

# toward IPv6-based Society

Jun Murai

WIDE Project

KEIO University

# Some FAQ you might want to answer..

Why we need IPv6 when,

1. IPv4 with NAT covers enough address space
2. IPv4 provides all you can do with IPv6
3. Transiting from IPv4 is too expensive
4. Privacy exposed by IPv6
5. No one make money with IPv6
6. IPv6 deployment is for IPv6 gang's own interests/benefits

and my friend in the Cabinet asking me..

7. Status of IPv6 transition?
8. Is Japan the ONLY country heating up on IPv6?
9. Does IPv6 solves 'digital divide'?
10. Does IPv6 make Japan strong?
11. Does IPv6 solves unemployment problem?
12. Does IPv6 recovers Japan's economy?

and my student is telling me...

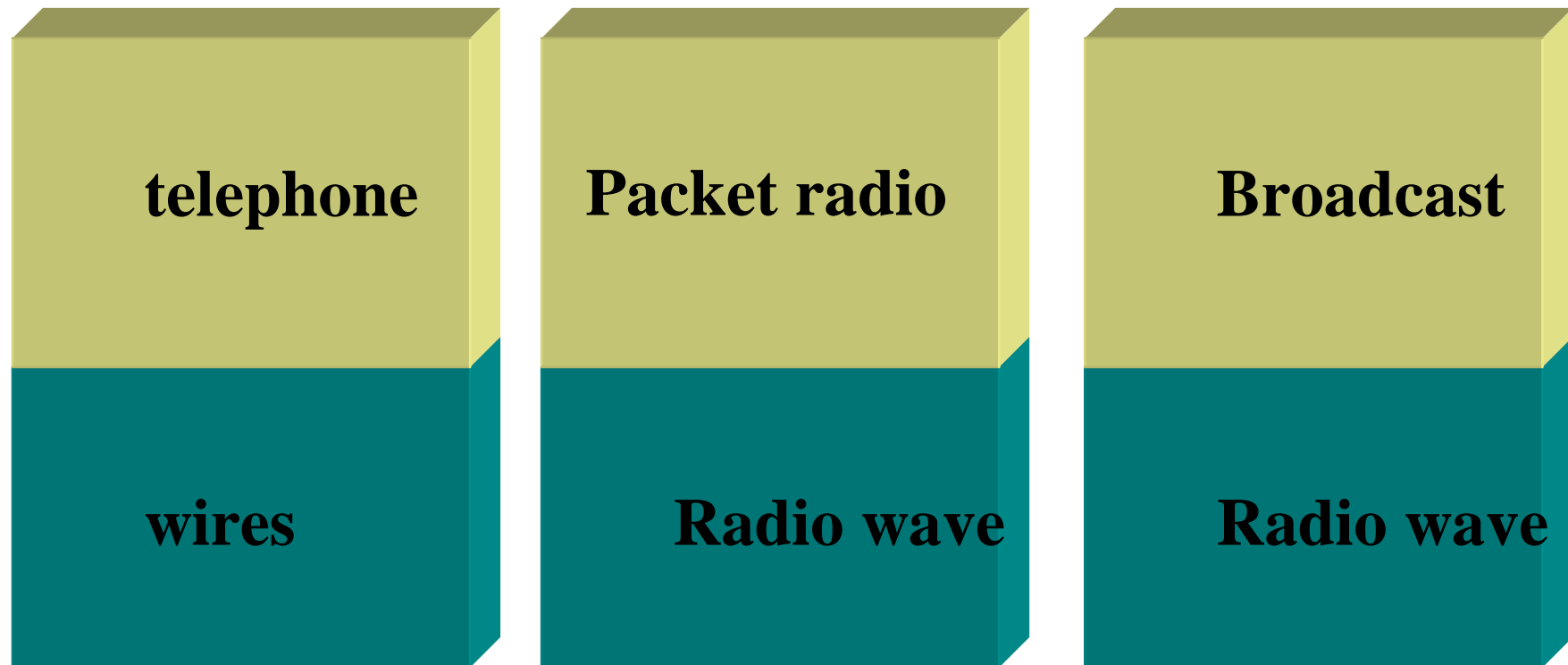
13. *I hate*

*the government*

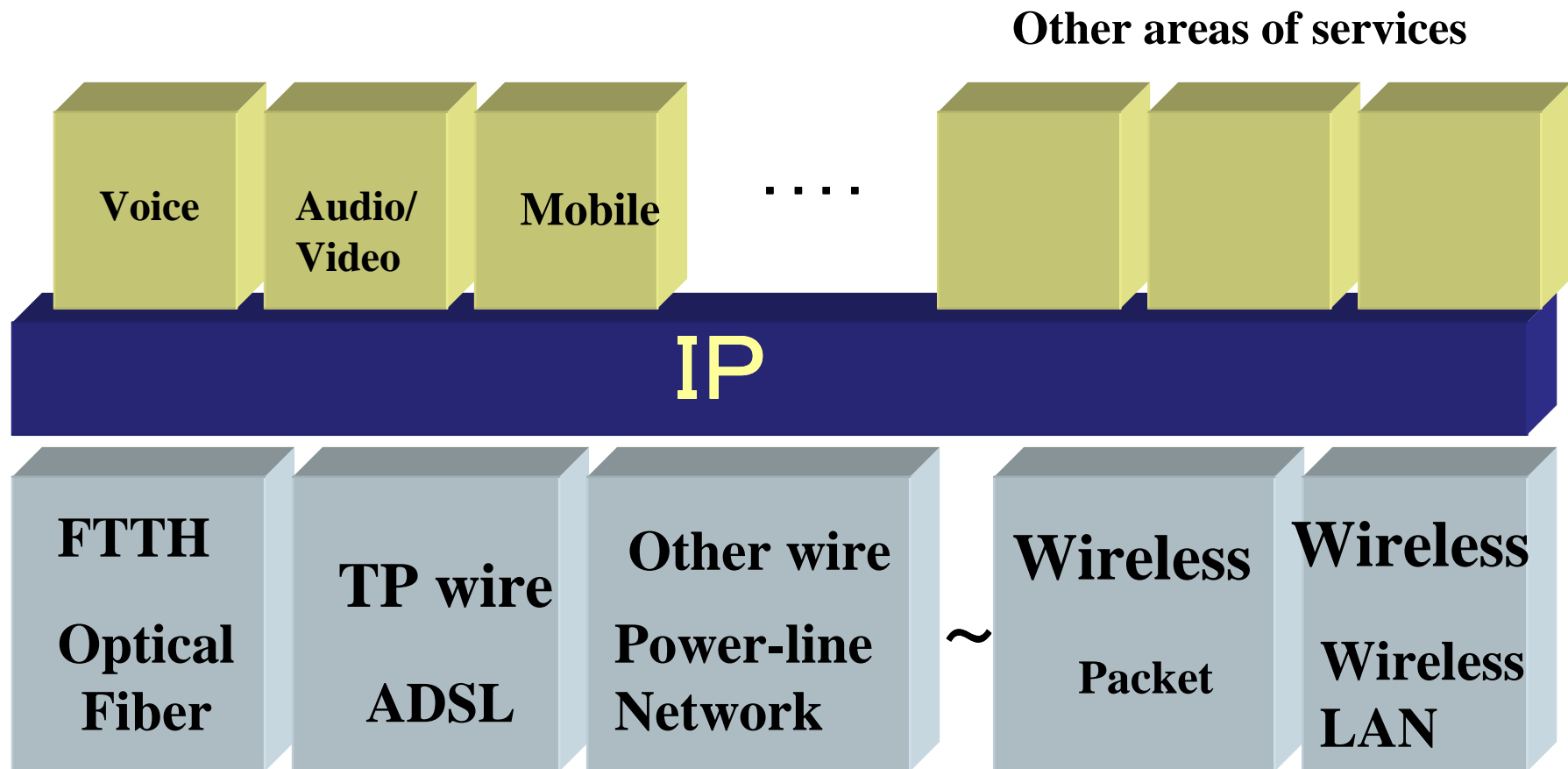
*talking about*

**IPv6!**

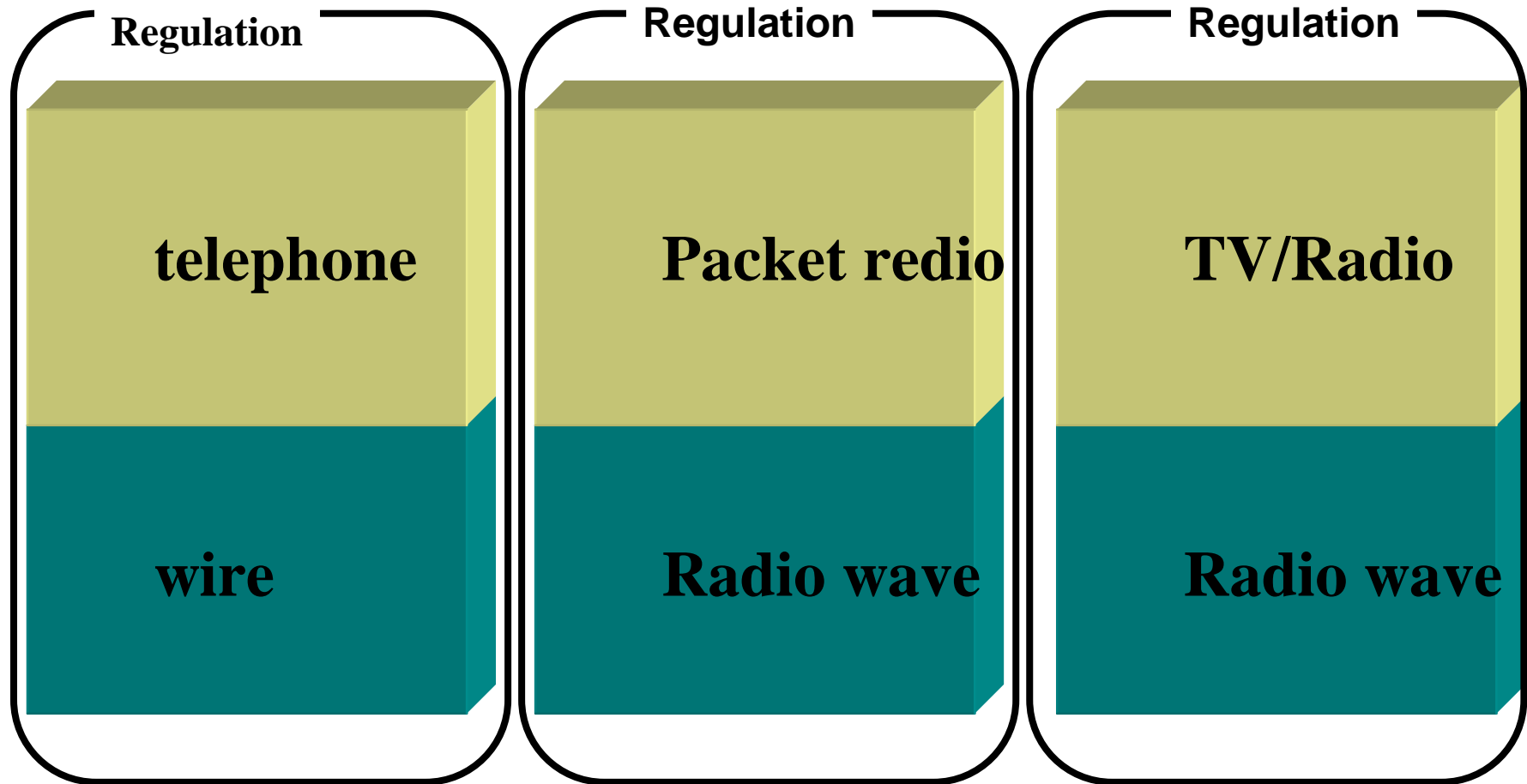
# Analog communication



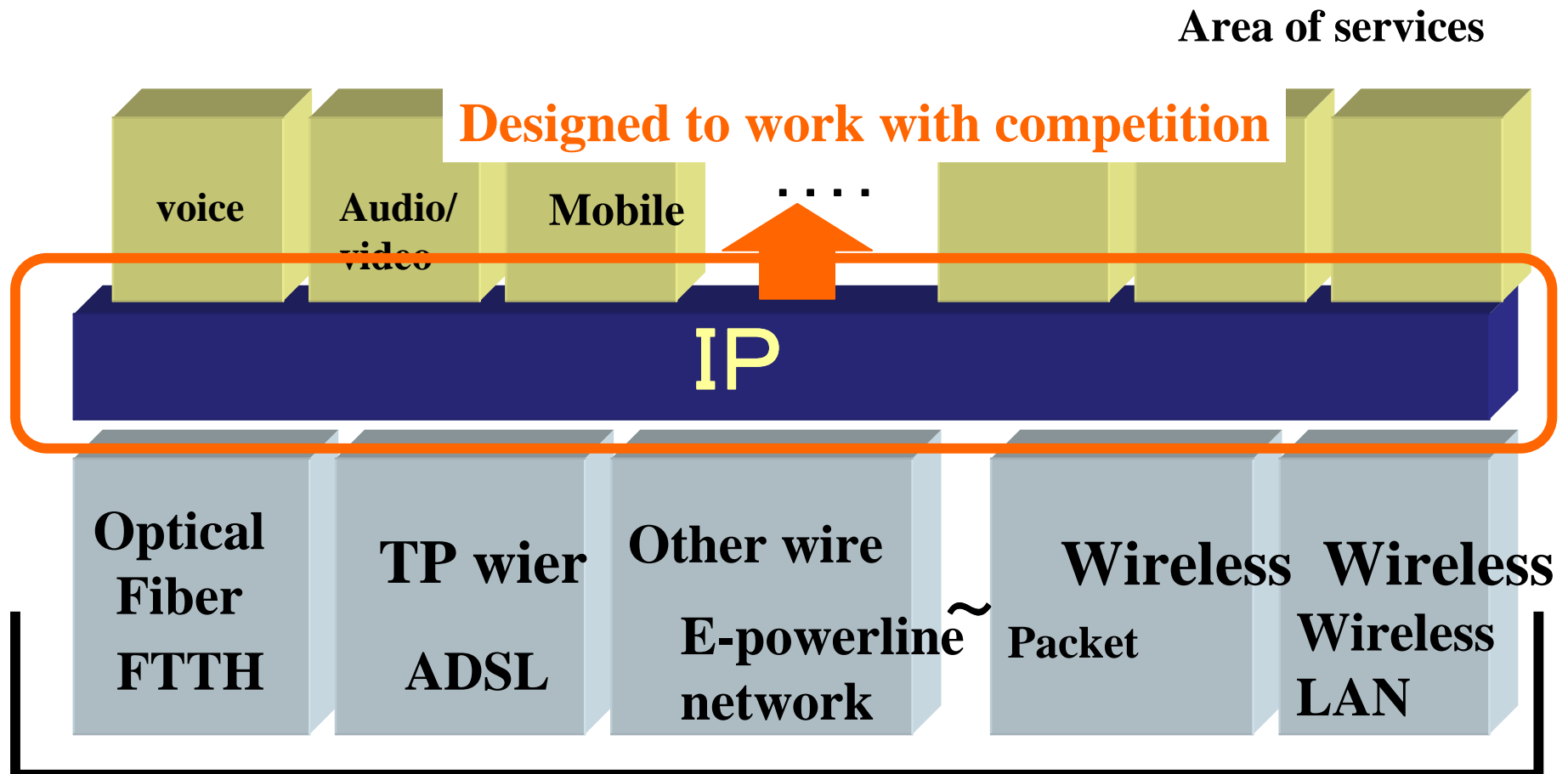
# Digital communication



# Regulations: Analog era



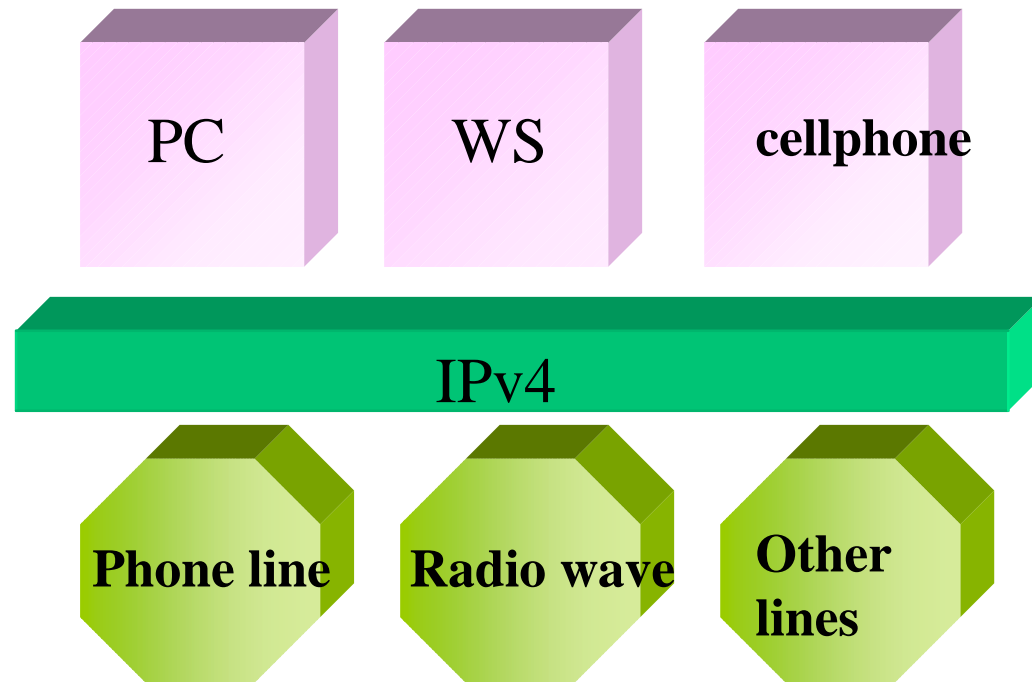
# Digital era with Internet



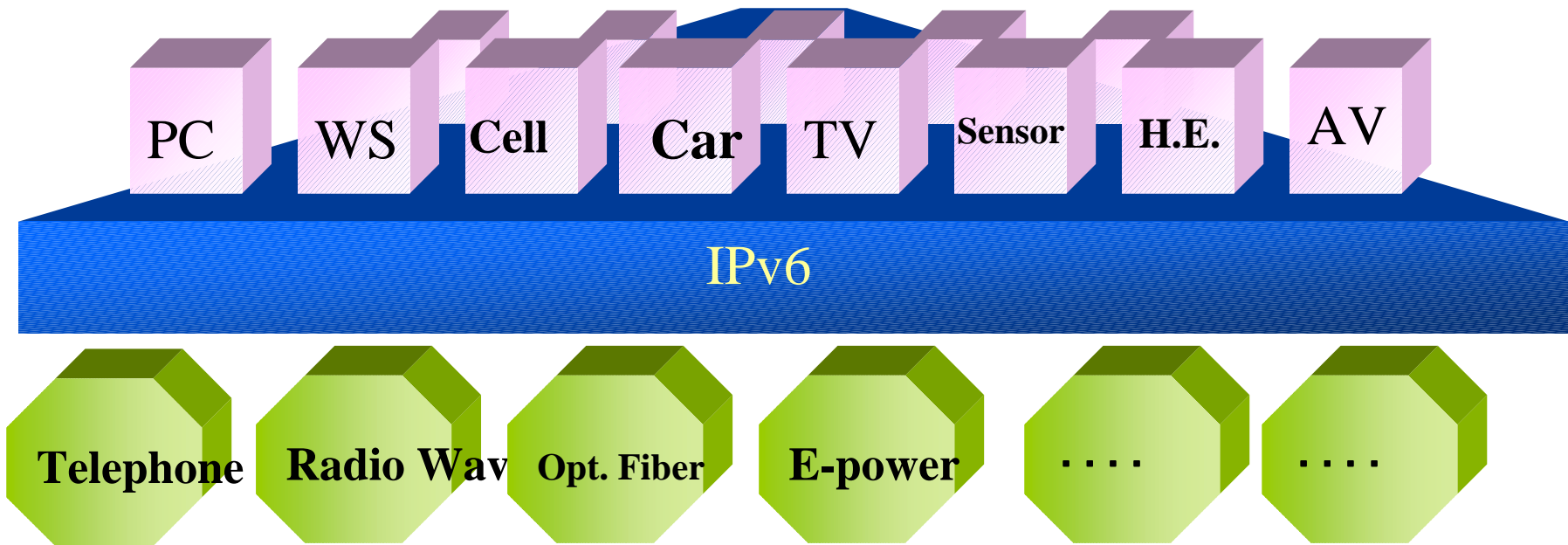
**IP employs alternatives: no need for regulation**



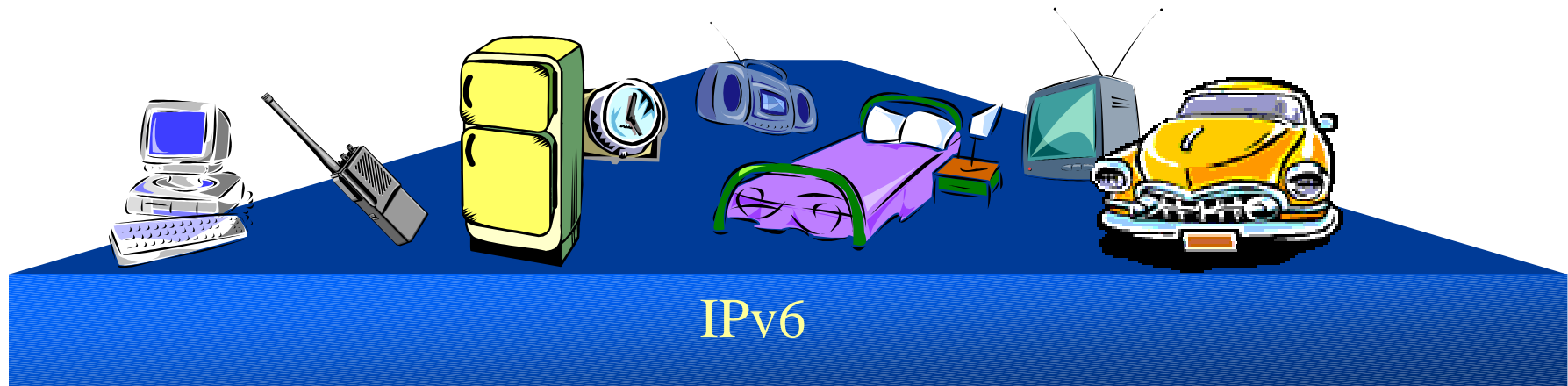
# Internet today



# A lot more things to care..



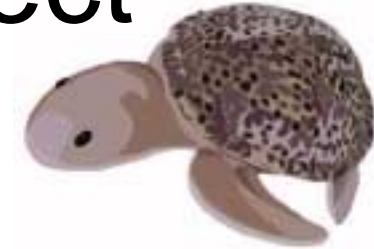
# A lot more things to care



- Phone Lin
- Radio Wav
- Opt. Fiber
