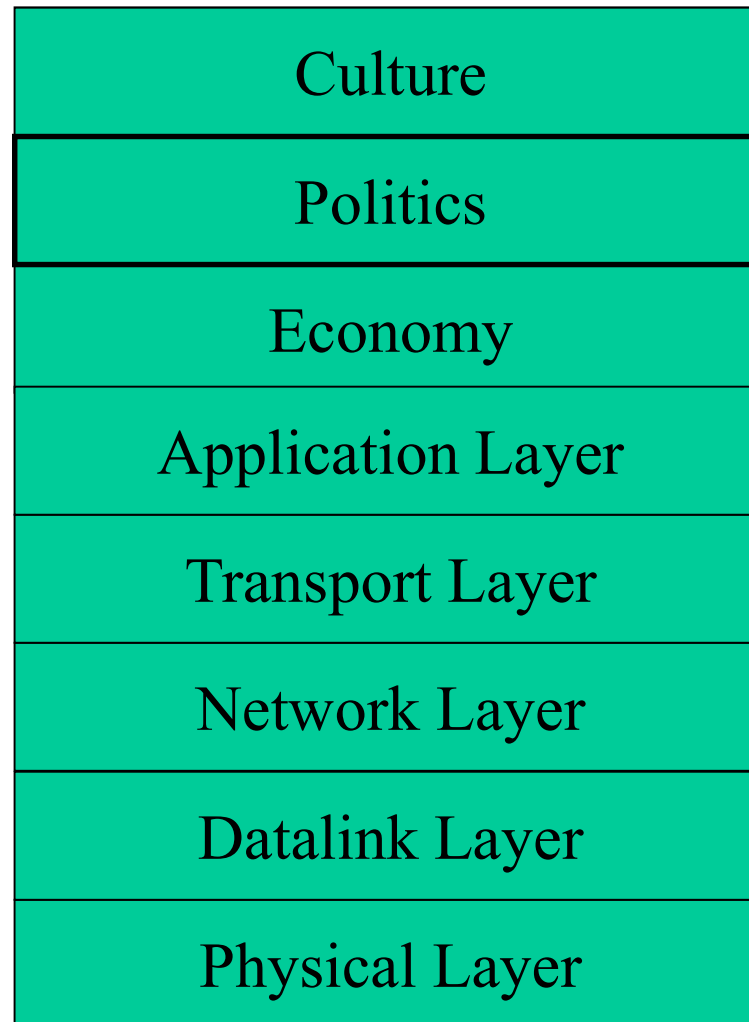Advanced Lecture on Internet Applications
12. Standardization, RFC, Operation, Implementation, Protocol Design

Masataka Ohta

mohta@necom830.hpcl.titech.ac.jp

ftp://ftp.hpcl.titech.ac.jp/appli12e.ppt

Culture
Politics
Economy
Application Layer
Transport Layer
Network Layer
Datalink Layer
Physical Layer

Layering Structure over the Internet and Standardization

The Standards-Making Universe

Traditional Model Telco Bodies

Traditional Model Information Systems Bodies

International Coordinating Organizations

PCS

ATSS OAS

Australian CCITT

CSRG

ECSA-T1

EIA/TIA

JATE

ECSA

TR8 TR1 TR9 TR10

CSA SCC

ANSI X3 CBEMA

NIST OIW

HATS Conf

RCR

BT SP

ETS

CEPT

CAC

ECMA

EWOS

CEN CENELEC

T5 T3 S3 T9

POSI GROUP

SPAG

SIS

SNV

C0S

EMUG

NNI

DIN

TTC (down)

NA

JTC

ISO-IEC

IEC

AFNOR

TTA

ITU-T

T1

ITU-R

Radio Conf

11 4 8 9

URSI

SMPTE

B'cast Unions

IEEE

POSIX

BSI

BCS

JISC

JSA

CT-AC

Internet Society

IETF

IANA PCR*

EDIFACT

Network Managem't Forum

SMDS Interest Group

ATM Forum

Fram Relay Forum

EuroFR Forum

NA ISDN Users Forum

Traditional Radio Bodies

X-Window Consortium

Open Software Fdn

Microsoft MAPI

Unix Int'l

SIGMA Group

Winsock Group

X/Open

VESA Stds Ass'n

RARE RIPE

New Model Information Systems Bodies

New Model Telco Bodies

De Jure Standard and De Facto Standard

- de jure Standard
  - specified by standardization organization formally recognized as such by countries through, e.g., international treaty
    - ITU
    - ISO(IEC)
- de facto Standard
  - naturally grown standard
    - compared to De Jure Standard
  - many de facto standardization organizations (forum) exist
    - sometimes called forum standards

WTO (World Trade Organization) Agreement

- non-tariff barrier and standardization
  - too many standards worsens interoperability of products
  - "international standards" must be respected not less than domestic standards to promote international competitions

How International Standards Enforced

- The WTO Agreement on Technical Barriers to Trade

  - 2.4 Where technical regulations are required and relevant international standards exist or their completion is imminent, Members shall use them, or the relevant parts of them, as a basis for their technical regulations except when such international standards or relevant parts would be an ineffective or inappropriate means for the fulfillment of the legitimate objectives pursued, for instance because of fundamental climatic or geographical factors or fundamental technological problems.

