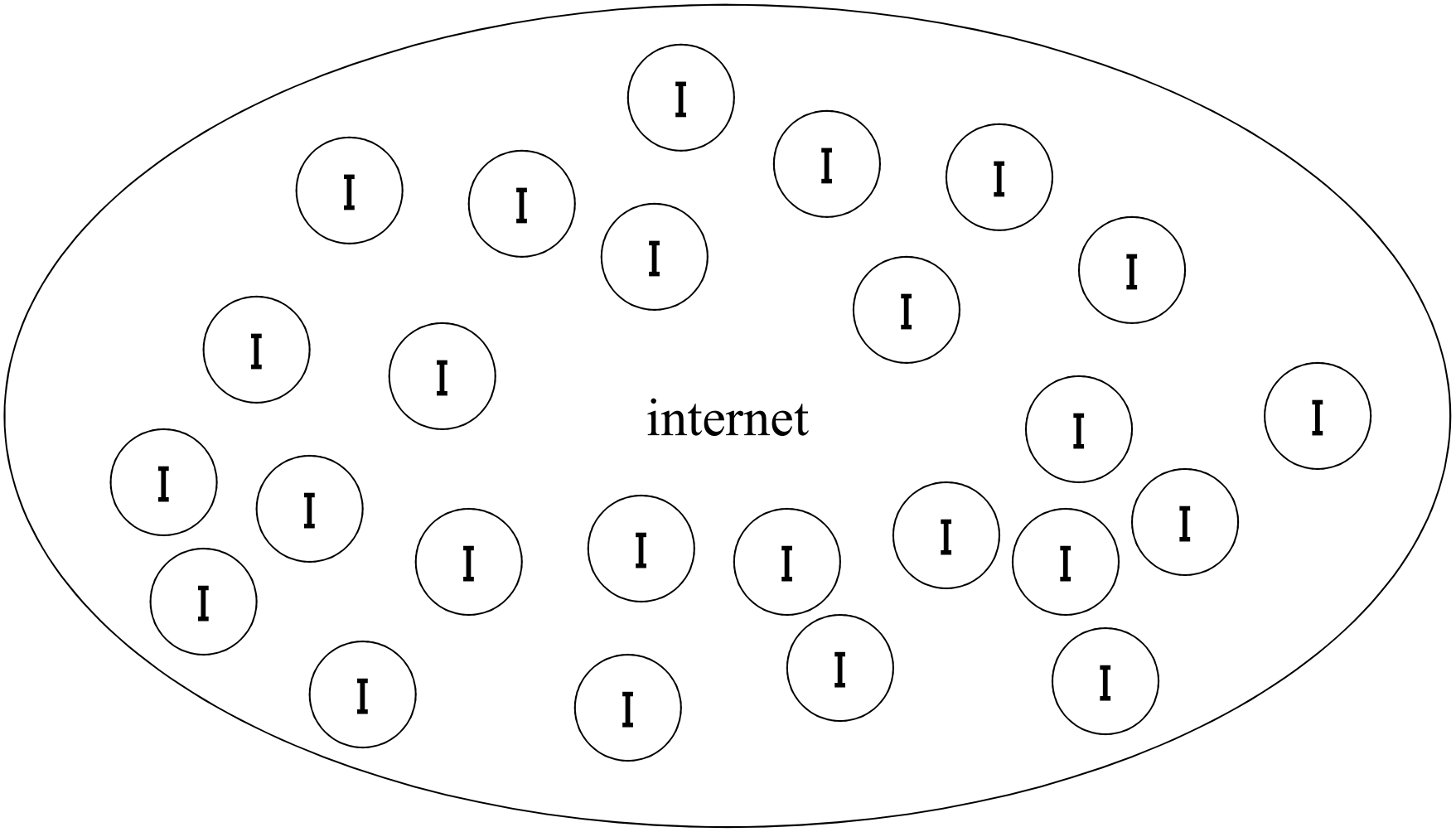


: VoIP phone network

X : telephone exchanger

I : internet phone device

evolution of the internet (4)



I : internet phone device

evolution of the internet (5)

How to Make Internet Phone Popular?

- persistent internet connectivity by ISPs!
  - should be available for most homes till 2005
  - automatically imply broadband
  - high speed backbone already available (2000)
- internet phone device?
  - dedicated ones (analog phone + TA)
  - PCs may be useful for calling
  - mobile devices with persistent connectivity?

How can Internet Phone Profitable?

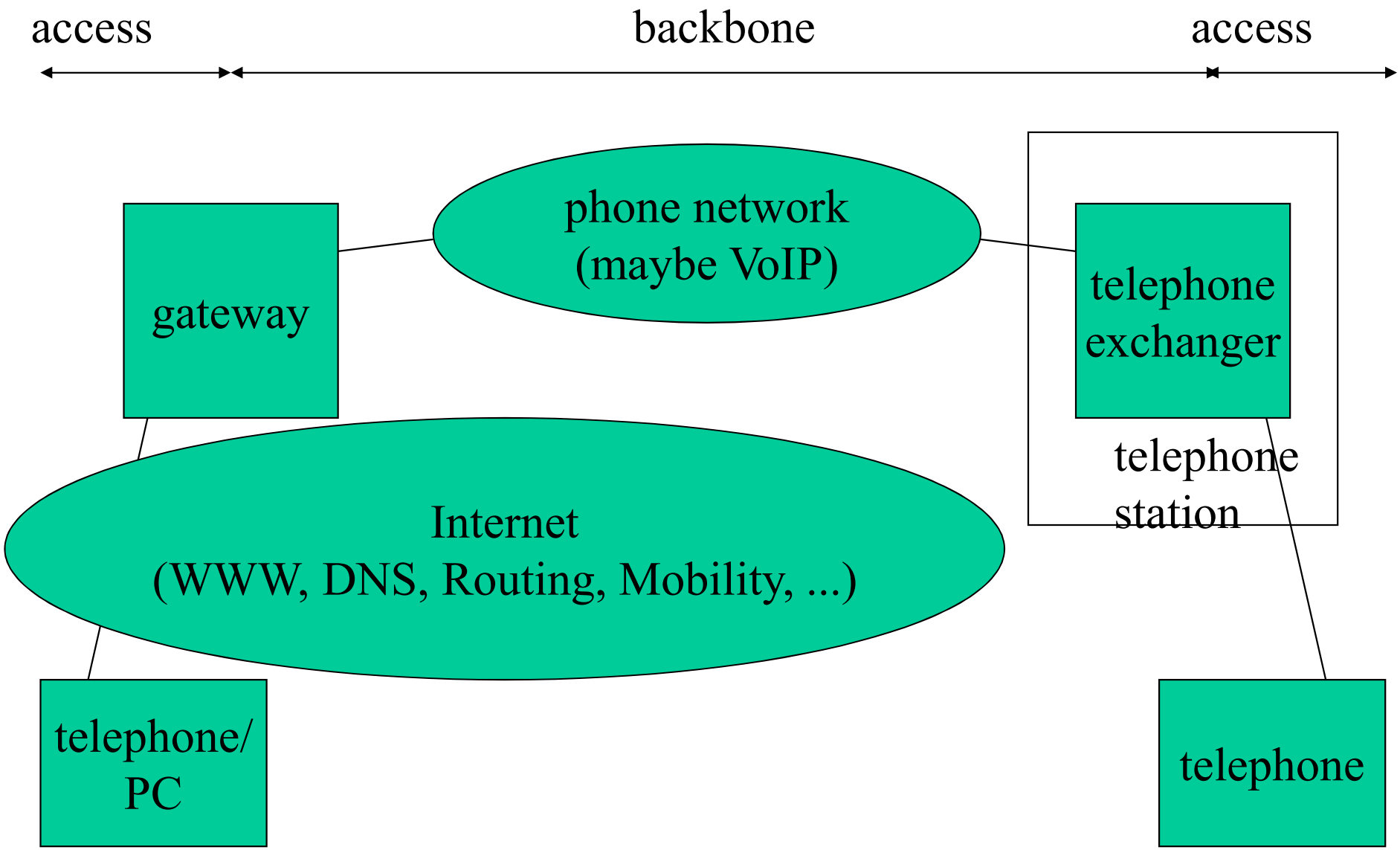
- let's make money by internet phone!
  - but, how?
  - internet charge is flat rated
  - with QoS guarantee, usage based charge?
  - no QoS guarantee necessary for voice
  - internet voice phone itself can not be profitable!