- E-power
- ....
- ....

protocol stacks

# Major WIDE IPv6 Project



- KAME : IPv6 for \* BSD \*
  - Participants
  - Keio Univ., Univ. of Tokyo, Fujitsu,
  - Foretune, Hitachi, IJ, NEC, Toshiba, Yokogawa
    - <http://www.kame.net>
- TAHI : IPv6 Test & Evaluation Software
  - <http://www.tahi.org>
- USAGI : IPv6 for Linux
  - Participants
    - Univ. of Tokyo, Keio Univ, IJ, Yokogawa, CRL, Glue-On, Toshiba, Hitachi, NTT-Soft
    - <http://www.linux-ipv6.org>



# Infrastructures & Middleware (1)

- NSPIXP6 (IX for IPv6 in Japan)
  - Operation from Middle of September 1999
  - IJ, NTT-C, DTI, WIDE, etc
- s-TLA Transition from p-TLA (on-going)
  - Routing Protocol for IPv6
    - Multicast : PIM-SM & PIM-DM
    - Unicast : OPSF for IPv6
- QoS/CoS Control
  - Diff-Serv Integration with ALTQ(Sony-CSL)
  - BB(Bandwidth Broker) with COPS
    - NAIST, Osaka Univ., Keio Univ., Fujitsu, Hitachi, etc
- Label Switch (MPLS)
  - Integrate IPv6, PIM, Diff-Serve and BB

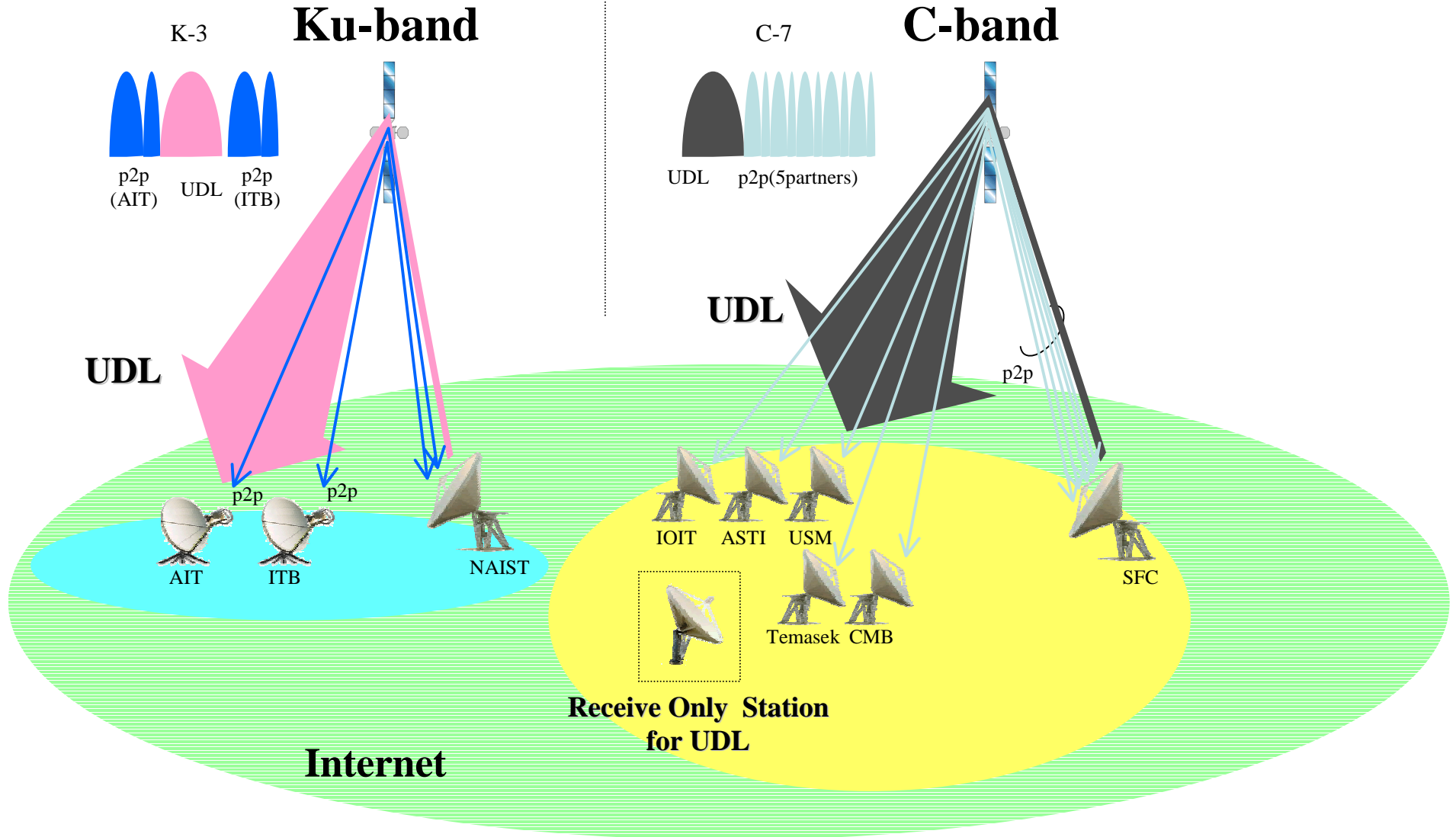
# Infrastructures & Middleware (2)

- DV over 1394 over IP
  - Full IPsec Encryption
  - Remote Control of DV Player with SSH
  - DV Multicast with PIM-SM over IPv6
- High Speed Datalinks
  - DWDM technology
- Internet via Satellite
  - All Project
- BIND
  - ISC / Nominum
- Root DNS Server (M-Root Server)
  - collaboration with USC-ISI
  - Secured DNS, IPv6 DNS