What is "International Standards" of WTO?

- standards specified by international body or system
  - 4. *International body or system*
    - Body or system whose membership is open to the relevant bodies of at least all Members.
  - "Member" means member countries and territories of WTO
  - private companies may also be a member

International Standardization Organization: ISO

- ISO does NOT stands for "International Standardization Organization"
  - pronounced as "aiso"
- members are countries
- specify standards in various areas
  - including standards for computers such as computer languages and character codes

International Standardization Organization on Electricity: IEC

- International Electrotechnical Commission
- mostly merged with ISO
  - electric (computer) standards are published as ISO/IEC standards

International Standardization Organization on Telecommunication: ITU

- International Telecommunication Union
- specialized agency of UN (United Nations)
  - Members are countries
- has three sectors (ITU-T, ITU-R, ITU-D)
  - private company can be a sector member
  - actual work done in SG (Study Group)

ITU-T

- originally named CCITT (International Coordinating Committee for Telephony and Telegraphy, Comite Consultatif International Telegraphique et Telephonique)
- standardize telecommunication
  - issued as ITU-T Recommendation
- standardize DSL and optical fiber

ITU-R

- assign radio wave resources

ITU-D

- help developing countries

Rise of Forum Standards

- forum can be created relatively easily
- de jure standardization organizations are slow to move
  - needs too much time for standardization
- forum become leader of standardization
- de jure standardization organizations revised their process
  - AAP (Alternate Approval Process) of ITU-T
    - minimum duration for standardization is a half year

Standardization Forums Related to the Internet

- IETF
  - naturally grown from DARPA research project
  - specify internet standard
  - mostly concentrate on network layer and above
    - W3C is for web at application layer
- IEEE
  - academic society of US
  - datalink and physical layers of Ethernet, Wifi, etc.

Application Layer	(W3C)
Transport Layer	IETF
Network Layer	
Datalink Layer	
Physical Layer	IEEE
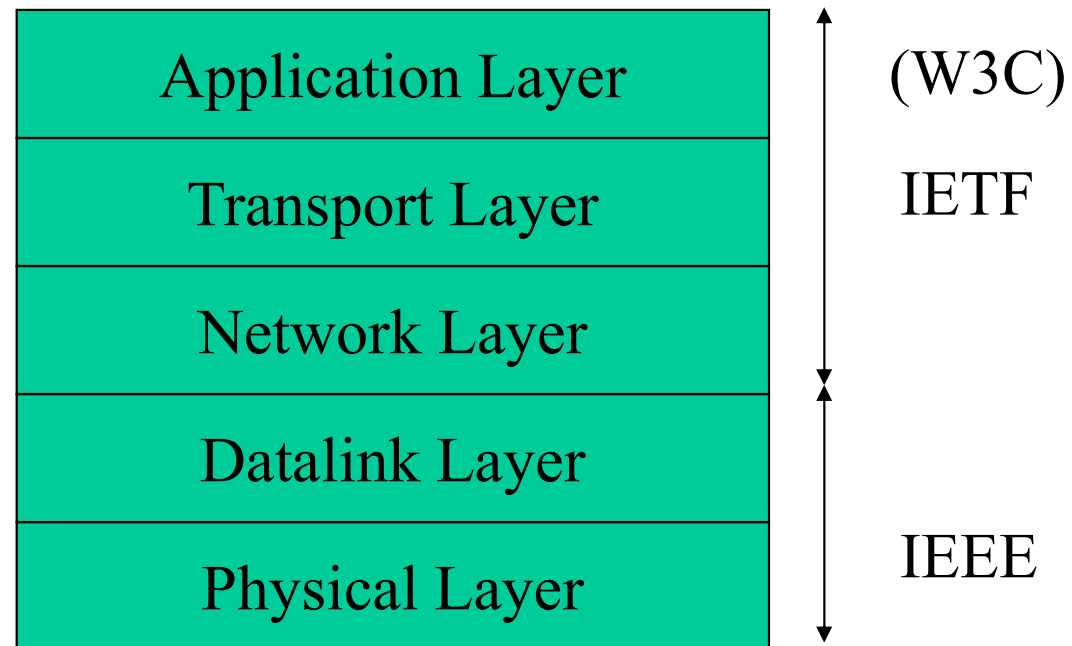
Major Forum Standards for the Internet