Service (Business?) Model for the Internet Era

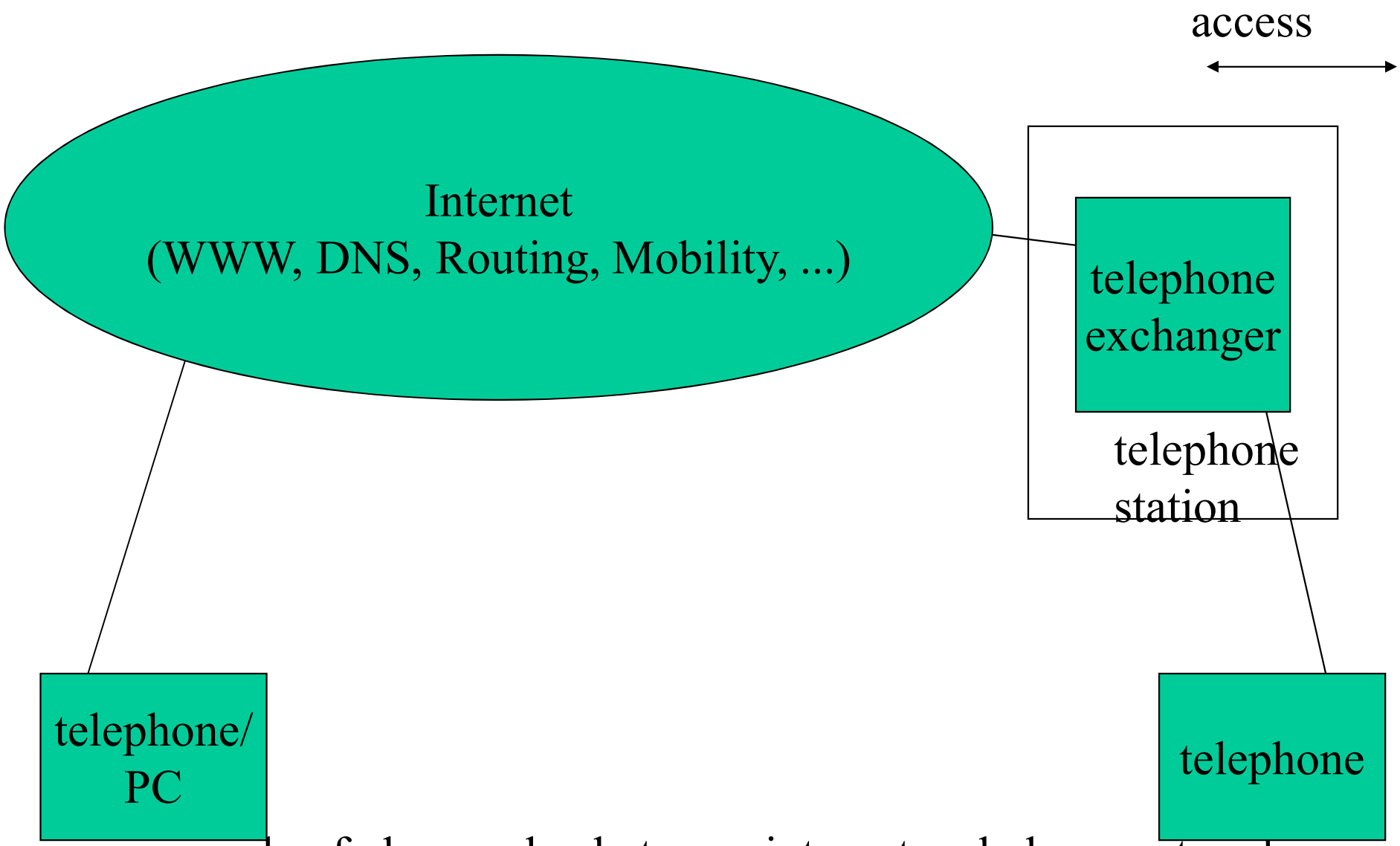
- within internet
  - communicate peer to peer
  - network do nothing, scarcely no ISP operations
    - no room for regulation or business
    - a lot of terminals can be purchased
- gateway between internet and phone network
  - should be profitable (as long as phone network alive)
- abandone immobile phone network?

Phone Relay Service between Internet and Phone Network

- provide relay gateways appropriately
  - maybe at all local stations
  - maybe at Tokyo, Osaka and USA
- free within internet (except for fixed ISP fee)
- usage based charge in phone network



example of phone relay between internet and phone network



example of phone relay between internet and phone network
place gateways at all local stations

Relay Service Model between Internet and Phone Network

- phone network -> internet
  - user in internet side may register (flat rate?)
    - telephone # necessary (maybe free)
- internet -> phone network
  - usage based charge within phone network
    - some security necessary (like calling card)
- phone network -> internet -> phone network
  - not very different from long distance carrier

The Mobile Internet

- mobile phone network is phone network
  - ￥0.3/128B means ￥20/sec @ 64kbps
- radio stations connected to wired high speed inexpensive flat rated internet service
  - wireless high speed inexpensive flat rated internet
  - security improvement necessary (802.11ai)
- wireless internet + IP mobility = the mobile internet

Regulation on Phone in Japan

- regulation on telecommunication equipment
  - electric power must be supplied from telephone station to analog phones
- no regulation on gateway service between internet and phone network

Regulate Internet Phone?

- difficult, if not business
- impossible to regulate voice communication only
  - gateways to phone network may be regulated
- what is regulated?
  - voice quality?
  - life line?
  - telephone number?

Voice Quality

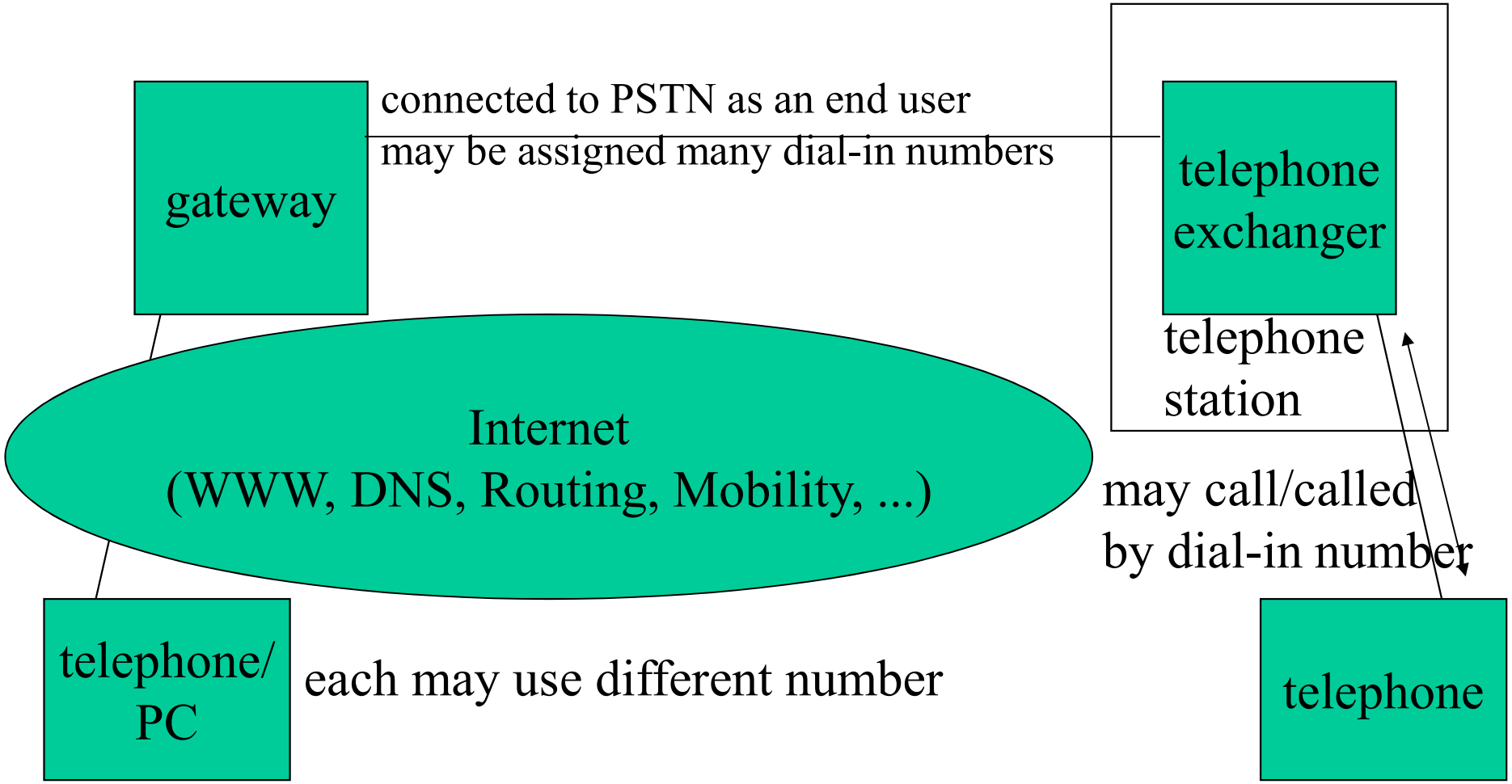
- may be important for charged service?
  - but, voice quality of telephone is low
    - voice quality of mobile phone is often even worse
- who complains, if it's free?
  - as backbone speed of internet far exceeds that of telephone network, not a problem at all

Is Telephone Lifeline?