then comes other protocols



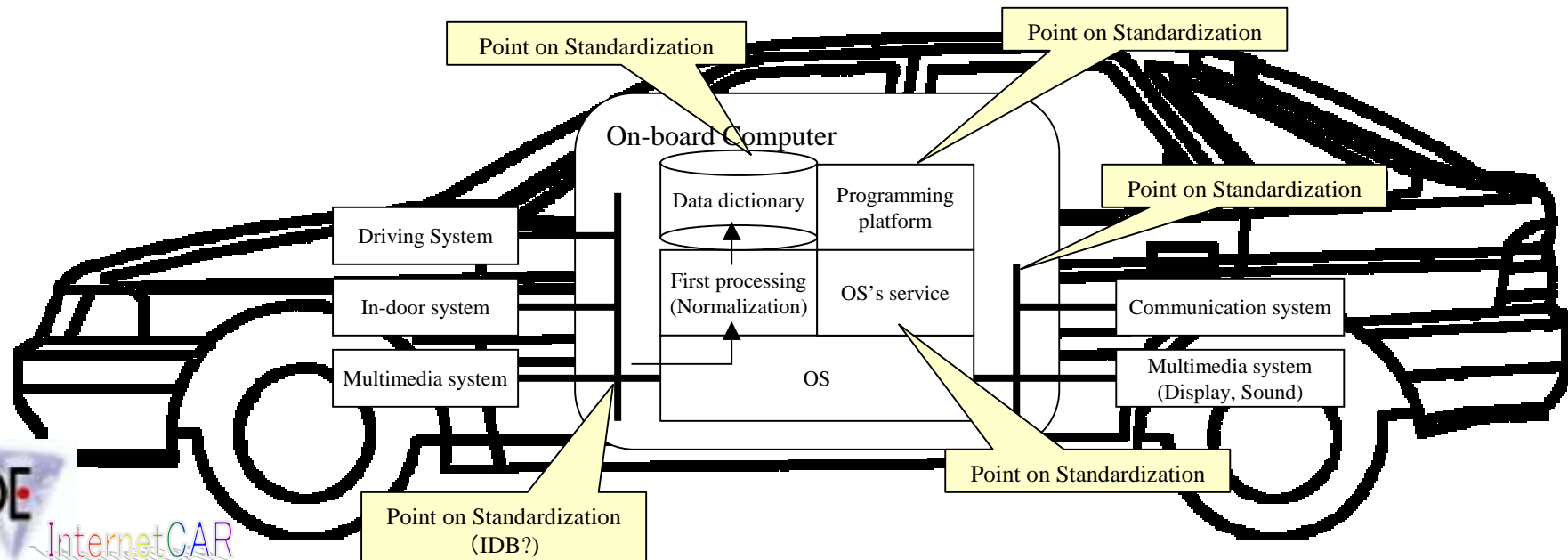
# UDL6 experiment in AI<sup>3</sup>



# Mobile Network6

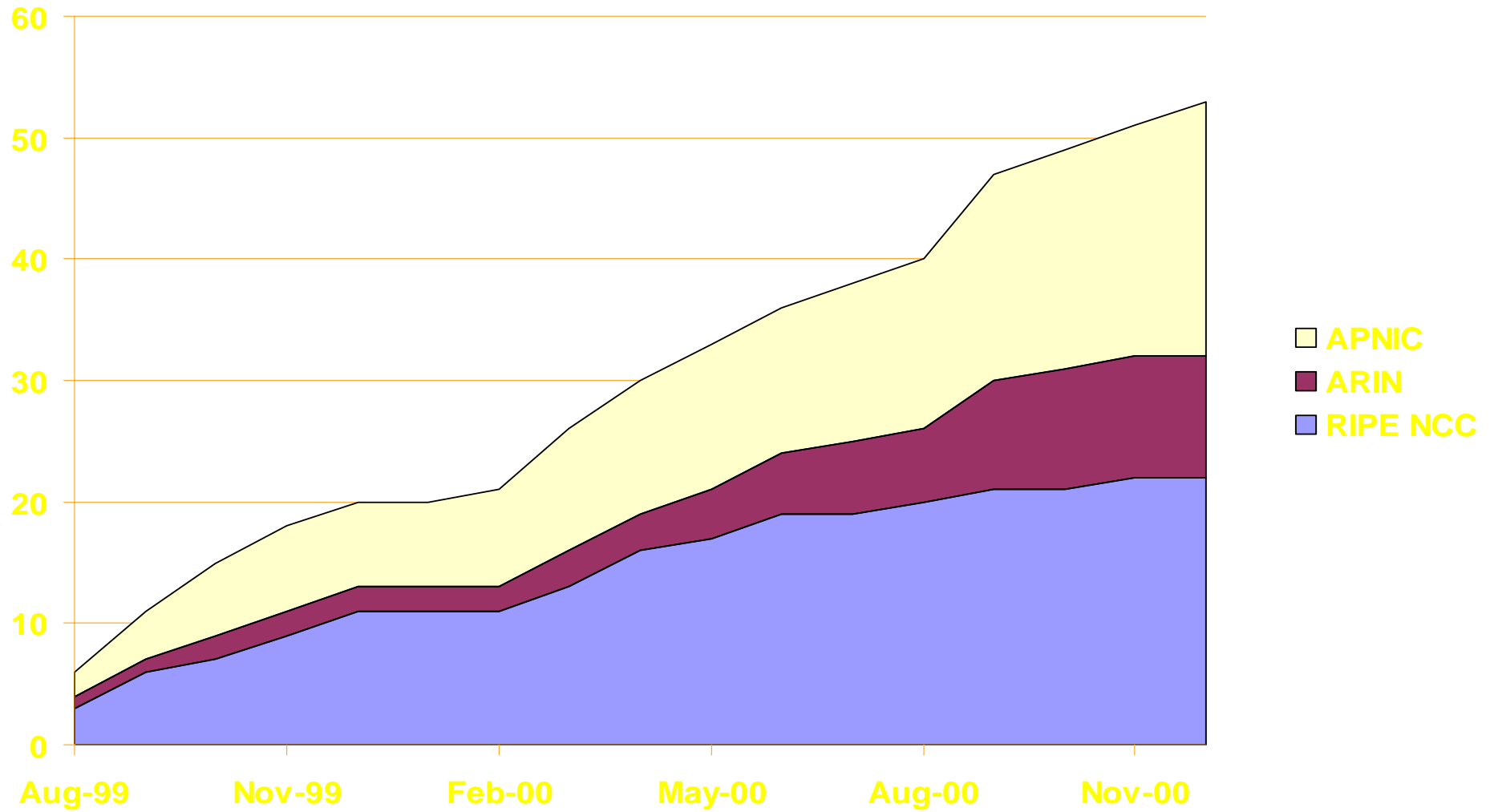
## MANET6

### Mobile IP6



then operation..

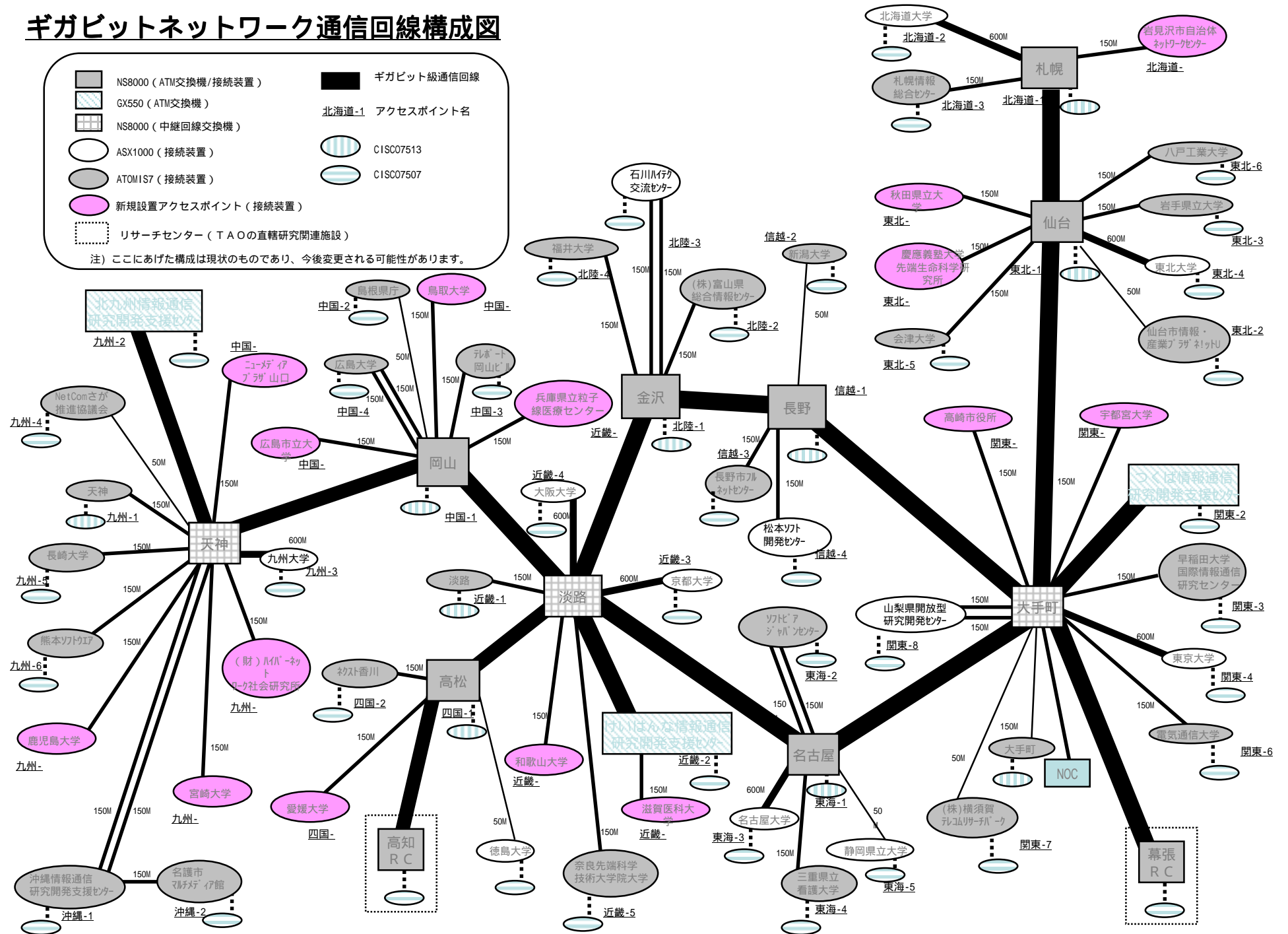
# RIR Allocations over Time

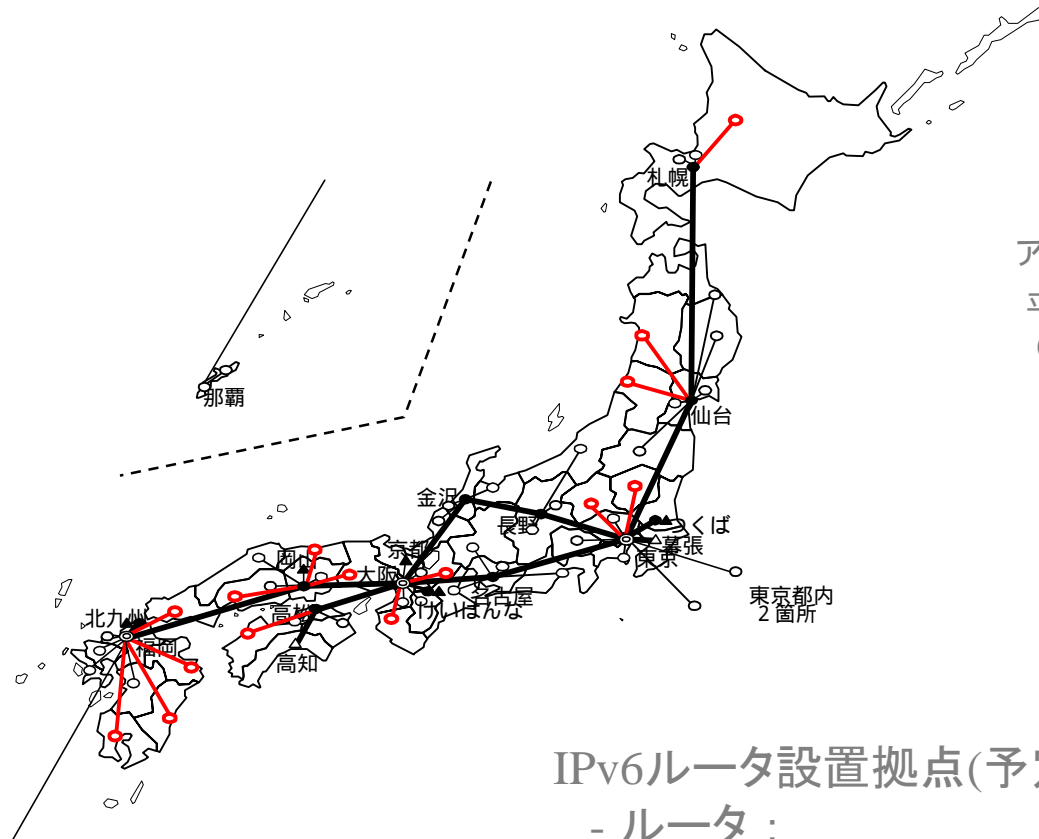


# ギガビットネットワーク通信回線構成図

	NS8000 (ATM交換機/接続装置)		ギガビット級通信回線
	GX550 (ATM交換機)		北海道-1 アクセスポイント名
	NS8000 (中継回線交換機)		CISC07513
	ASX1000 (接続装置)		CISC07507
	ATOMIS7 (接続装置)		
	新規設置アクセスポイント (接続装置)		
	リサーチセンター (TAOの直轄研究関連施設)		

注) ここにあげた構成は現状のものであり、今後変更される可能性があります。





アクセスポイント：合計64箇所  
 平成12年度補正追加分：15箇所  
 (赤丸で表示)

### IPv6ルータ設置拠点(予定)

- ルータ :

- 大手町(東京)、淡路町(大阪)
- リサーチセンター(東北大、幕張、東大、高知工科大)
- ギガラボ(筑波、けいはんな、岡山、北九州)
- 東北大、東京大、慶應義塾大、名古屋大、ソフトピア、
- 富山県総合情報センタ、JAIST、NAIST、京都大、
- 阪大、倉敷芸科大、広島大、広島市立大、九州大、
- NetCom佐賀、CRL那覇

```

L TEST-TLA-6BONE:3FFE:116
  INNER:3FFE:24
  TELEBIT:3FFE:0100:24
  SICS:3FFE:0200:24
    NVG-NTNU:3FFE:0200:0000:48
    DIGITAL-SE:3FFE:0200:0007:48
    ELLIEMTS:3FFE:0200:0008:48
    LITNET:3FFE:0200:000C:48
    SZCZECIN:3FFE:0200:000F:48
  G6:3FFE:0300:24
    DIGITAL-ETC:3FFE:0301:DEC0:44
    DIGITAL-BE:3FFE:0301:DEC1:48
    VUB-ULB:3FFE:0301:DEC1:F000:52
  JOIN:3FFE:0400:24
    BERLINGSF:3FFE:0400:0100:48
    WUNSC:3FFE:0400:0160:48
    FIL:3FFE:0400:0180:48
    PLANET:3FFE:0400:01F0:48
  WIDE:3FFE:0500:24
    NTT-SOFTWARE-LAB:3FFE:0503:732
  SURFNET:3FFE:0600:24
    DIGITAL-BE:3FFE:0604:0002:48
    VUB-ULB:3FFE:0604:0002:F000:52
    AUCS:3FFE:0604:0008:48
    ELTE-INF:3FFE:0608:0001:0300:56
  ESNET:3FFE:0700:24
  ISI-LAP:3FFE:0800:24
  CKNET:3FFE:0900:24
    ITSG-RIT:3FFE:0900:0008:48
    TORMAN:3FFE:0902:0001:48
    SZCZECIN:3FFE:0902:0002:48
    CETL:3FFE:0902:0003:48
    PMWAW:3FFE:0902:0004:48
    ELEPHANT:3FFE:0902:0005:48
    ZWIERACZ:3FFE:0902:0006:48
    IREPW:3FFE:0902:0007:48
    AMG:3FFE:0902:0008:48
    PC:3FFE:0902:0009:48
    SZCZECIN:3FFE:0902:000C:48
    POLBOX:3FFE:0902:0013:48
  NWNET:3FFE:0A00:24
    MSR-REDMOND:3FFE:0A00:0006:48
    WWU:3FFE:0A00:0007:48
  VIAGENTE:3FFE:0B00:24
    VIAGENTE-TUNS:3FFE:0B00:0001:48
    CANET2-BACKBONE:3FFE:0B10:0800:40
    CANET2-RAN-NBMA:3FFE:0B00:0801:48
    RISQ:3FFE:0B00:0C00:40
    RISQ-LOCAL:3FFE:0B00:0C01:48
    VIAGENTE-LOCAL:3FFE:0B00:0C02:48
    VIAGENTE-ITTE:3FFE:0B00:0C18:0002:64
  ACORN-NS:3FFE:0B00:1800:40
  CISCO:3FFE:0C00:24
    DEVA:3FFE:0C00:8008:48
    APNIC:3FFE:0C00:F008:48
  ANSNET:3FFE:0D00:24
  IFB:3FFE:0E00:24
  NRL:3FFE:0F00:24
    TORRENT:3FFE:0F00:0007:48
  CSELT:3FFE:1000:24
    SRIULS-LAB:3FFE:1001:0010:48
    CIB-NAENR:3FFE:1001:0020:48
    IBN:3FFE:1001:0010:48
    BROADCOM:3FFE:1001:0040:48
    NETLAB-DII-PISA:3FFE:1001:0050:48
    HTC:3FFE:1001:0060:48
    SSGRR:3FFE:1001:0070:48
    IASI-CNR:3FFE:1001:0080:48
    IENST-UNIP:3FFE:1001:0090:48
    POLITO:3FFE:1011:32
    CSIRDEL:3FFE:1022:32