IETF and Standardization for Internet Technolocies

- internet is a result of a DARPA project
- results (protocol standards) are published as RFCs (Request for Comments)
- later, standardization organization of IETF (Internet Engineering Task Force) established
- after that, an international organization of ISOC (Internet Society) was incorporated as a upper organization

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

- implement functions by terminals (ends) not by the network
  - network equipment has only single function (to connect terminals) and is high speed
- implement functions 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)

End to End Principle and Standardization

- in networks supporting lots of functions
  - the functions must be by whole network
    - standardization is essencially important
- in the internet
  - new functions are supported by end systems
  - standardizations are, primarily, unnecessary
  - standardizations on network functions are still important
    - network layer (IP, address, routing, QoS, multicast, etc.) and below

Structure of Internet Standardization
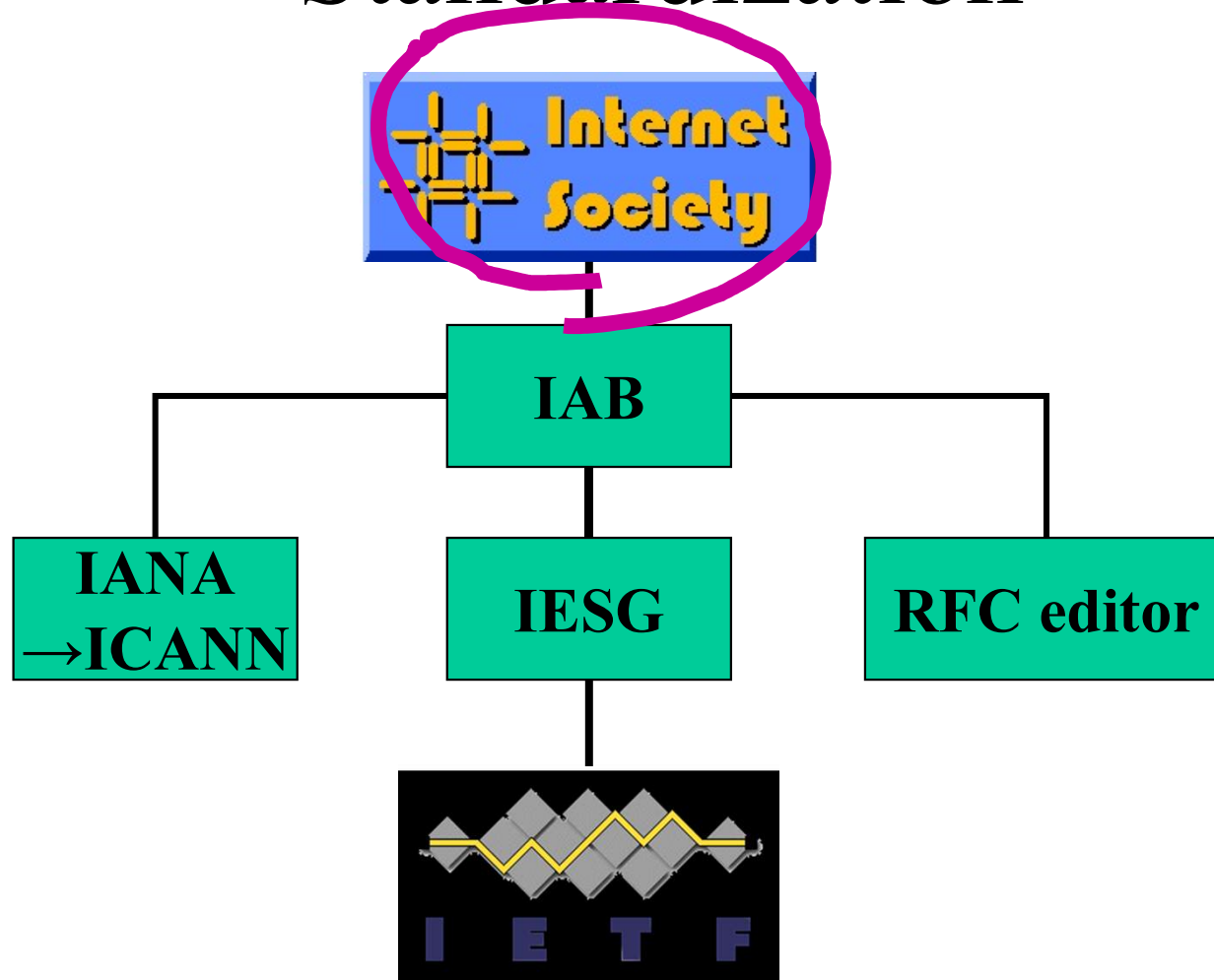
ISOC (Internet SOCiety)