- power must be supplied from telephone station to analog phones
  - ISDN phones also receive power
    - not enough for TA (terminal adapter)
      - TA can not be used upon power failure
      - some TA have slot for optional battery
- mobile phone has batteries
  - users are responsible to keep power supply
  - so should internet phone

Regulation by Telephone Number

- assign telephone number only when regulating condition is followed
- internet terminals are
  - identified primarily by IP addresses
    - domain names are also useful
      - identification by telephone number may be possible but is not necessary
- to received call from PSTN to internet
  - dial-in capability of PSTN is enough
    - assign many telephone numbers to a gateway



use ordinary (not 050 but 0ABJ) telephone number without regulation

Business Strategy with Internet Phone

- short term
  - attracting customers to ISPs
    - customers can save telephone charge
  - dial-up ISPs will disappear
- long term
  - attracting customers by telephone book service
    - map something to some phone ID
    - may be offered by search engines

Centralized/Distributed Internet Phone

- ISP operating central server
  - may be charged or free
  - can correct various privacy related information
- P2P
  - ISP can not control
  - completely free, unregulated

Protocols around Internet Phone

- H.323
  - standardized by ITU-T (phone companies)
- SIP
  - protocol for multicast meeting by IETF
- MGCP
  - complicated protocol by IETF
- NOTASIP

H.323

- ITU-T standard for phone over LAN
  - may be used for VoIP
- not scalable by itself
  - intermediate server (gate keeper) is used between LAN
    - details of gate keeper not specified
- negotiate port number etc. by TCP

SIP (Session Initiation Protocol)

- control realtime (multicast) multimedia stream
- may be used to control unicast voice stream
  - extended by IETF IPTEL WG
- assume intermediate servers (proxies)
- negotiate port number etc. by TCP

MGCP (Media Gateway Control Protocol, rfc2705)

- construct “VoIP phone network” with LANs using H.323 and/or SIP
  - control calls by telephone number
  - central server of “call agent” control phone terminals (media gateway)
    - very complex for simple functions
  - SIP becomes more popular than H.323
- more complicated with evolution of SGCP->MGCP->MEGACO

Problems of MGCP

- central server maintains all the state
  - especially correspondence between phone IDs and IP addresses
    - what is phone ID?
- back up server for fault tolerance is practically impossible
  - server down causes interruption of all the commnications
  - because of dependence on centralized server

NOTASIP Project

- a project for internet phone
  - funded by TAO (agency of MPT)
- no inventions, no complications
  - recognize terminals by URLs
  - manage connection to PSTN by RADIUS
    - security of calling card (4 digit PIN) is enough
  - analog telephone device should be usable as is
  - routing and mobility should depend on internet

Protocol Suites for NOTASIP

- NOTASIP signaling
- callee is described by URL
- RADIUS protocol to manage charging to PSTN

UDP and Port Number Negotiation

- UDP port number must be negotiated before communicating over the port number
  - communication requests are listened by a port
    - waited by a wild card source port number
    - after negotiation, must wait by a specific port #

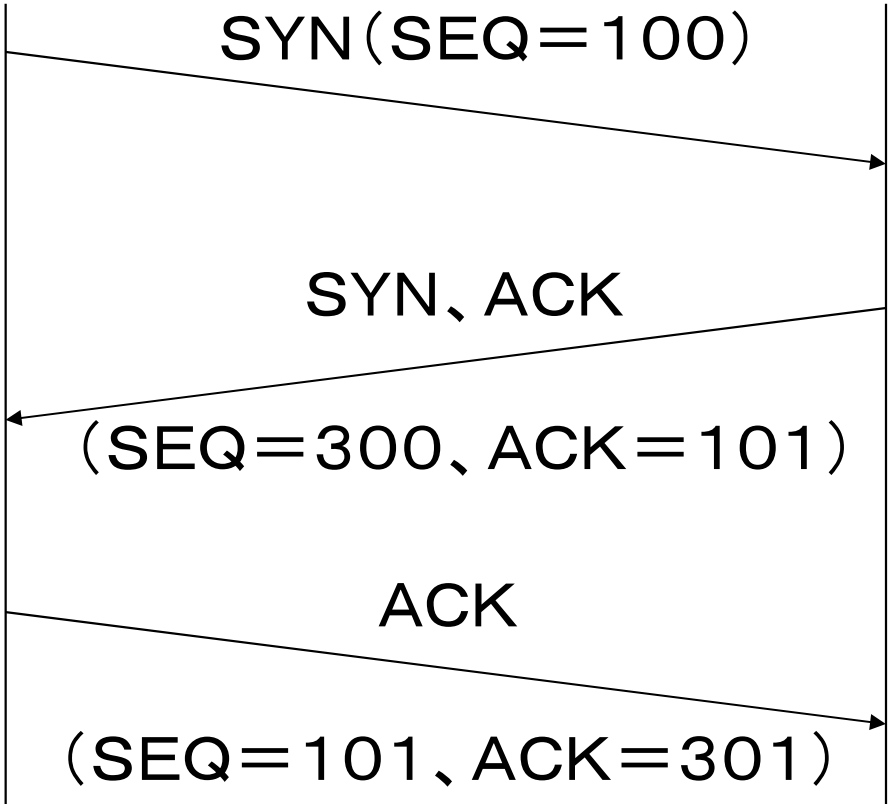
UDP and Port Number Negotiation

- negotiate by TCP?
  - like PORT/PASV command of TCP?
- negotiate by UDP?
  - like negotiation of TCP sequence numbers

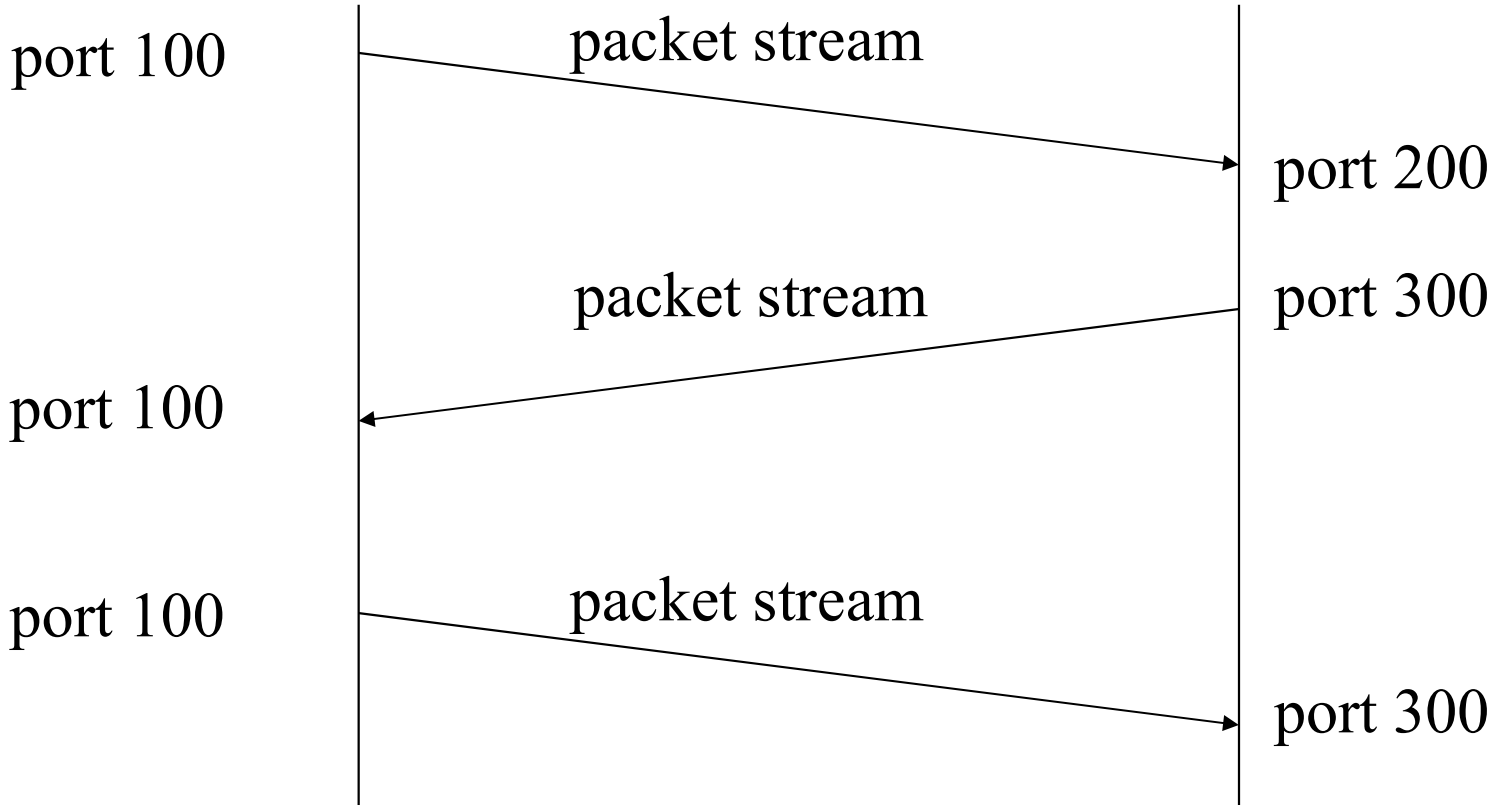
NOTASIP (Nothing Other Than A Simple Internet Phone)