```

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UNUNET-UK:3FFE:1100:24
  UNUNET-UK-INTERNAL:3FFE:1100:48
  UNUNET-UK-LONDON:3FFE:1100:52
    UNUNET-UK-LONDON-P2P:3FFE:1100:0000:CC00:56
  UNUNET-UK-CAMBRIDGE:3FFE:1100:0000:1000:52
  UNUNET-UK-CAMBRIDGE-P2P:3FFE:1100:0000:1C00:56
  UNUNET-UK-PALO-ALTO:3FFE:1100:0000:C000:52
    UNUNET-UK-PALO-ALTO-P2P:3FFE:1100:0000:CC00:56
  NRS:3FFE:1108:0400:48
  KIT:3FFE:1108:0401:48
  USART:3FFE:1108:0404:48
  NATAN:3FFE:1108:0406:48
  DIT-NG:3FFE:1108:0407:48
  SOT-ECS:3FFE:1108:0800:40
  DRA-UK:3FFE:1108:08AA:48
  TYCL:3FFE:1108:0900:40
  ITRF:3FFE:1108:09F0:44
  DIGITAL-CA:3FFE:1200:24
    DIGITAL-CA-DEC:3FFE:1200:2000:56
    DIGITAL-CA:3FFE:1200:2000:48
    DIGITAL-AU:3FFE:1200:2004:48
    DIGITAL-JP:3FFE:1200:2005:48
    DIGITAL-SG:3FFE:1200:2006:48
  DIGITAL-CA-OTHER:3FFE:1200:3000:56
    CHITL-TW:3FFE:1200:3001:48
    NIT:3FFE:1200:3002:48
    TRITON:3FFE:1200:3003:48
    MITRETEK-DEC:3FFE:1200:3004:48
    ENCOMIX:3FFE:1200:3005:48
    PROCESS:3FFE:1200:3006:48
    SUMITOMO-JP:3FFE:1200:3007:48
    TOTALTEC:3FFE:1200:3008:48
    UOK-US:3FFE:1200:3009:48
    TESS-MTY:3FFE:1200:300A:48
    HOLLYNET:3FFE:1200:300B:48
    NETDOT-TUS:3FFE:1200:300C:48
    DEC-INTERNAL:3FFE:1200:4000:56
    DIGITAL-JP 2:3FFE:1200:5000:56
  BAY:3FFE:1300:24
    HOLLYNET:3FFE:1300:0008:48
  UNIC:3FFE:1400:24
  UD:3FFE:1500:24
  NUS-IRDU:3FFE:1600:24
    SINGAREN-AR:3FFE:1600:0001:48
    SINGAREN-KRDL:3FFE:1600:0002:48
    NTUNET:3FFE:1600:0003:48
    NTU-NTRC:3FFE:1600:0004:48
    NUS-CIR:3FFE:1600:0005:48
    NUS:3FFE:1600:0006:48
    NUS-CWC:3FFE:1600:0007:48
  MREN:3FFE:1700:24
  NTT-ECL:3FFE:1800:24
  ICOM:3FFE:1900:24
  CAIRN:3FFE:1A00:24
  UL:3FFE:1B00:24
  MERIT:3FFE:1C00:24
    UTEXAS:3FFE:1CF6:48
  OUTERNET:3FFE:1CF8:32
  THISTLEDOWN:3FFE:1CF8:FF01:48
  TH-CERNET:3FFE:1CF9:32
  WAMNET:3FFE:1CFB:48
  ZEBRA-NET:3FFE:1CFE:48
  KSI-DOM:3FFE:1CFE:48
  ATT-LABS-EUROPE:3FFE:1D00:24
    DIT:3FFE:1D01:0001:48
    HOLLYNET:3FFE:1D01:0002:48
    STACKEN:3FFE:1D01:0003:48
  ATT-LABS-EUROPE:3FFE:1D02:32
  ATT-LABS-AMSTERDAM:3FFE:1D04:52
  ATT-LABS-GENEVA:3FFE:1D05:32
  DIGITAL-ETC:3FFE:1DEC:32

```

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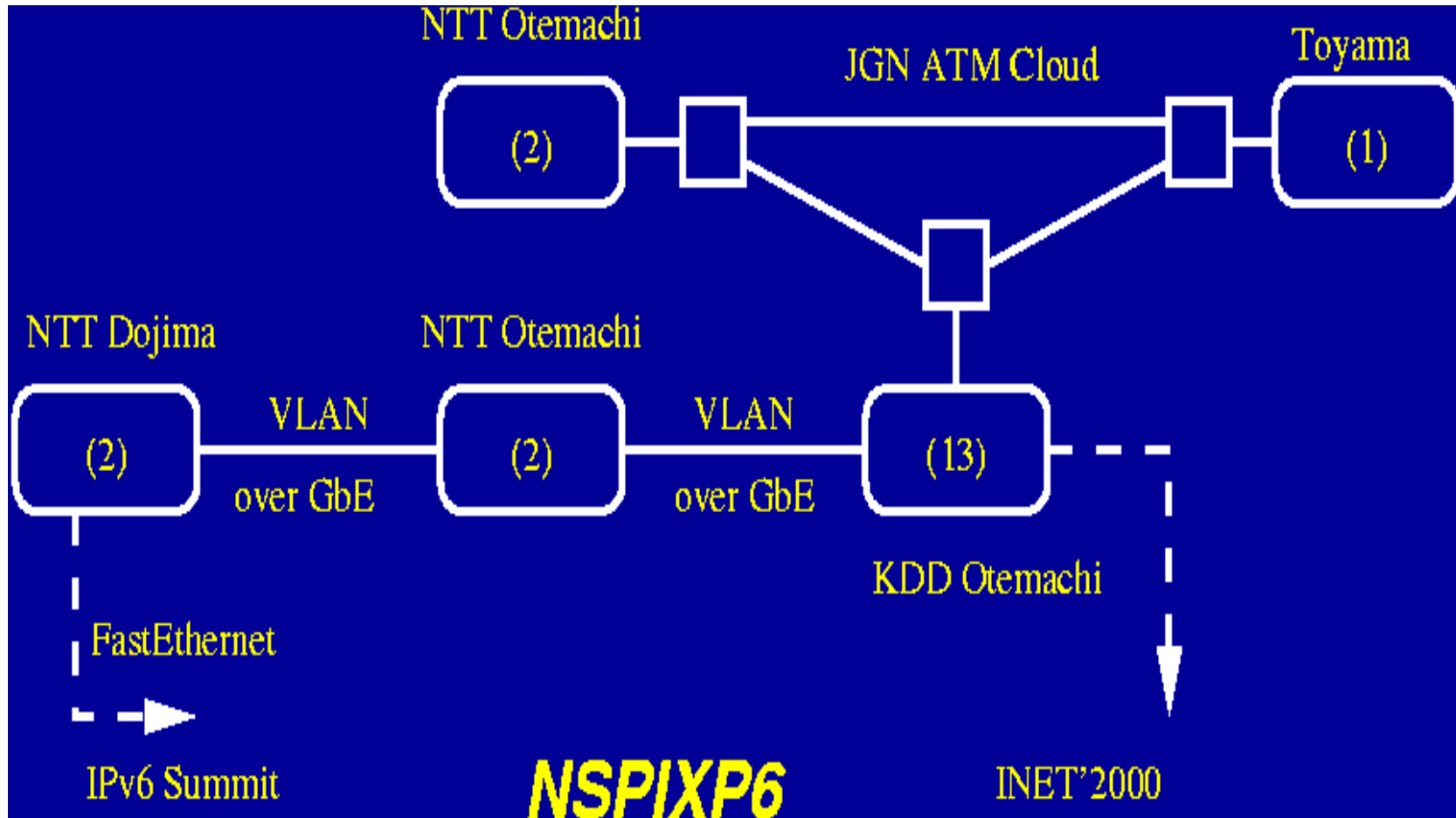
SWISSCOM:3FFE:1E00:24
  DIGITAL-ETC:3FFE:1E81:32
  NETCOM-UK:3FFE:1F00:24
  SWITCH:3FFE:2000:24
    SWITCH-BACKBONE:3FFE:2000:48
    ETHZ:3FFE:2000:0400:48
    EPFL:3FFE:2010:48
    TELEPORT:3FFE:2022:F000:48
    TK-LINZ:3FFE:2024:0001:48
    SIMMCOMM:3FFE:2028:0001:48
    SIMULTAN:3FFE:202A:0001:48
  JANET:3FFE:2100:24
    JANET-ULCC:3FFE:2100:48
    JANET-PTT:3FFE:2100:0001:48
    JANET-ULANC:3FFE:2101:48
    JANET-UCLCS:3FFE:2101:0007:48
  STUBA:3FFE:2200:24
  INEN-CNAP:3FFE:2300:24
  GUNET-PILOT:3FFE:23F0:28
  DUTHNET:3FFE:23FF:32
  INR:3FFE:2400:24
    STC-IPNG:3FFE:2401:32
    IPV6UA:3FFE:2402:32
    YRN:3FFE:2403:32
  NLNET:3FFE:2500:24
    NLNET-AMSTERDAM:3FFE:2500:0300:40
    NCJA:3FFE:2500:0900:1000:56
  SMS:3FFE:2600:24
  ERA:3FFE:2700:24
  VBNS:3FFE:2800:24
  SPRINT:3FFE:2900:24
    CSIK:3FFE:2900:FFFA:48
  UIO:3FFE:2A00:24
    UNINETT:3FFE:2A00:0100:40
    UIO-IP:3FFE:2A00:0100:1000:52
    NR:3FFE:2A00:0100:2000:52
    UTI:3FFE:2A00:0100:3000:52
    UNK:3FFE:2A00:0100:4000:52
    SERAF:3FFE:2A00:0100:6000:52
    PVV:3FFE:2A00:0100:600C:64
    TELENOR:3FFE:2A00:0200:40
  RNP:3FFE:2B00:24
    POP-MG:3FFE:2B00:0022:48
  BT-LABS:3FFE:2C00:24
  GRNET:3FFE:2D00:24
    NTUA:3FFE:2D00:0002:48
    UOA:3FFE:2D00:0003:48
    UPATRAS:3FFE:2D00:0005:48
    AEGEAN:3FFE:2D00:000B:48
    TELATH:3FFE:2D00:0014:48
    TELIP:3FFE:2D00:001F:48
    ARIADNE:3FFE:2D00:0022:48
  ETRI:3FFE:2E00:24
    KAIST:3FFE:2E01:0003:48
    KT-IPV6:3FFE:2E01:0006:48
  BMB-FSZ:3FFE:2F00:24
  AMS-IX:3FFE:3000:24
  RCCN:3FFE:3100:24
  CERNET:3FFE:3200:24
    TH-CERNET:3FFE:3201:32
    XD-CERNET:3FFE:3218:32