- concentrate on port # negotiation
  - other information (such as encoding format) should be obtained at the time IP address and port number information was obtained
    - maybe by URLs
- negotiate port # by streaming
  - not affected by packet drops

Connection Establishment of TCP
3-way Hand Shaking

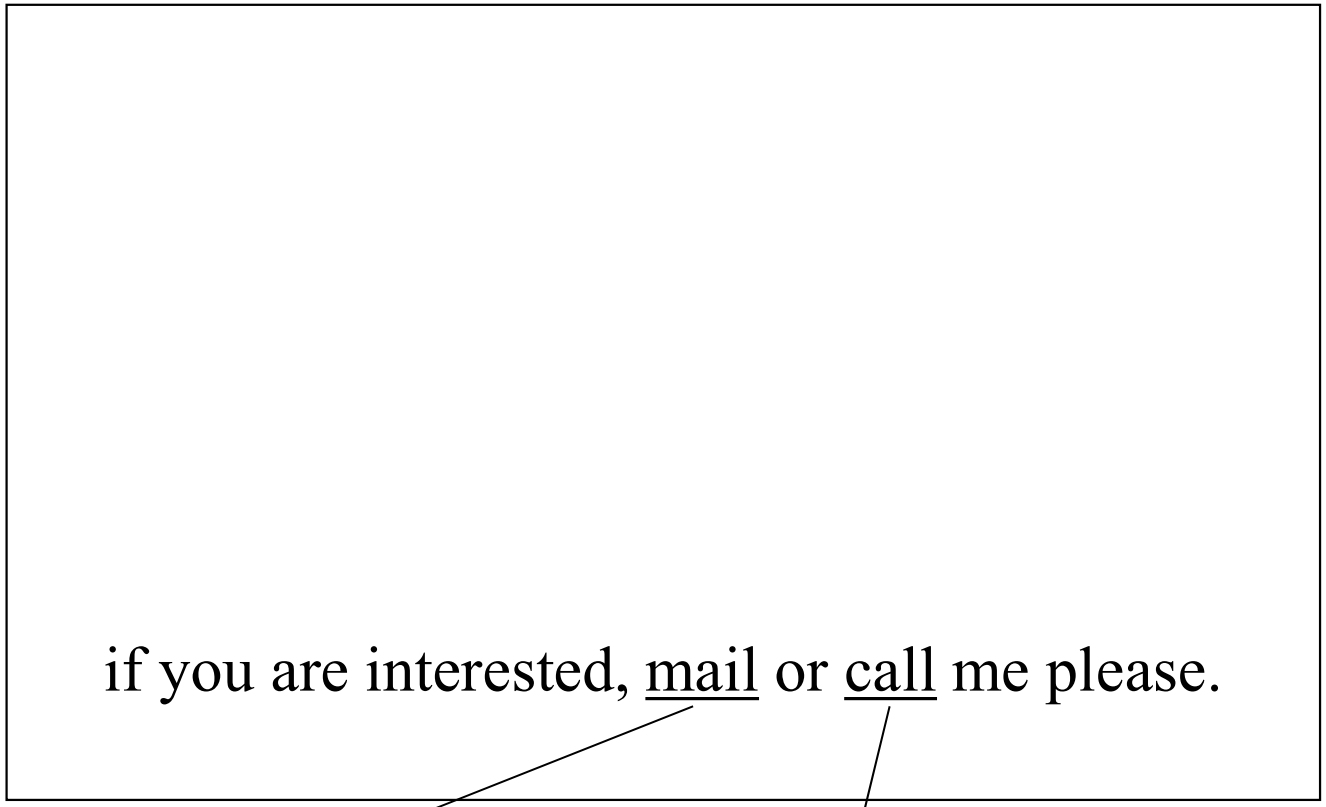


3-way Handshake of NOTASIP



Depending on URLs Means

- in user's home page
  - can embed phone URL like mailto: ones
- phone book is
  - search engine (maybe with advertisement)
    - search before calling
      - can directly call (access) others in internet
      - may call others in PSTN through (charged) gateways
- URLs with location of telephone number not useful
  - need proprietary mapping to IP address



example of a web page with internet phone URL

Products (?) for NOTASIP

- TA between analog phone device and internet (Ethernet)
  - also act as web server
    - may be used as private phone book
  - can be configured from analog phone device
- software on windows PC
  - initiated from browsers
  - free (?)

Treatment of Telephone Number with NOTASIP

- not used internally
- analog phone device needs phone number
  - terminal (TA) convert phone number to (URL pointing to) IP address
  - terminal may ask other phone book servers
    - like name servers of DNS

論文発表

- “The Simple Internet Phone” presented at INET2000
  http://www.isoc.org/inet2000/cdproceedings/4a/4a_3.htm

  The "Simple Internet Phone" has an architecture tuned for a coming situation in which non-Internet networks, such as IP-based private telephone networks, will disappear. While the "Simple Internet Phone" is a form of VoIP, most, if not all, VoIP protocols are designed placing the priority in the affinity to the telephone network. However, it is obvious that the telephone network will be replaced by the Internet, and will eventually disappear. At that time, most of the features of VoIP protocols will become obsolete. Instead, the “Simple Internet Phone” is designed placing the priority in the affinity to the Internet and its architectural principles as an end-to-end globally connected and scalable IP network. As a result, most features of VoIP are substituted by the existing Internet protocols. With Internet phones callees are required to have persistent connection to the Internet with globally unique addresses, which contributes to promote the healthy development of the Internet.

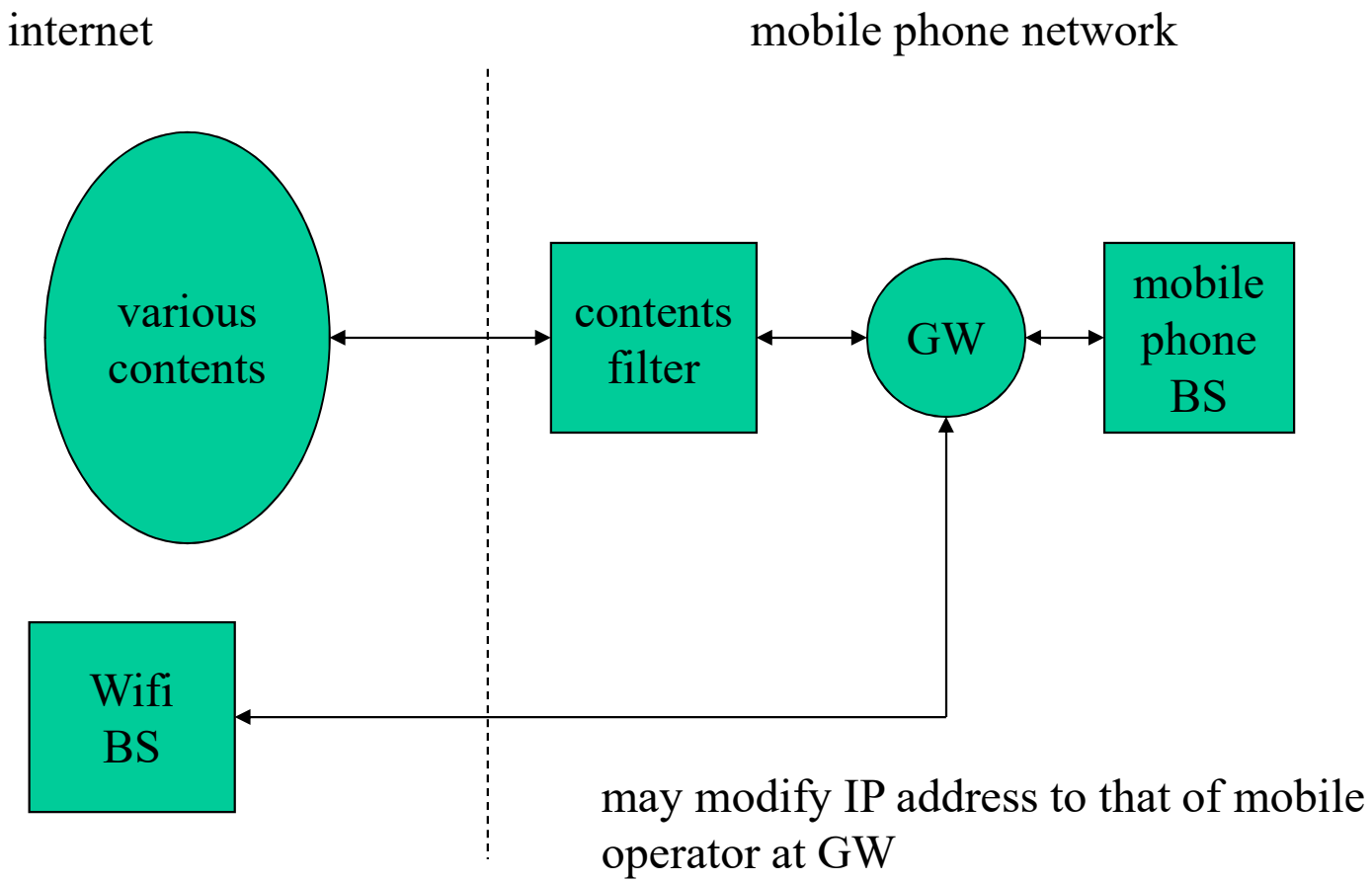
Current State of VoIP and Internet Phone

- NGN standardized by ITU-T is VoIP
- internet phone with central servers widely available
  - skype, line, comm, ...
  - no URLs

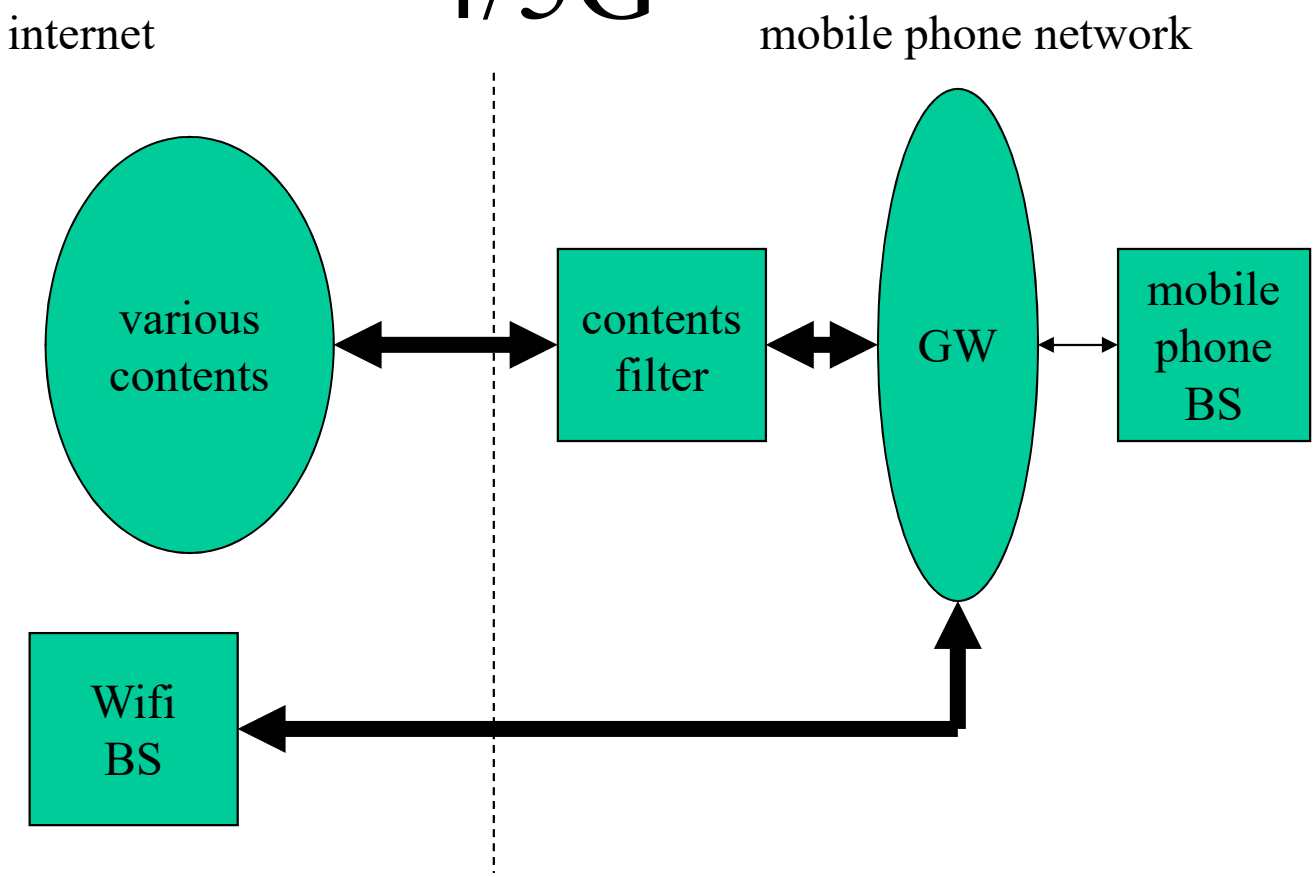
Future of Mobile Phone Network and Public Wifi Service

- does Wifi complements 4/5G?
  - inherit complexity of phone network forever
- does Wifi replace 4/5G?
  - low cost, simple, efficient
- partly depends on IEEE