```



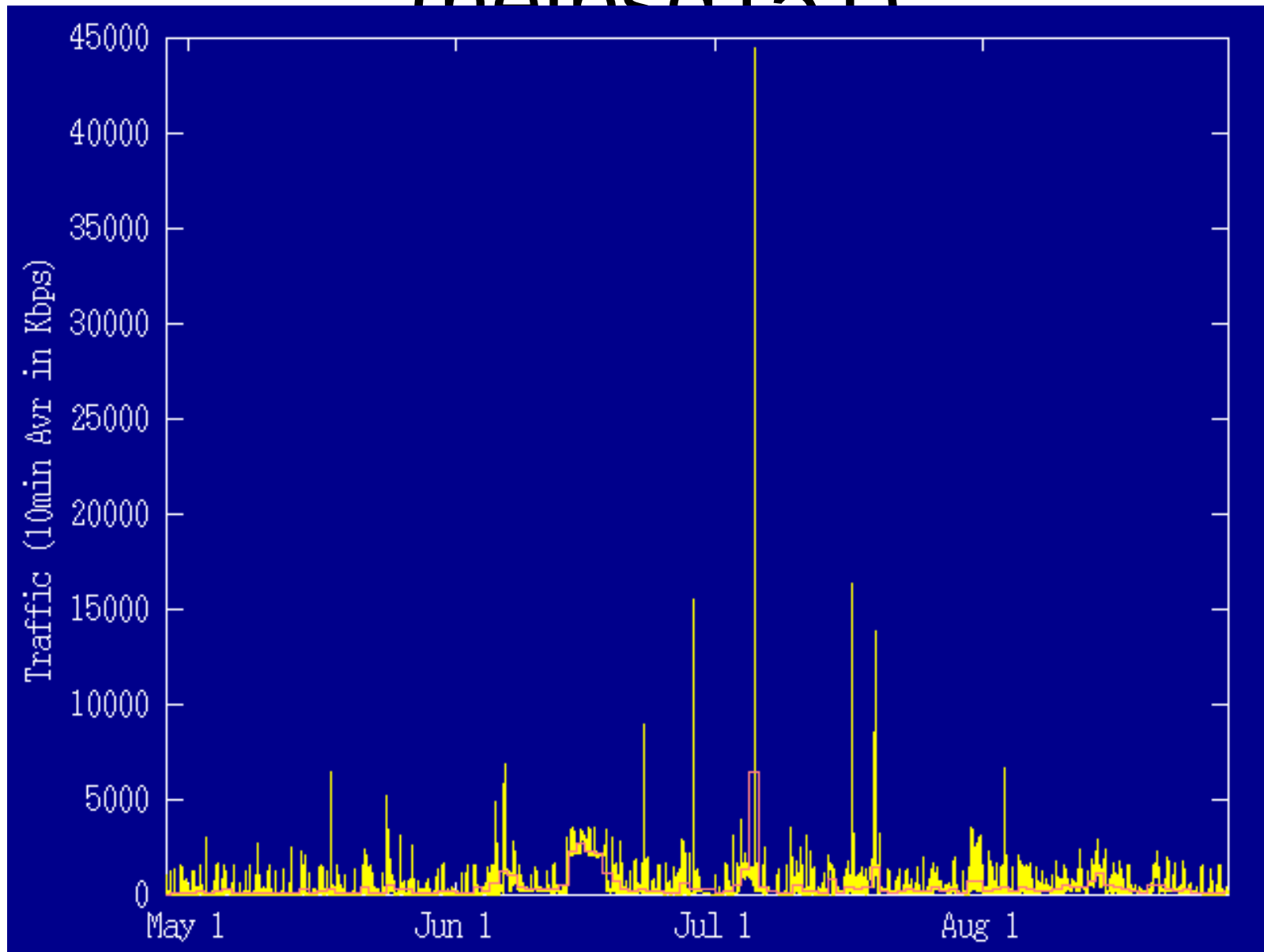
## 6Boneにおけるアドレスの階層構造

# About 25 ISPs on NSPIXP6



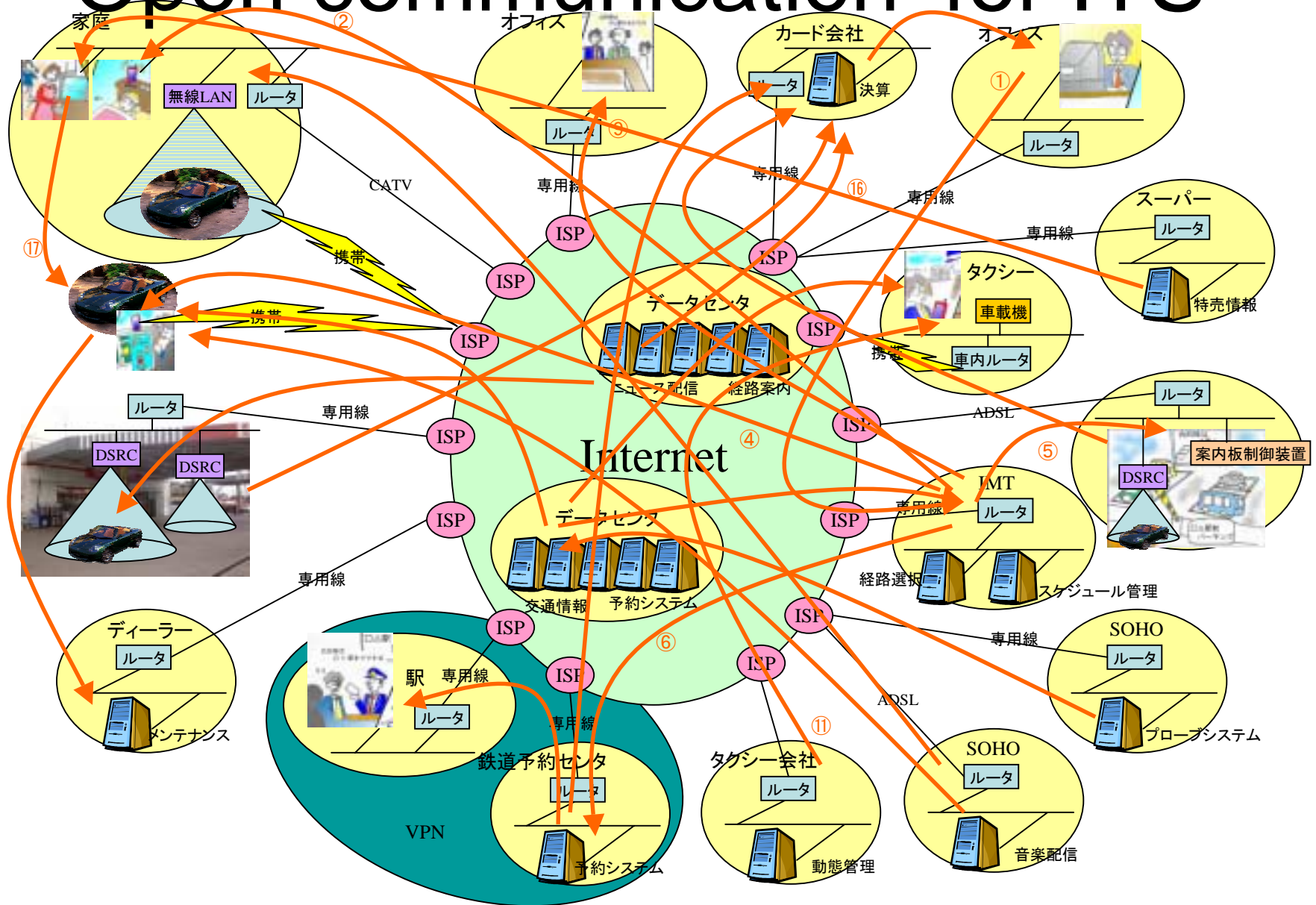


# NSPIXP6 (Kbps) (nothsd151)



**contribution for a new world**

# 'Open communication' for ITS



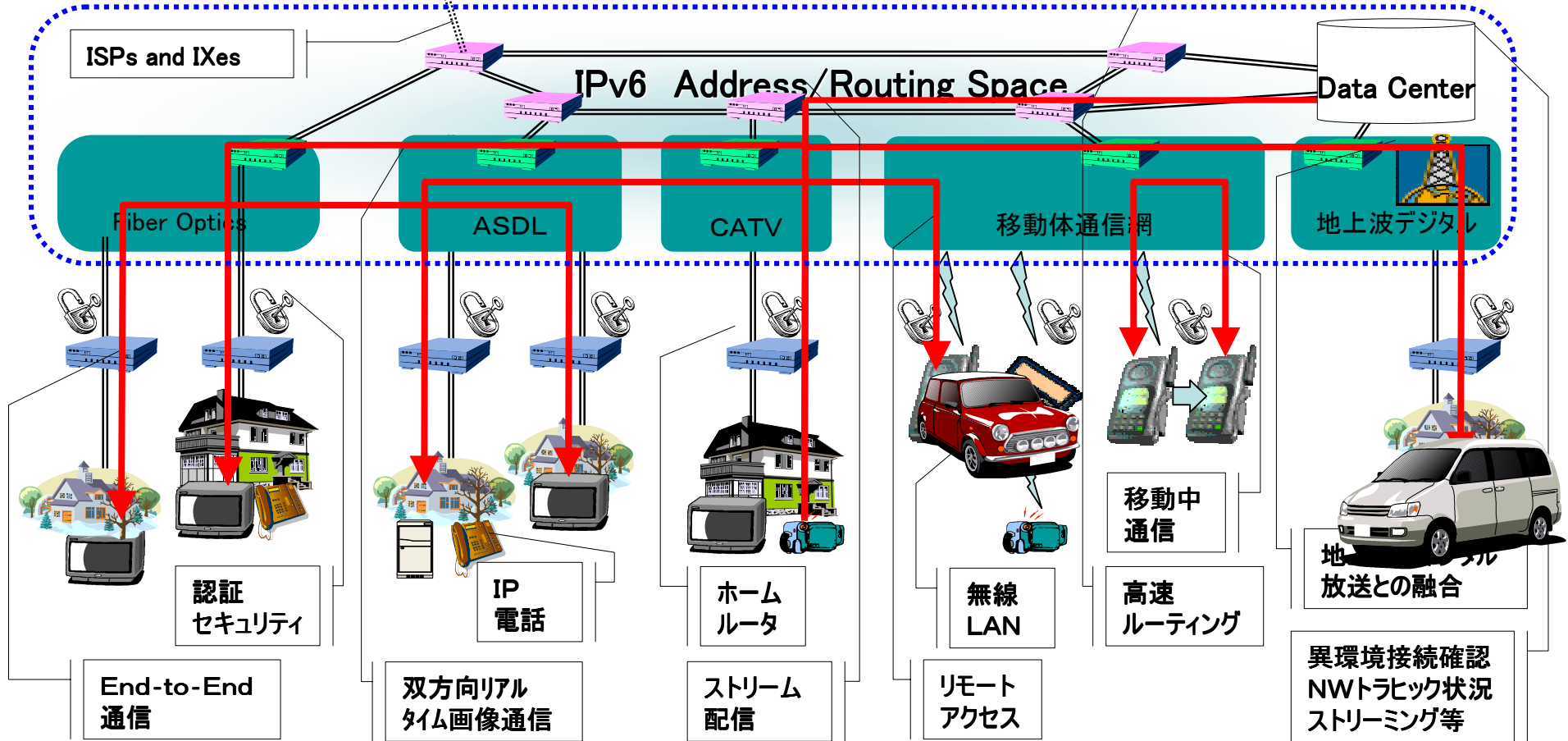
# Internet for Everybody, Everywhere and Everything

Geographical Location

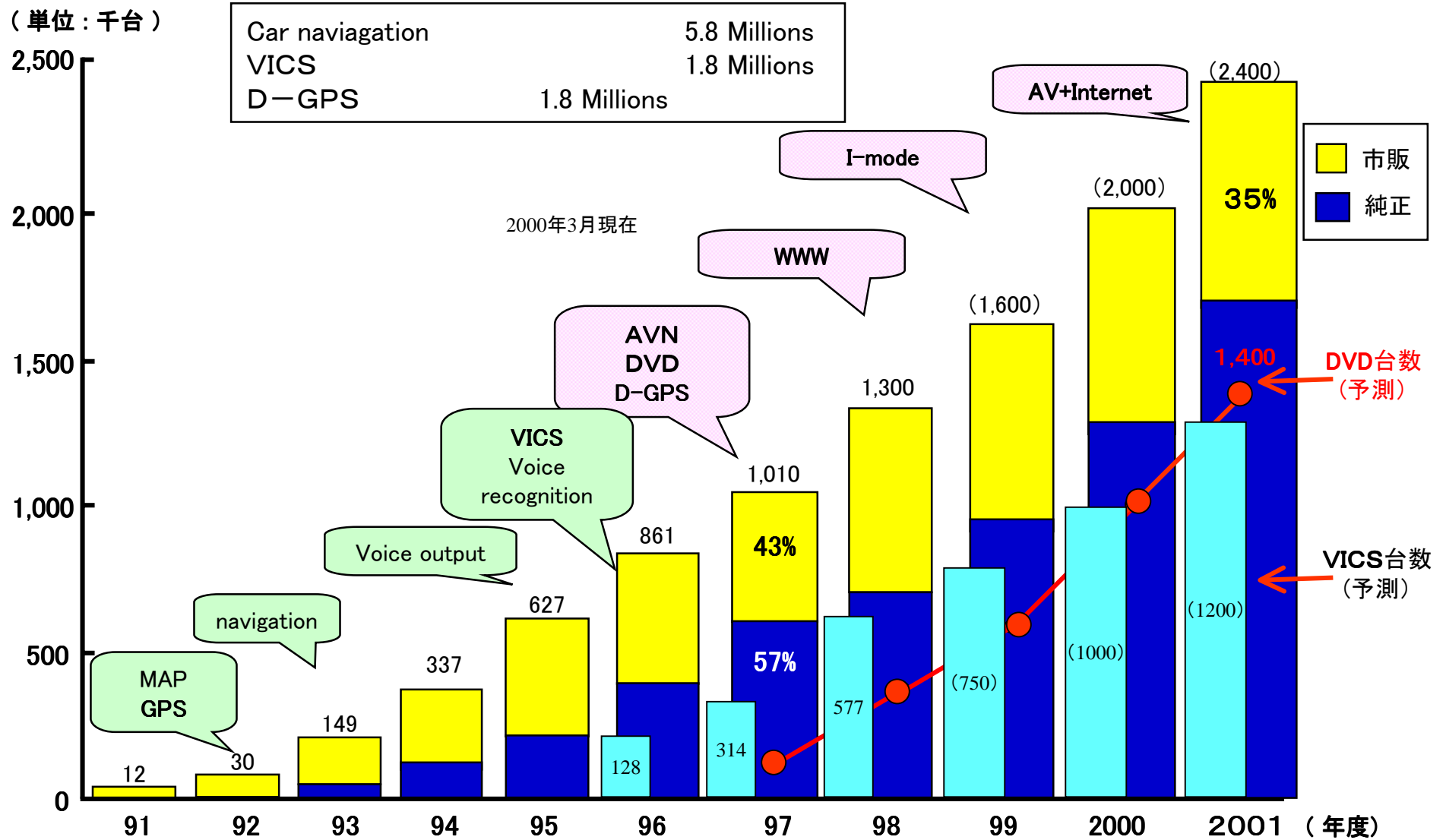
Contents Repository

Peer to Peer Sharing

Global Rendezvous Space by DNS



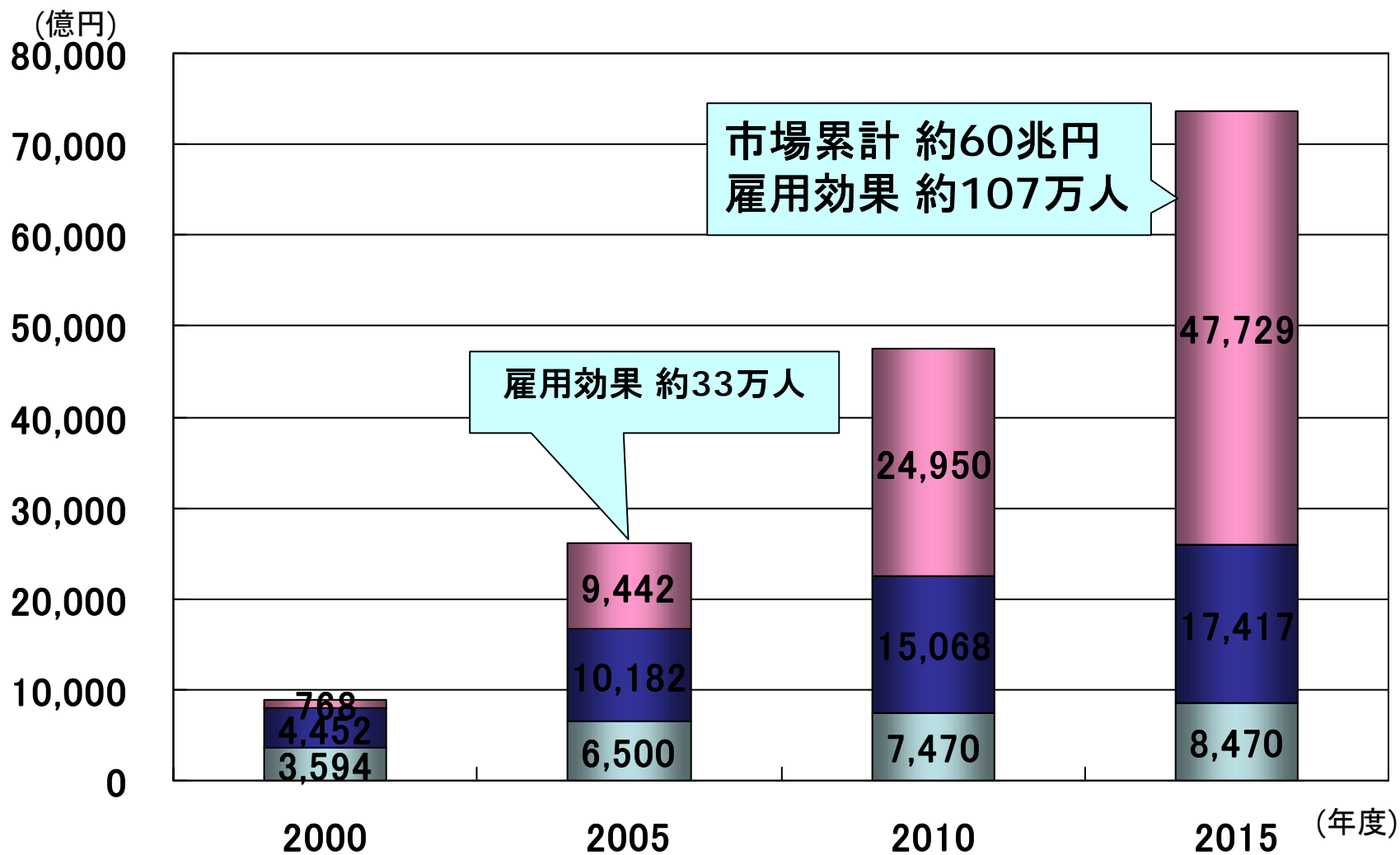
# Market trends (# of automobiles with ITS devices)



# 日本ITS市場予測

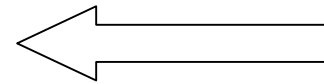
郵政省電気通信技術審議会答申(99年2月)

■ ITSの情報通信システム ■ 車載機等の端末機器 ■ ITSの情報通信サービス

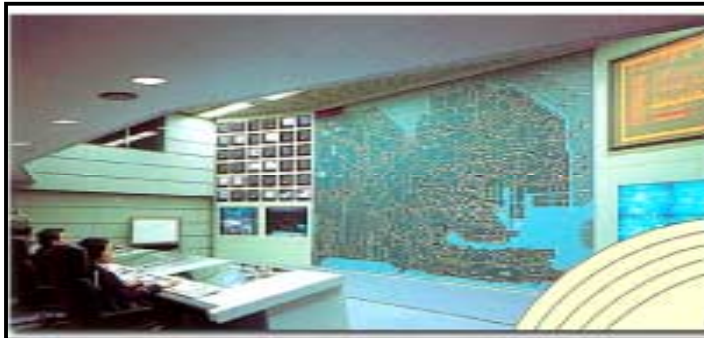


# Automobile ITS today

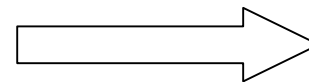
Input Device Infrastructure (sensor, camera and others)



Information CENTER



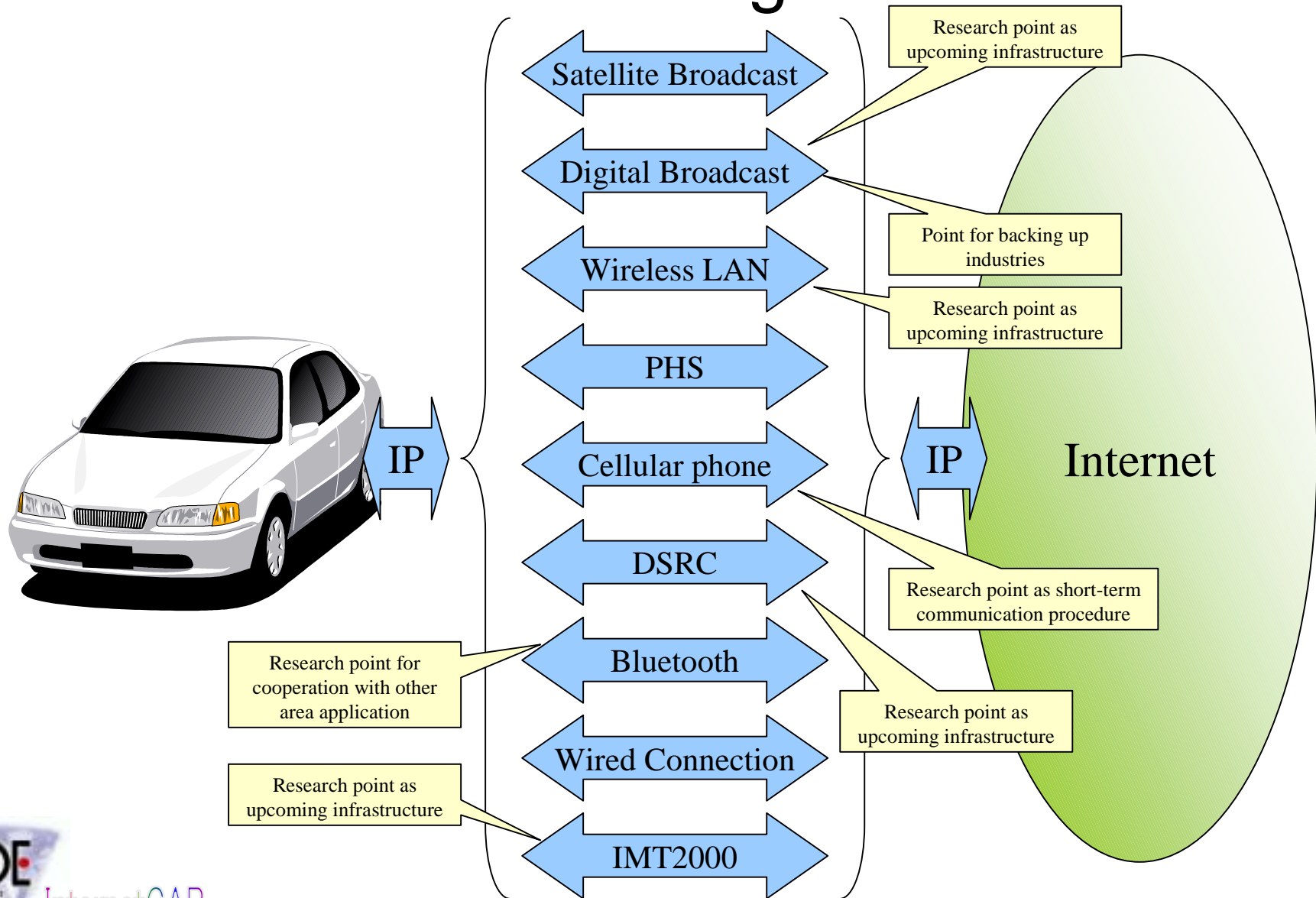
Output device infrastructure (signals, display and transmitter)