Wifi to Complement 4/5G

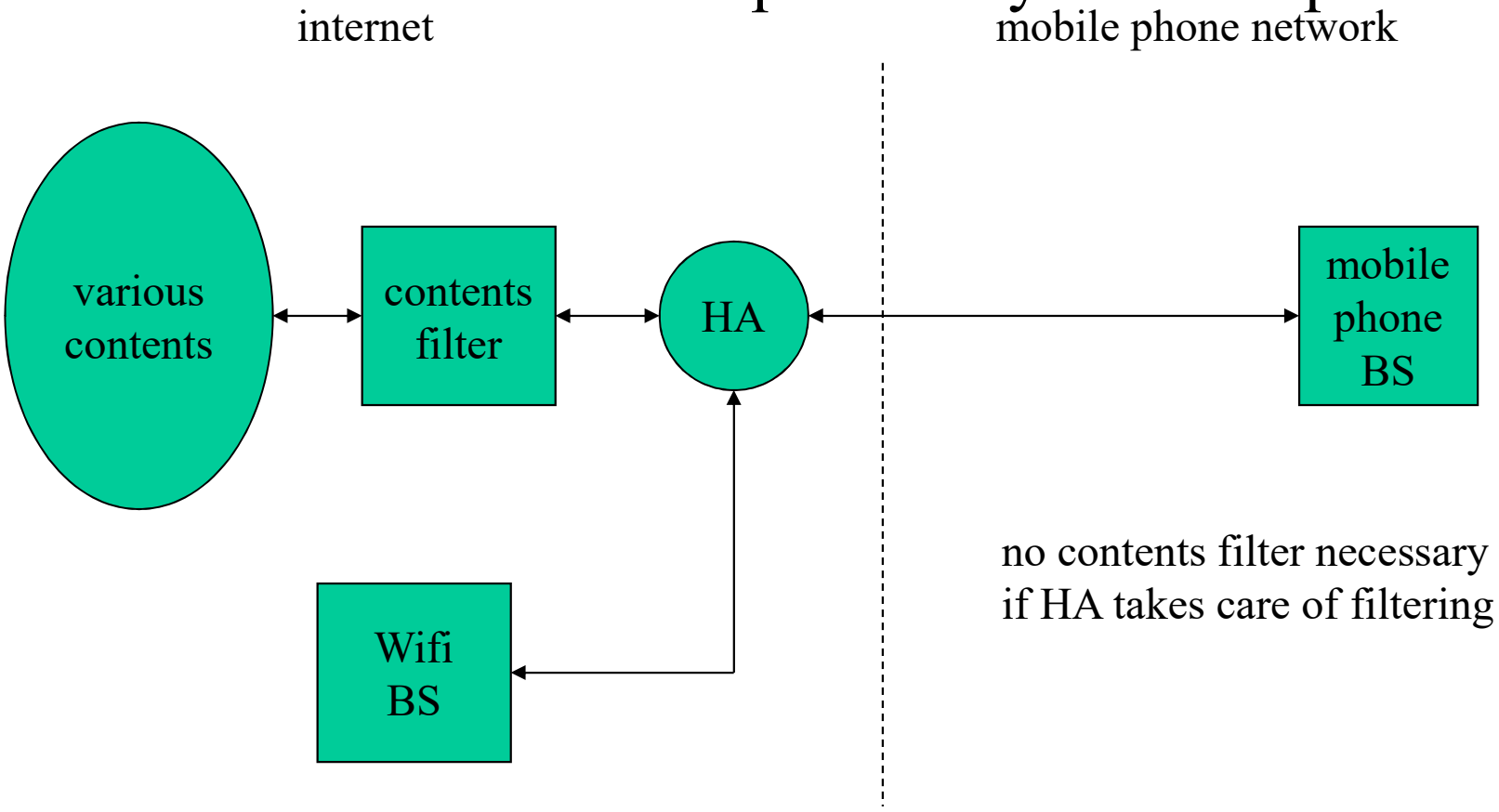


Future of Wifi to Complements 4/5G



Wifi to Replace 4/5G

HA and contents filter operated by mobile operator



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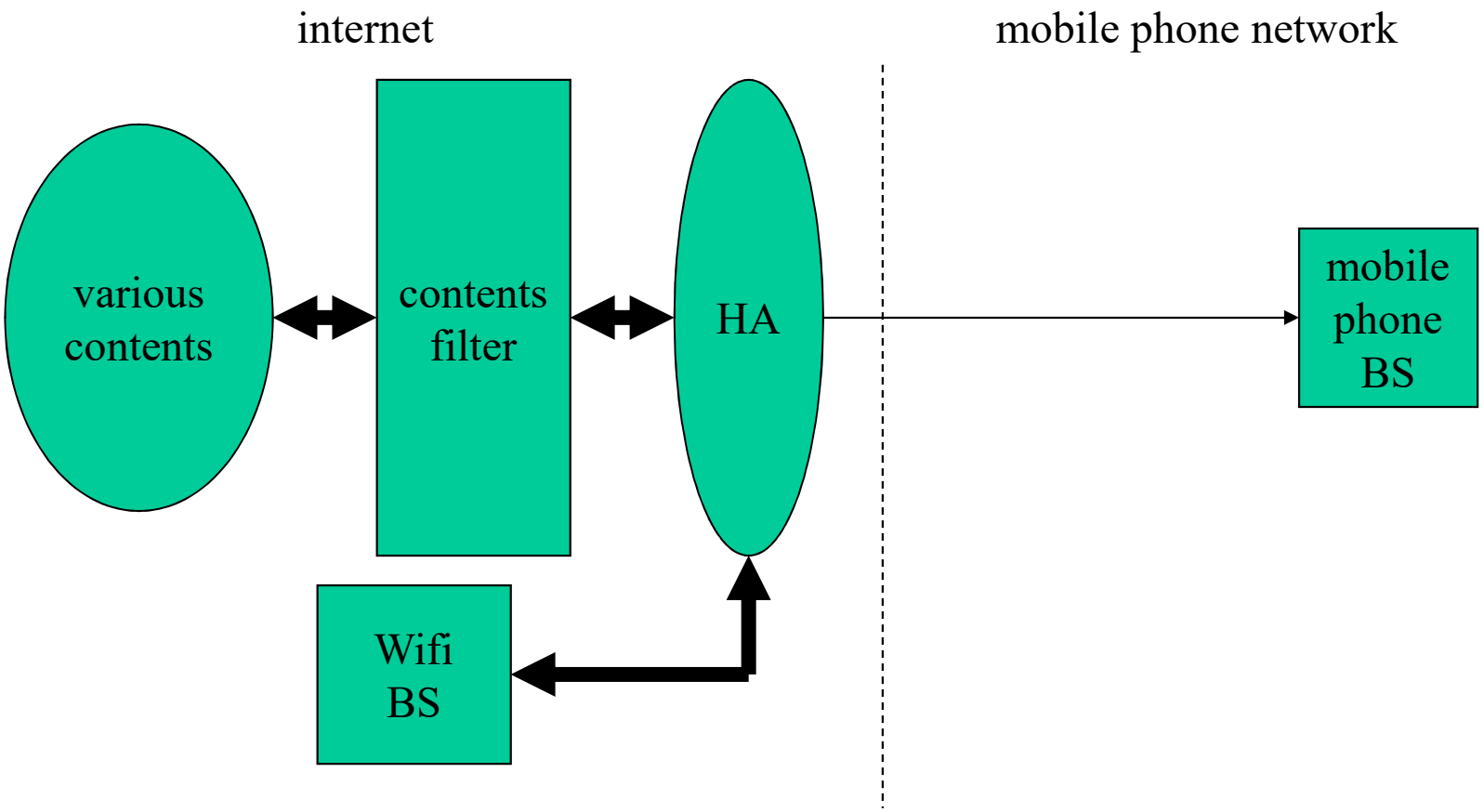
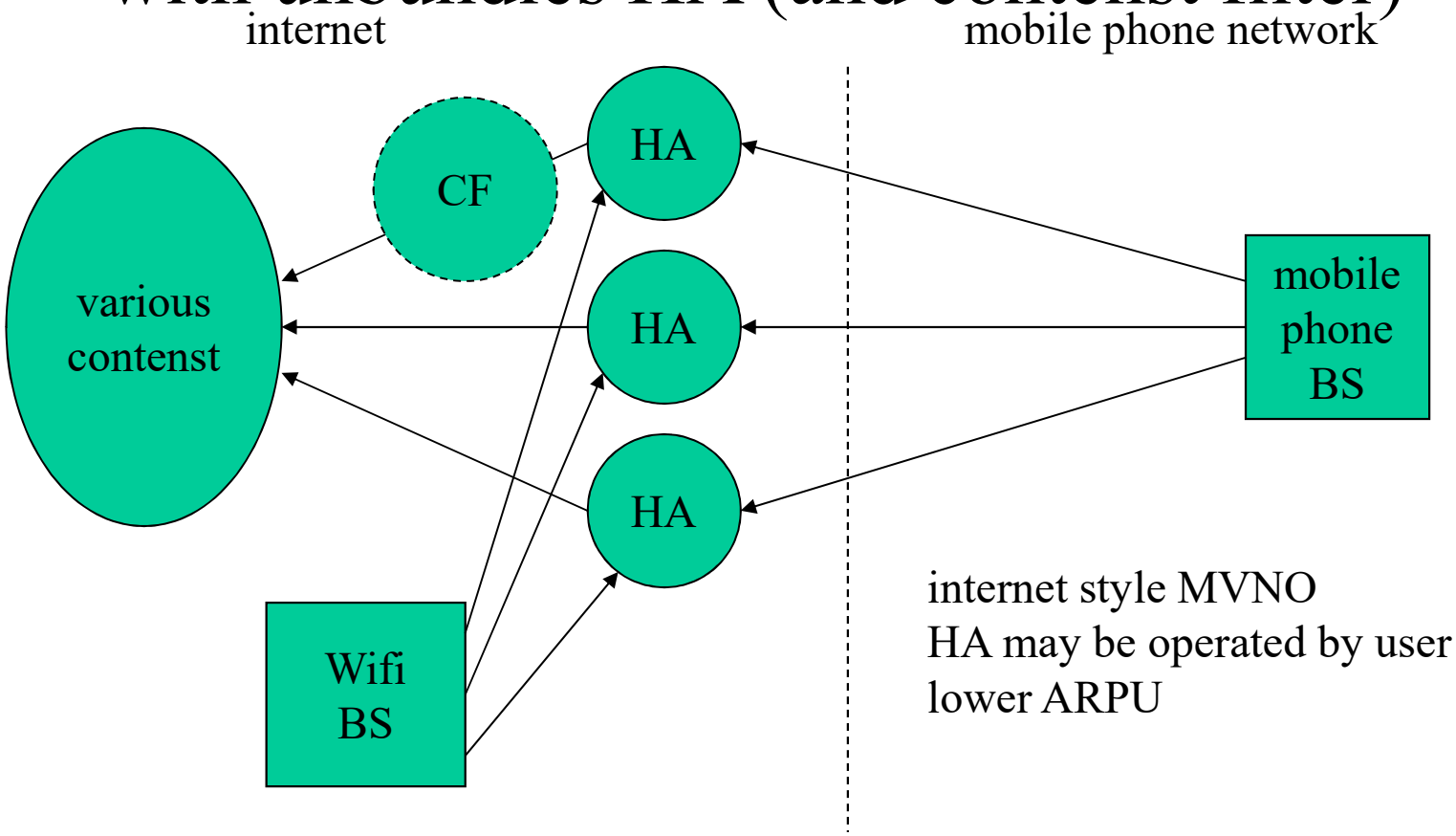