Very expensive infrastructure  
for input  
and output  
Huge sized  
'Center'

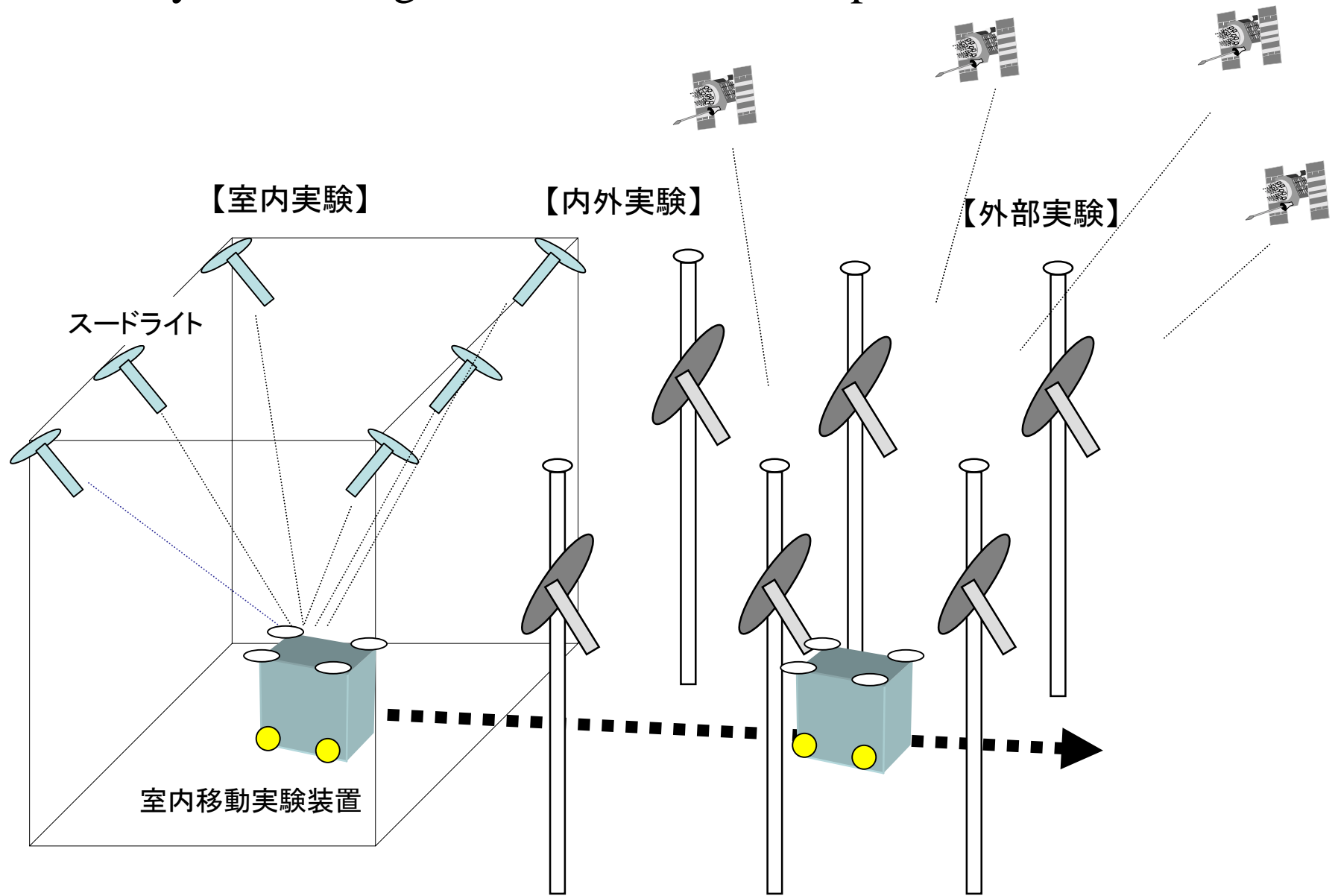
# Independent from wireless technologies

## -Let them grow!-



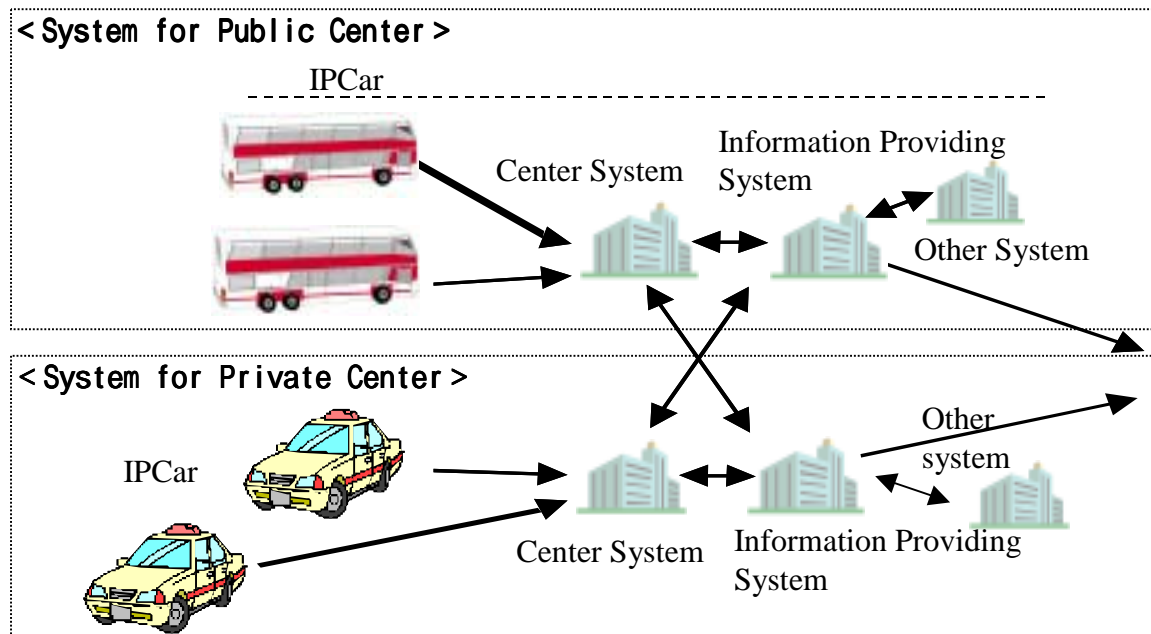


# 'Tiny' Pseudo Light device under development: 1-1.5cm



# The Testbed

- **Term:**
  - Feb 2001-Mar 2001 (about 1 month)
- **Area**
  - Center of Yokohama City
- **The Number of Vehicles**
  - 280 vehicles (Trucks, Bus, Taxi and Garbage Trucks etc.)
- **Sharing information**
  - On the Internet
    - Specific protocol
    - WEB



# Specific data used for the testbed

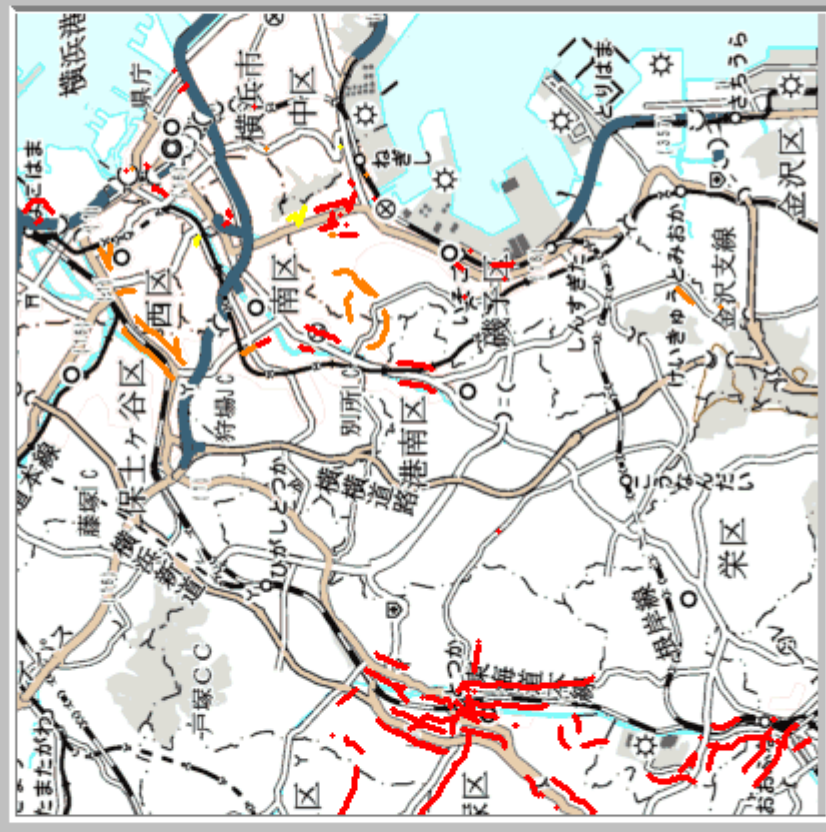
- Travel time
- Velocity
- Positioning information of GPS
- Wiper information
- ABS status
- Emergency attention

情報種別

- 速度
- 事故
- [特定所要時間](#)
- [任意所要時間](#)
- 雨量
- 速結
- [地区・情報](#)

速度 地図情報

[文字情報](#)



[更新](#) [拡大](#) [縮小](#)  
 地図サイズ:   
 縮尺:

中心位置情報:

地名: 港南区大久保二丁目  
 緯度: N35.24.14.52  
 経度: E139.35.30.76

凡例:

- 10Km/h 未満
- 10Km/h 以上 20Km/h 未満
- 20Km/h 以上 30Km/h 未満
- 30Km/h 以上 40Km/h 未満
- 40Km/h 以上

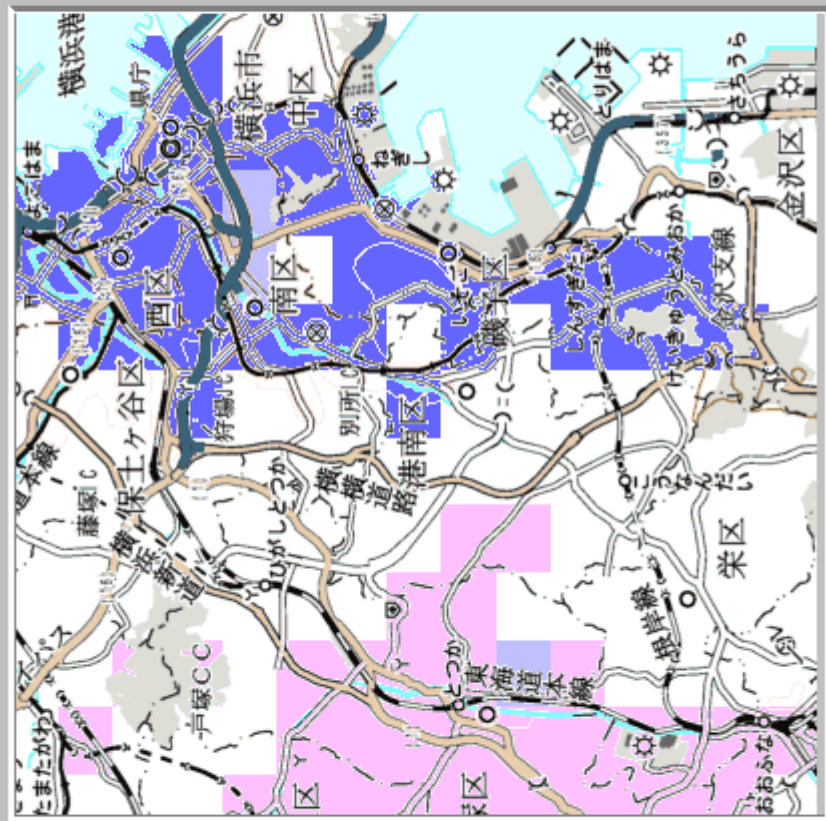
[事故情報表示](#)

情報種別

- [速度](#)
- [事故](#)
- [特定所要時間](#)
- [任意所要時間](#)
- [雨量](#)
- [凍結](#)
- [地区・情報](#)

雨量 地図情報

[文字情報](#)



地図サイズ: 
 縮尺:

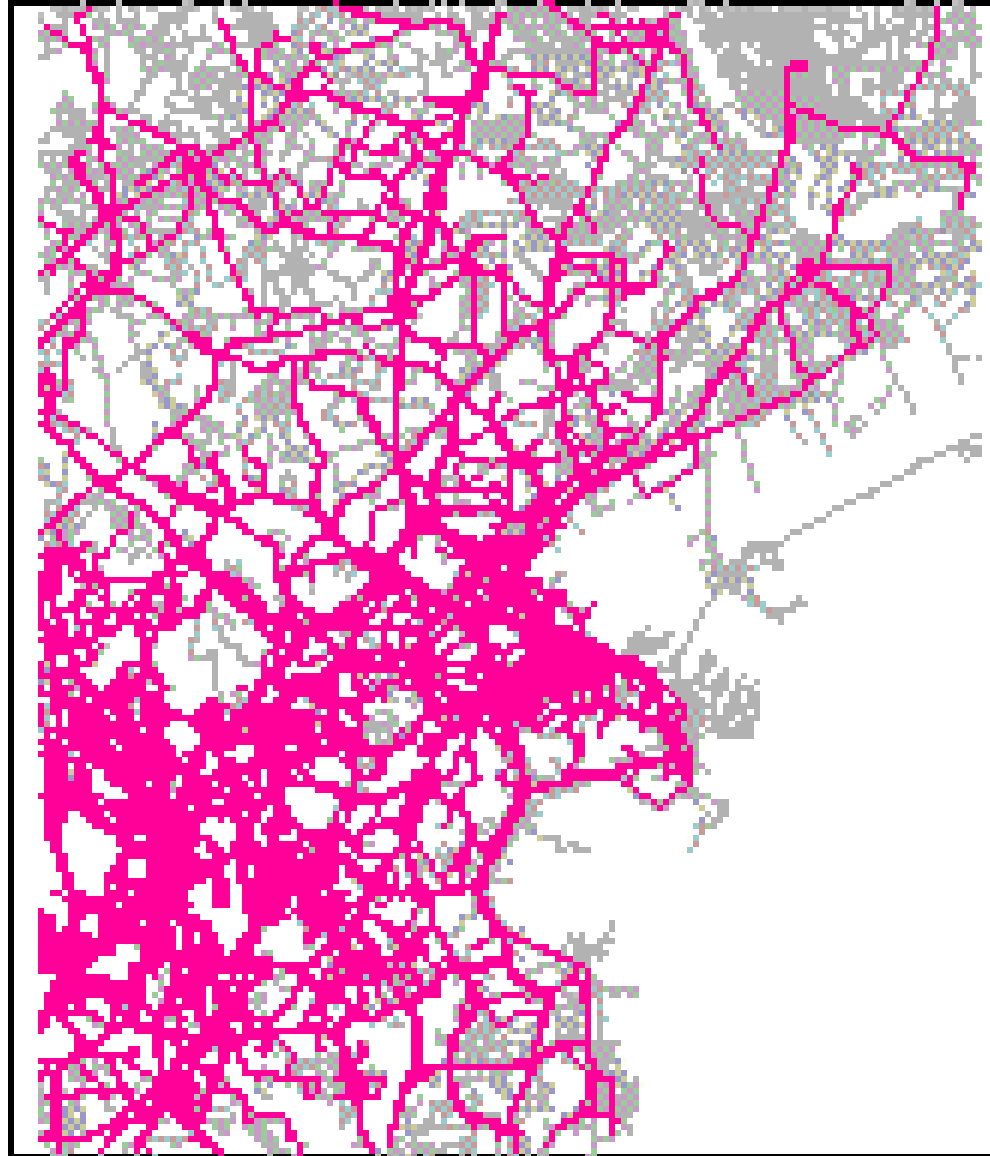
中心位置情報:

地名:   
 緯度:   
 経度:

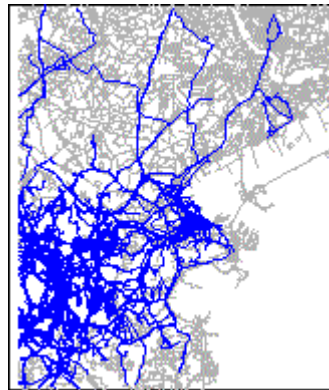
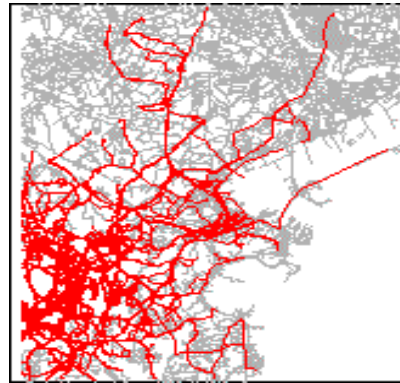
凡例:

<input type="checkbox"/>	不明	<input type="checkbox"/>	雨
<input type="checkbox"/>	降雨なし	<input type="checkbox"/>	大雨
<input type="checkbox"/>	小雨		

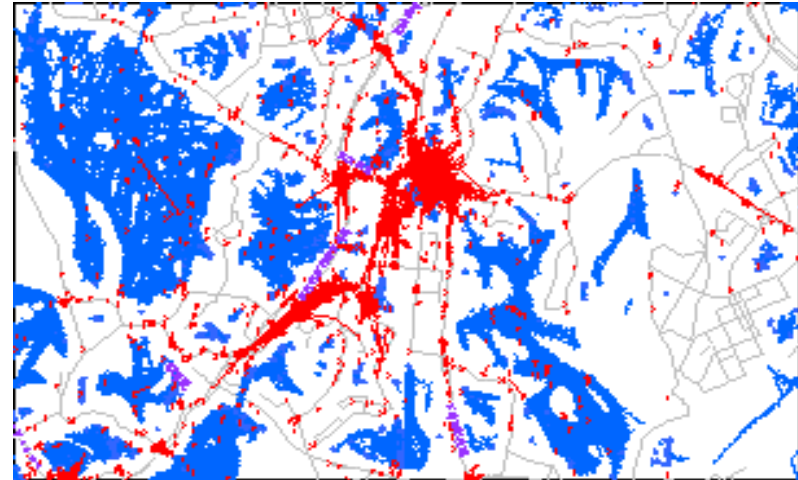
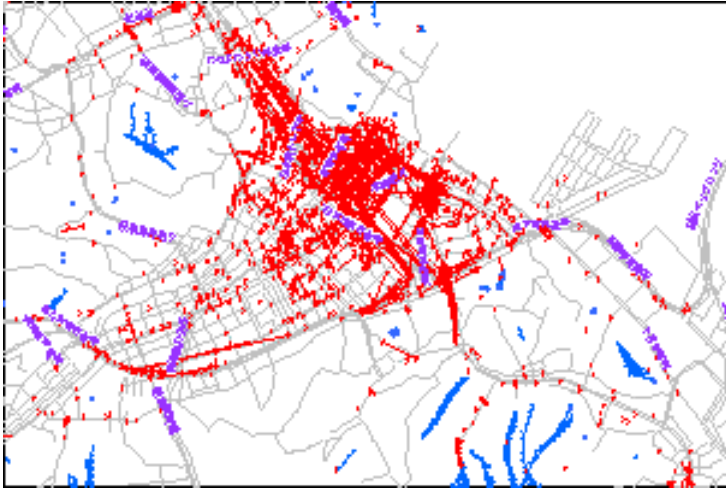
# The TAXI tracking: Early morning to Midnight



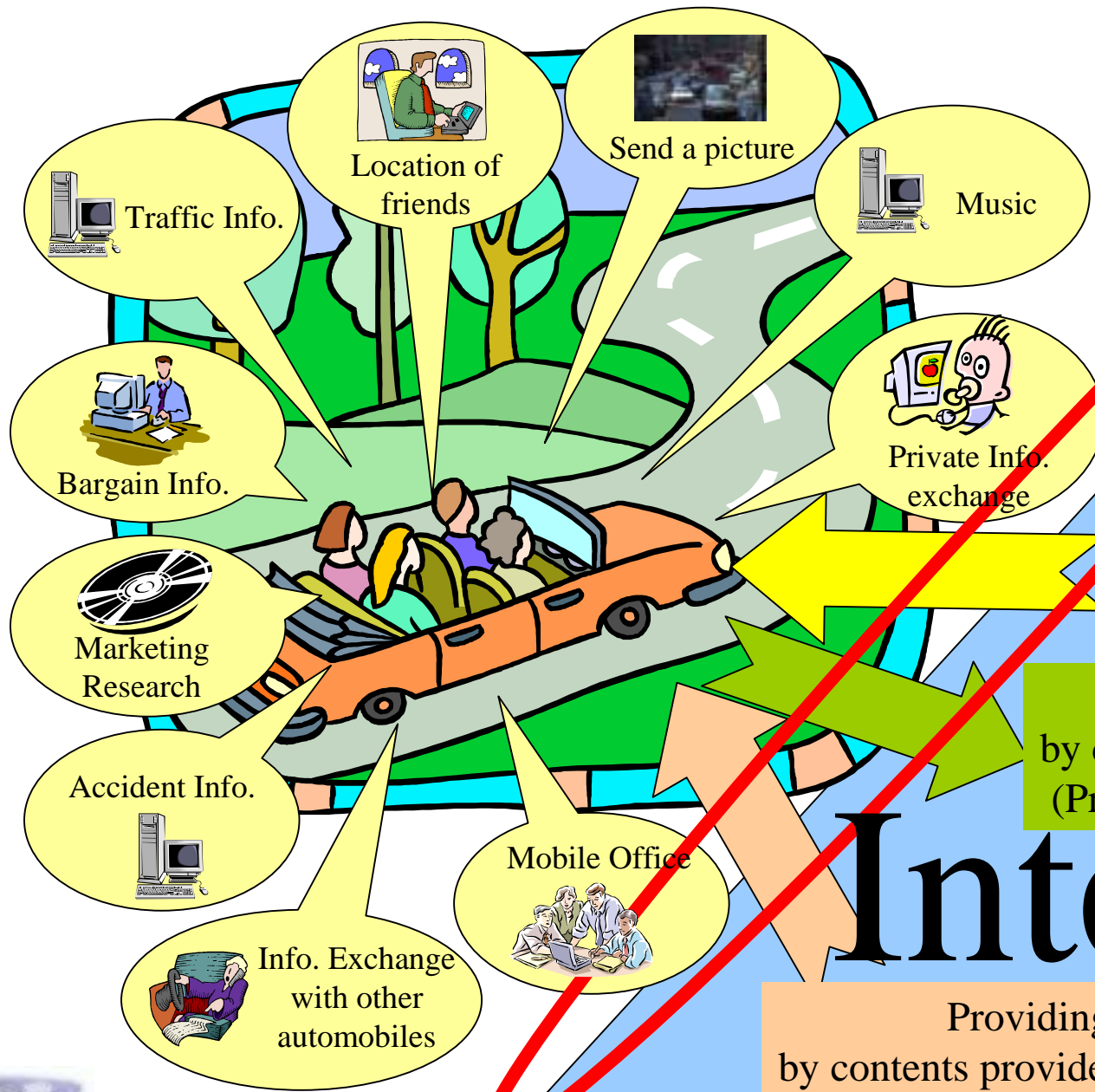
# Taxi: Post processing of the archived data



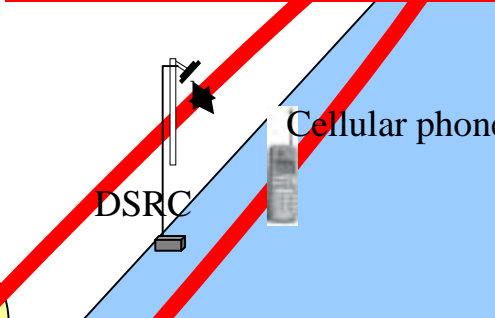
# GPS Error (RED), Map matching error (BLUE)







Internet Connectivity  
(ISP)



Providing a software  
by software houses  
or Sunday programmer  
(ASP)

Sending information  
by contract or other incentive  
(Probe Information System)

# Internet

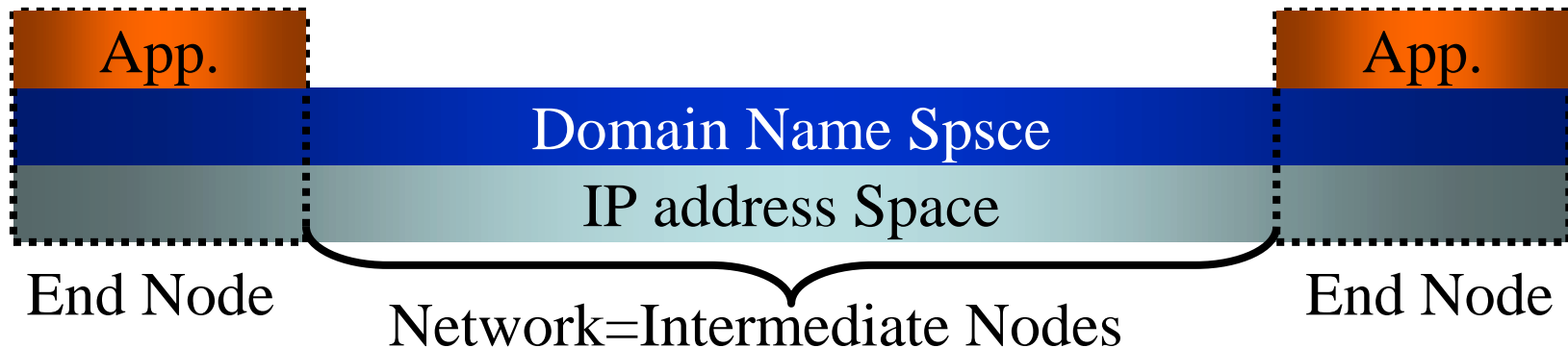
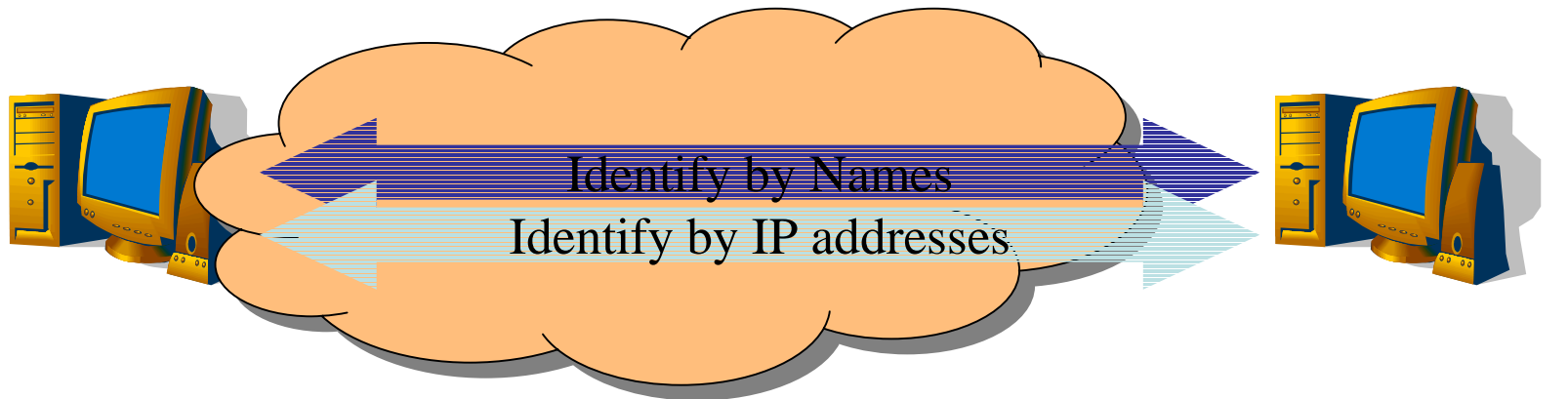
Providing contents  
by contents provider or private persons  
(IP)

then, some important issues..

# Identifier Rendezvous mechanism

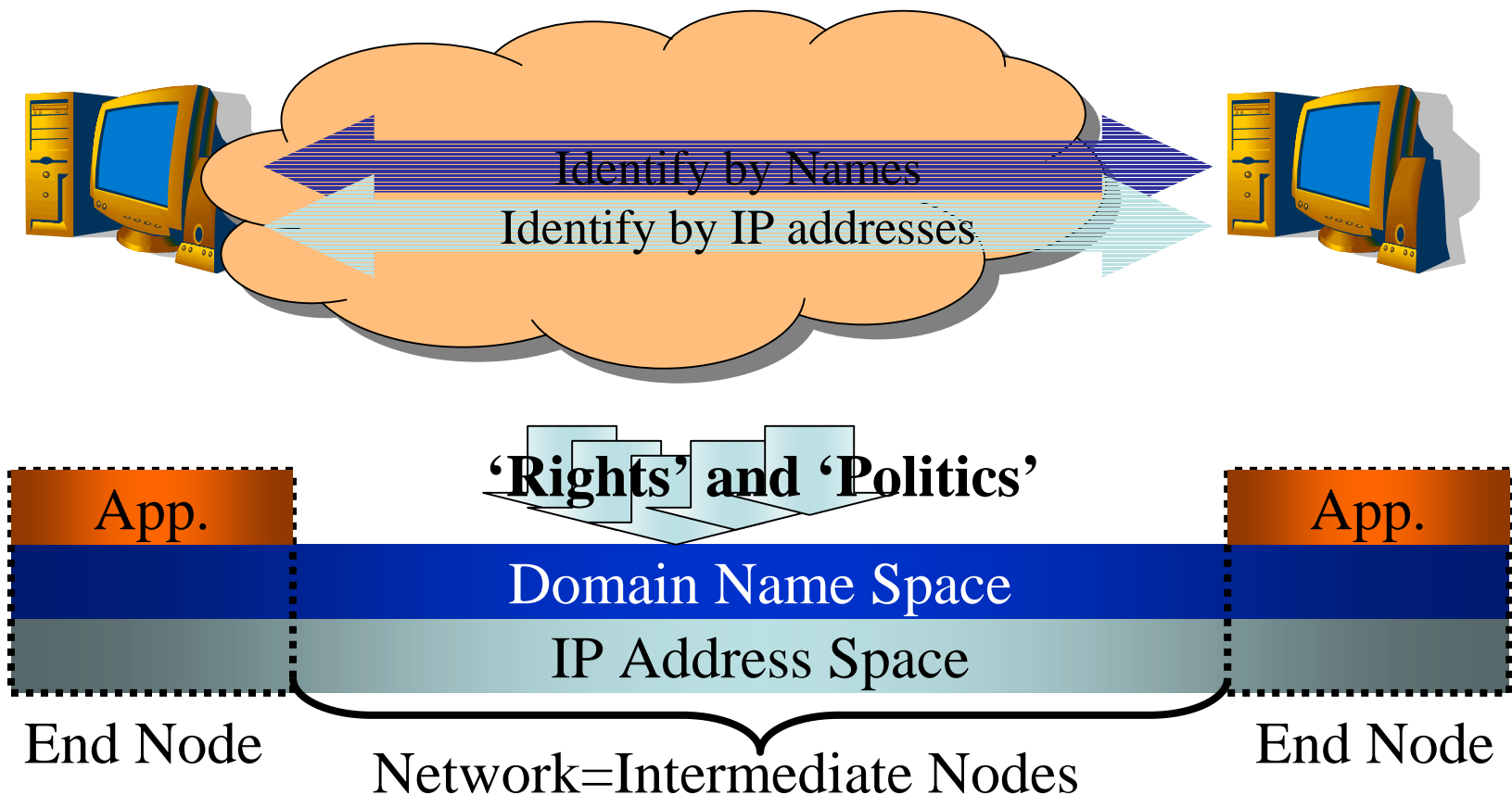
# Identifier: extremely important

- roles
  - Identify an IP address from a Name
  - Identify a Name from an IP address