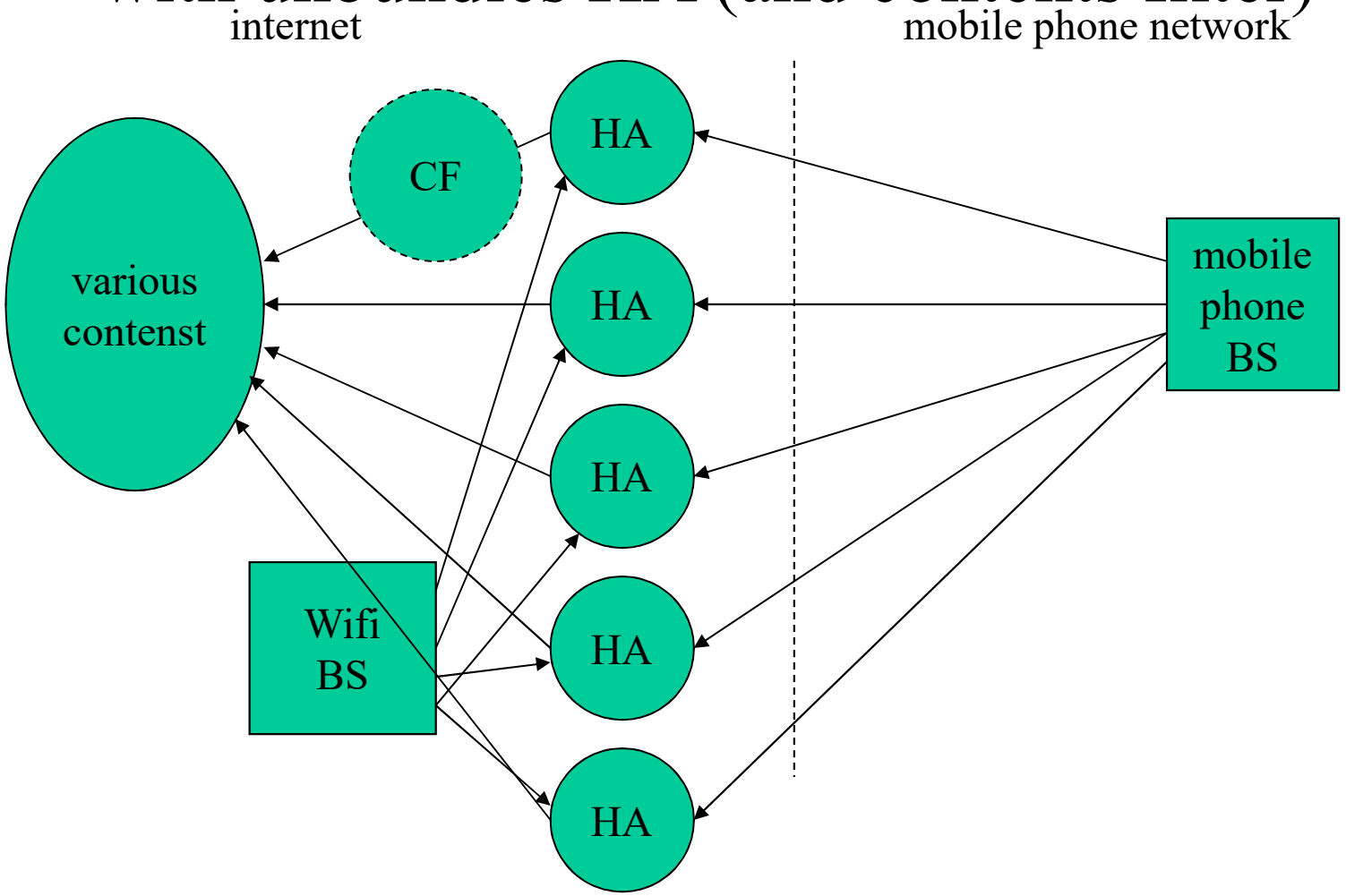
Wifi to Replace 4/5G

with unbundles HA (and contenst filter)



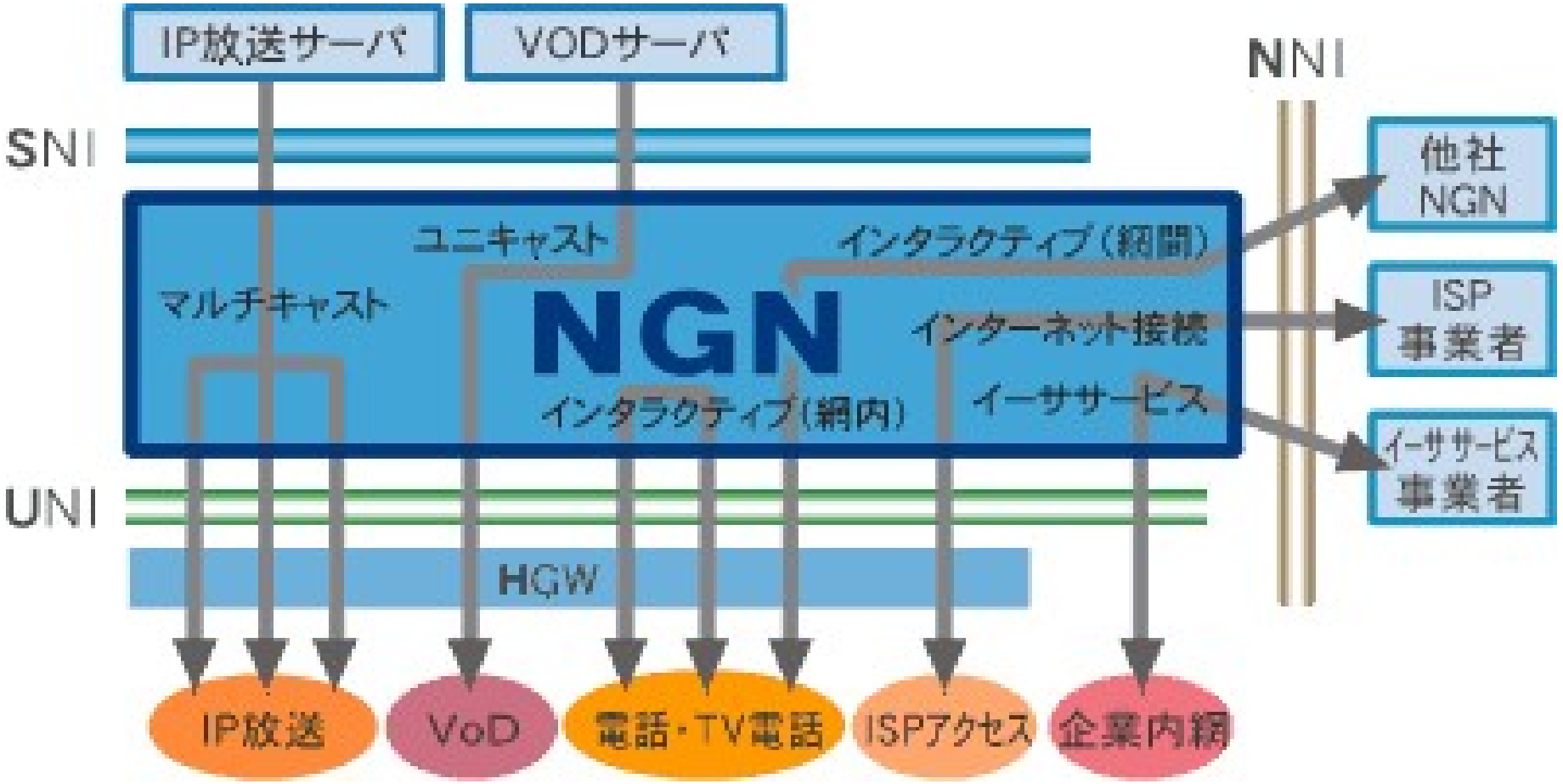
Future of Wifi to Replace 4/5G

with unbundles HA (and contents filter)