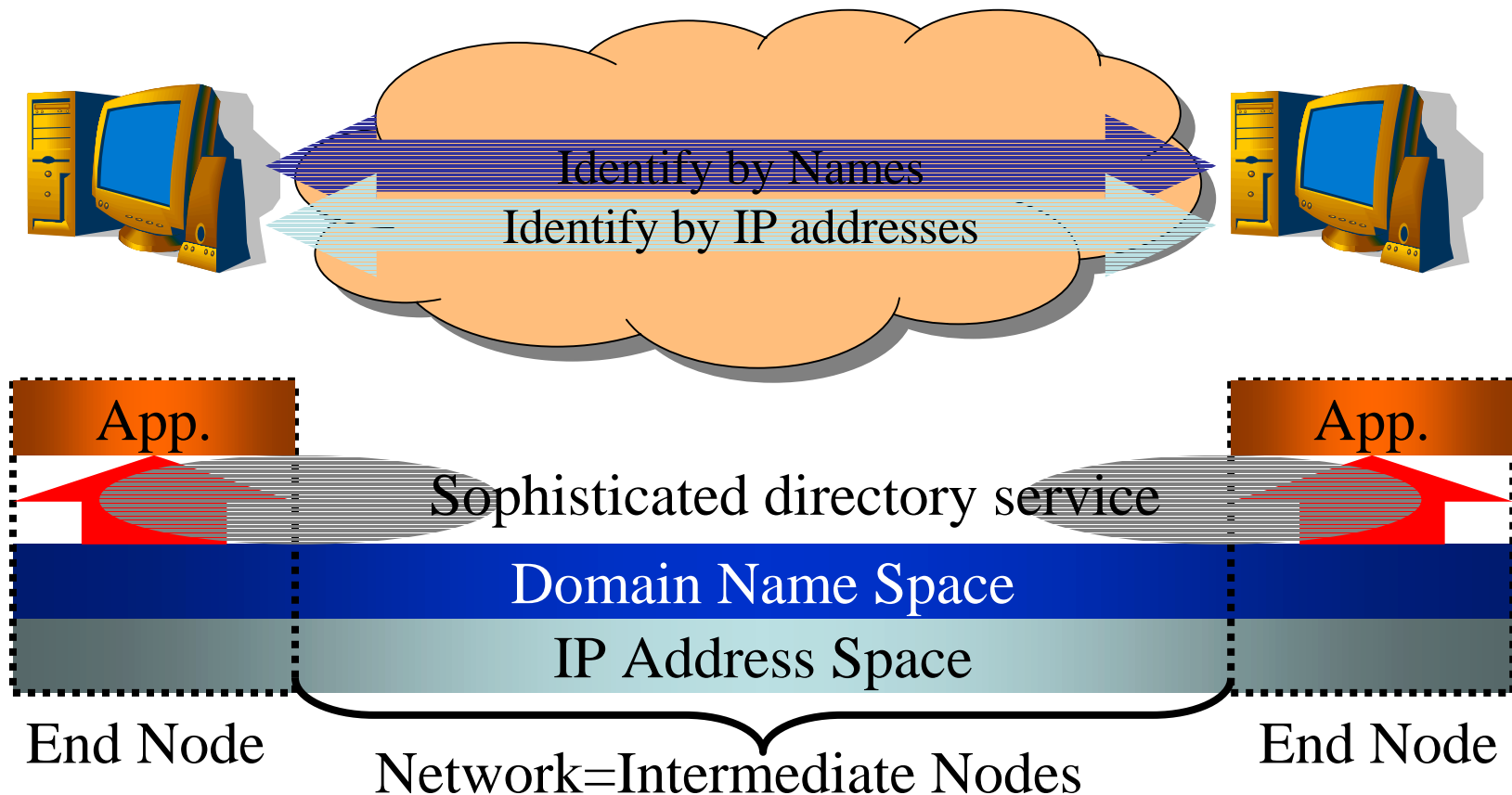
# Identity: should not be mixed with ID

- Issues
  - Intellectual property
  - Intellectual property right versus Operation and Uniqueness



# End node solution with sophisticated directory service

- Use DNS to map IP addresses and ‘symbols’ (=domain names)
- Sophisticated ways to provide ‘rendezvous’ spaces
  - Multiple convenient spaces on top of a unique domain name space
  - Some are ready: keywords and other directory services



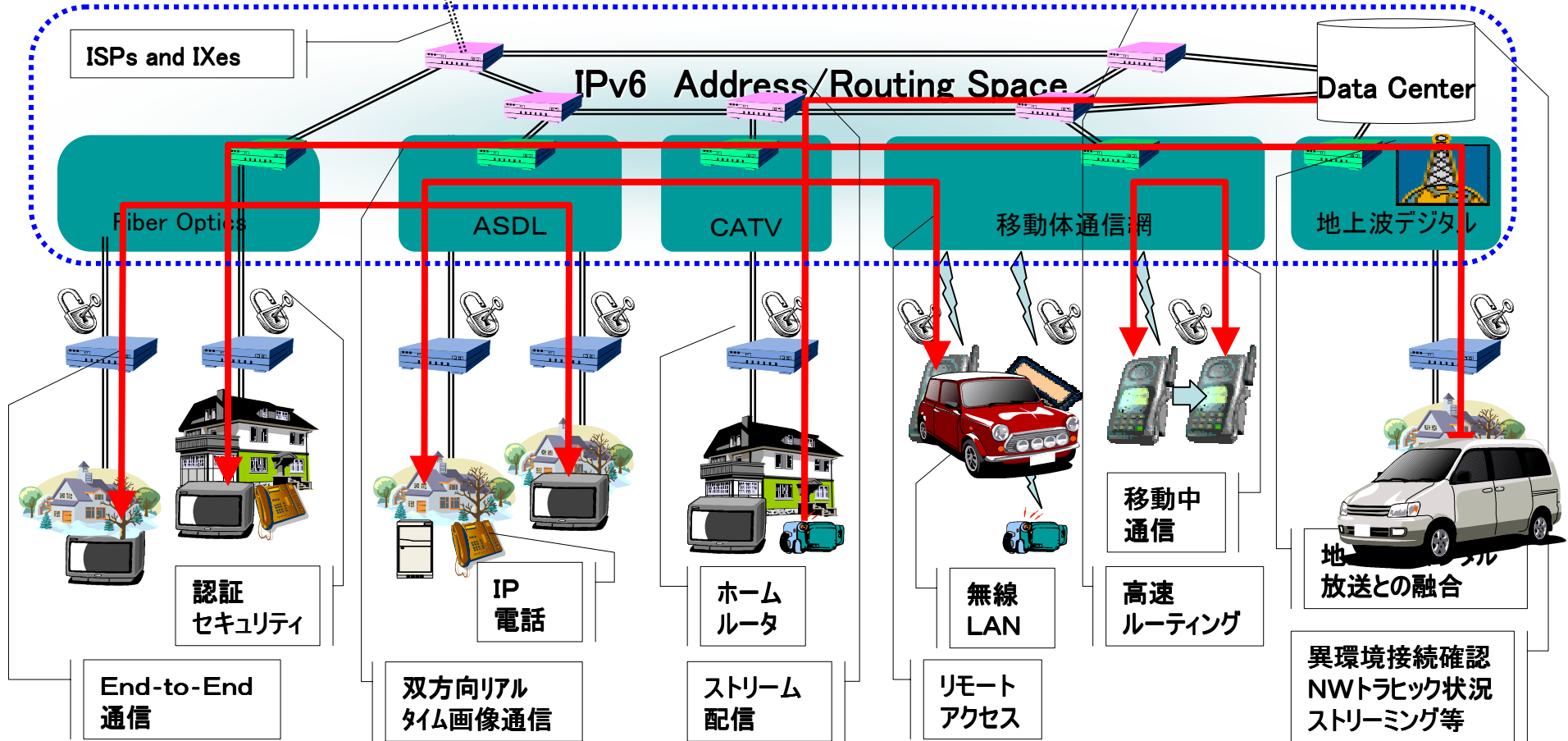
# Internet for Everybody, Everywhere and Everything

Geographical Location

Contents Repository

Peer to Peer Sharing

Global Rendezvous Space by DNS



# more to work ..

- Services for IPsec
- Address registry  
Address assignment
- # of routing entries
- 'home user' model
  - Multi homing
  - V4/V6 cohabitation
  - Privacy mechanism
  - Identifiers/names
- DNS! ?

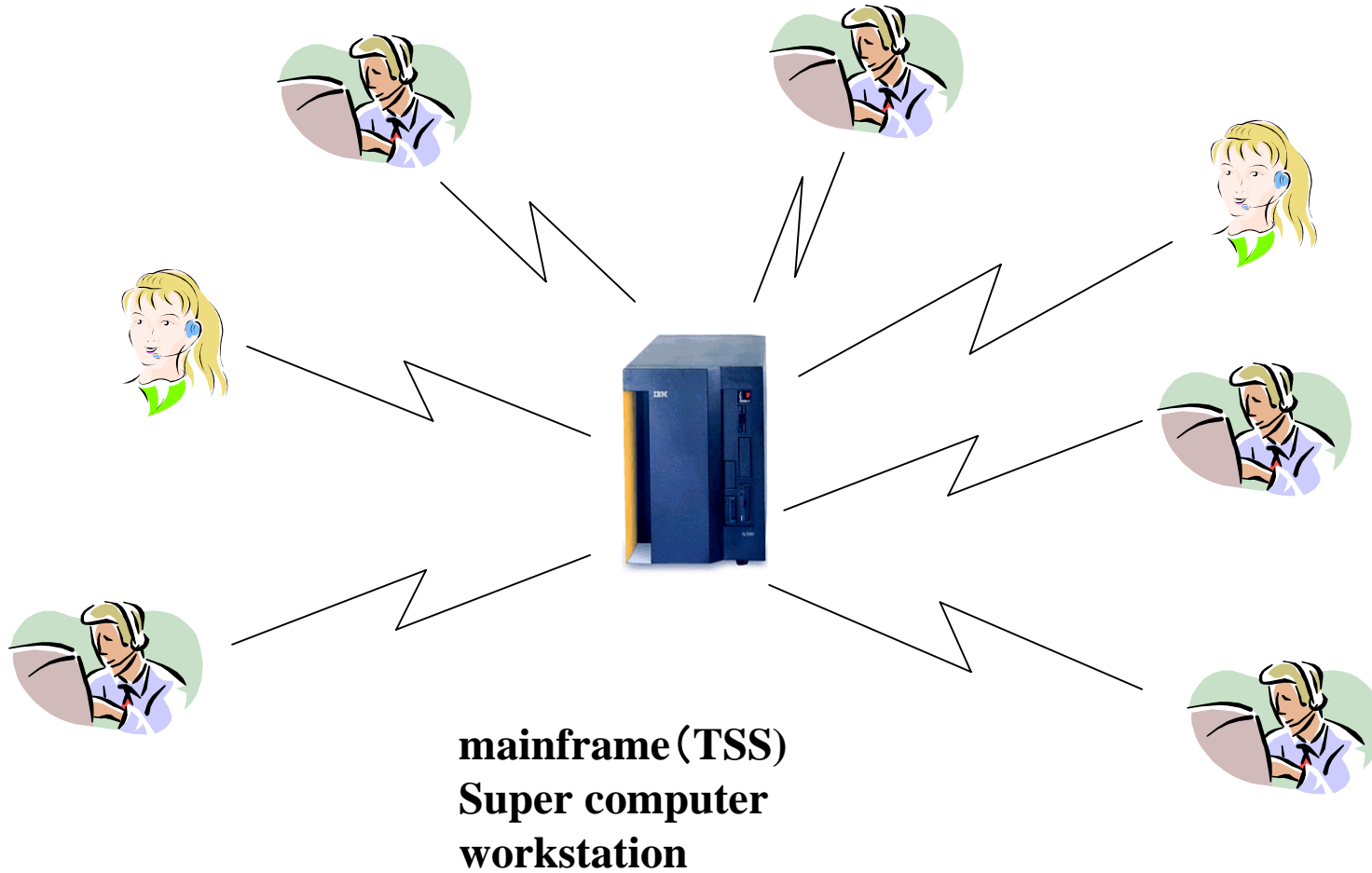


...and working to achieve

‘v6 is for everyone’

# Here comes 'computer'!

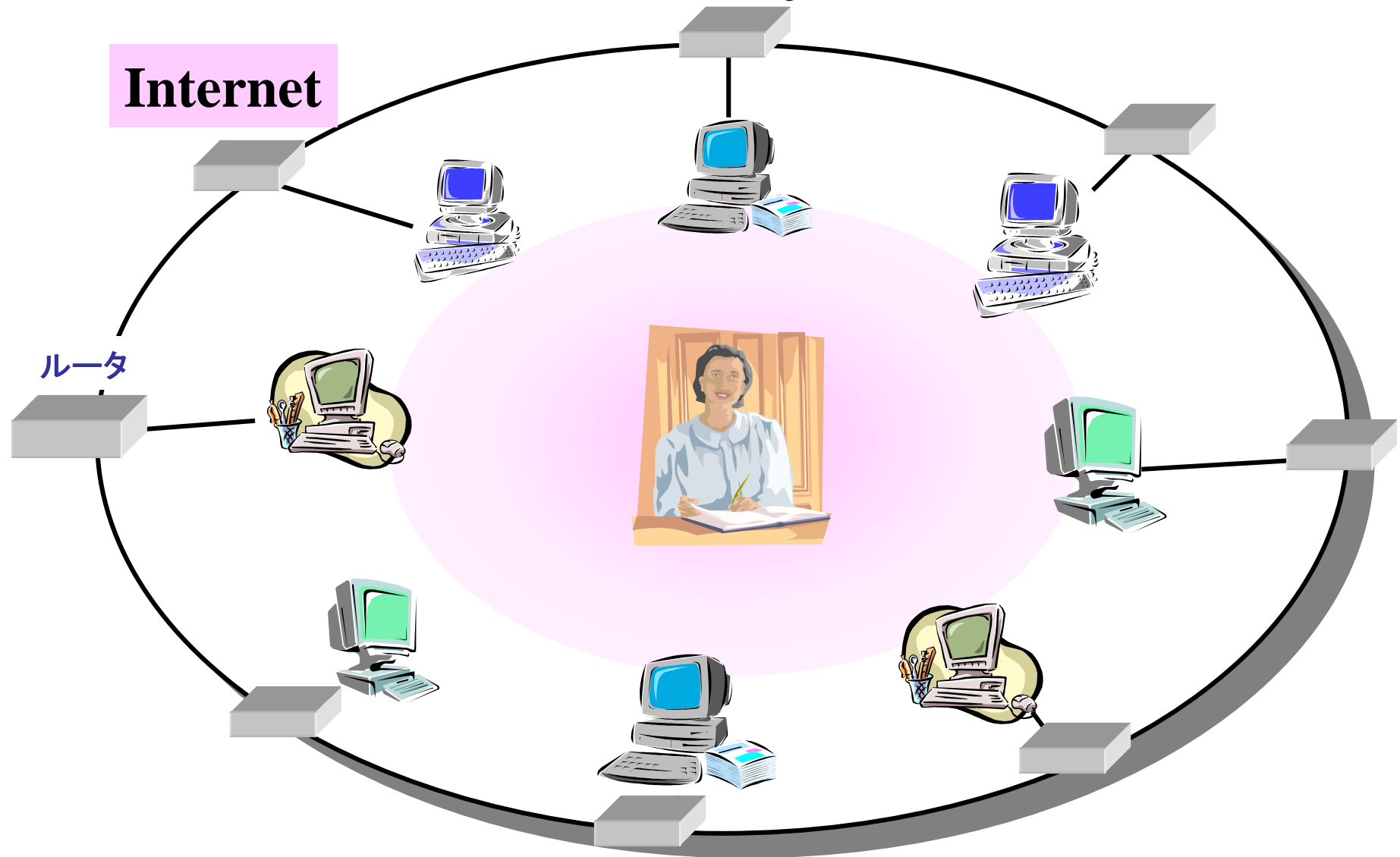
## Users work for the computer



# Now computers help me working..



then, connect them by the Internet



# Now, the IP is for everything