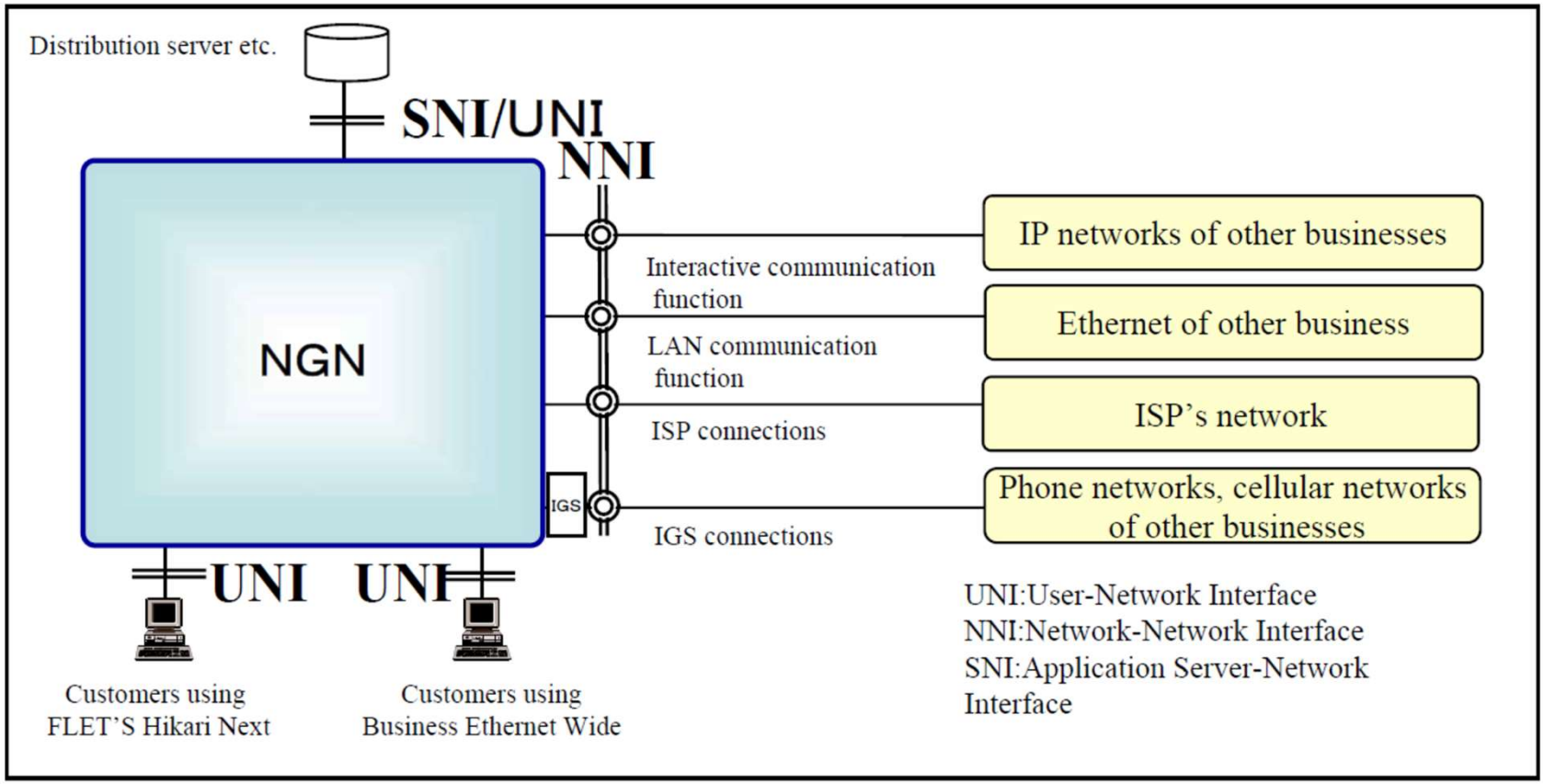


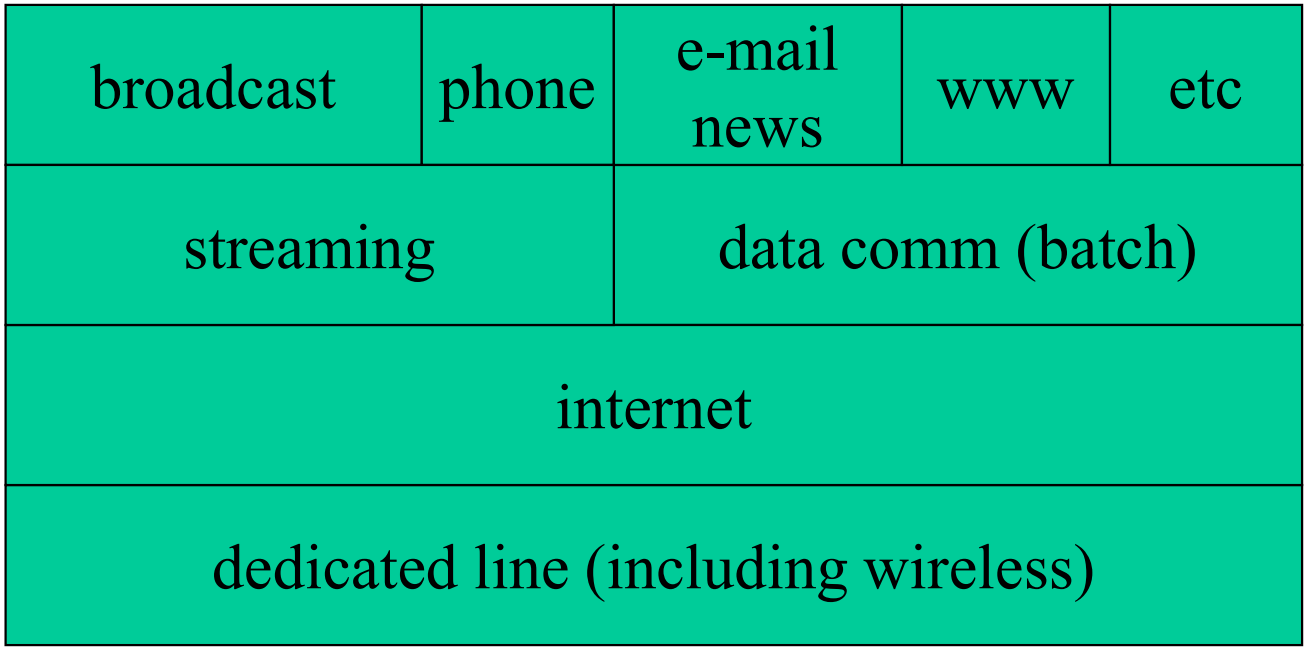
NGN (Next Generation Network)

- is an IP network, but, ...
- against E2E principle, too much
- can guarantee QoS (BW and delay)
  - no detailed specification
- should be highly secure
  - as secure as phone network (same as internet)
- should be highly reliable
  - as reliable as phone network (same as internet)

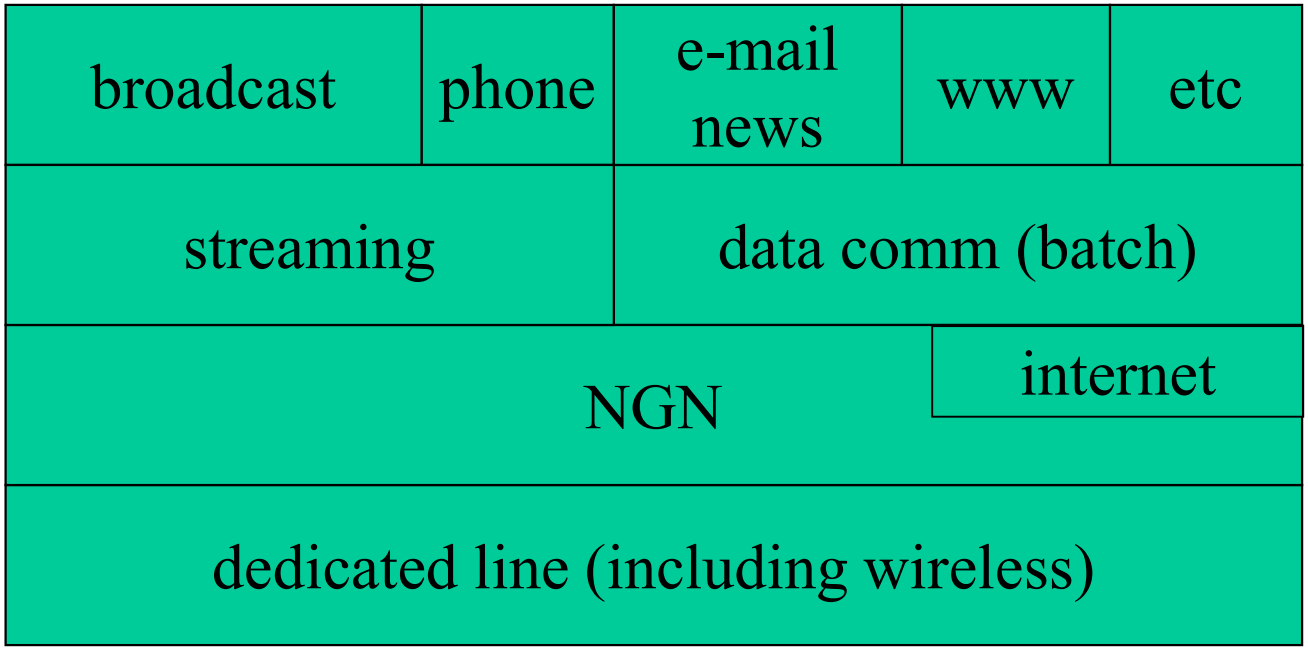

IP放送サーバ
VODサーバ
SNI
NNI
他社
NGN
ISP
事業者
イーササービス
事業者
ユニキャスト
インタラクティブ(網間)
マルチキャスト
NGN
インターネット接続
イーササービス
インタラクティブ(網内)
UNI
HGW
IP放送
VoD
電話・TV電話
ISPアクセス
企業内網

(Reference) NGN Connection Interfaces servers, etc.





network in the future



ambition of NGN

Wrap Up

- with persistent internet connectivity
  - free internet phone will be available
  - phone network (incl. VoIP and mobile ones) will disappear
- internet phone service is not profitable
  - require GW service to phone network necessary for the time being
- regulating internet phone is
  - not necessary, not possible and not meaningful