- international academic society foro internet
- was consists from paying individual members
- annual plenary was INET
  - held around the world
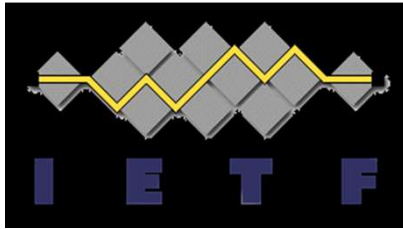   - at Yokohama in 2000
- www.isoc.org

Role of ISOC

- incorporated in 1992 as organization above IAB
- initial by-laws: RFC2135
- responsible for legal/organizational matters
- finiancial support for IETF
- choose IAB (and IESG) members
- coordination with ITU
- operated by the board of trustees
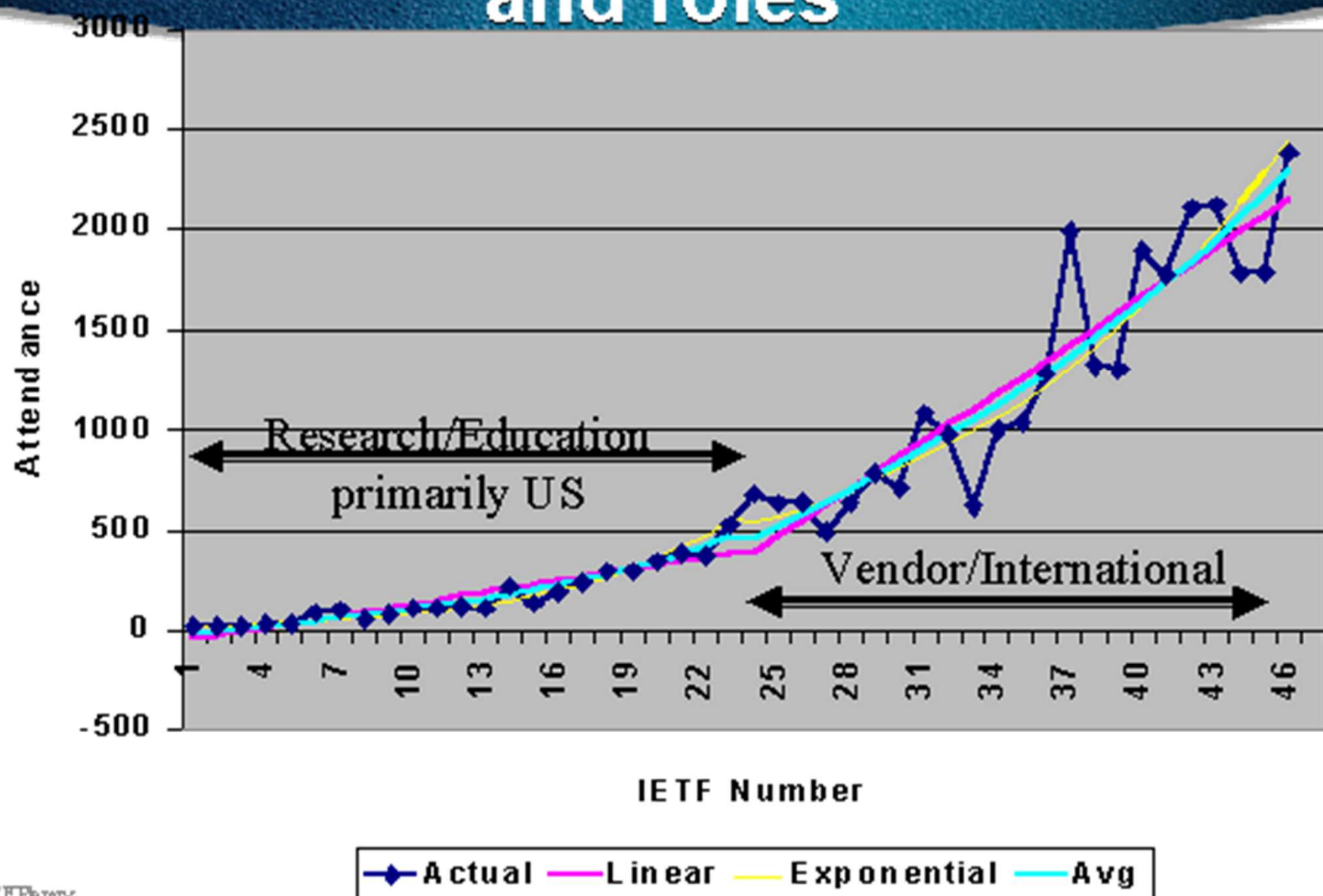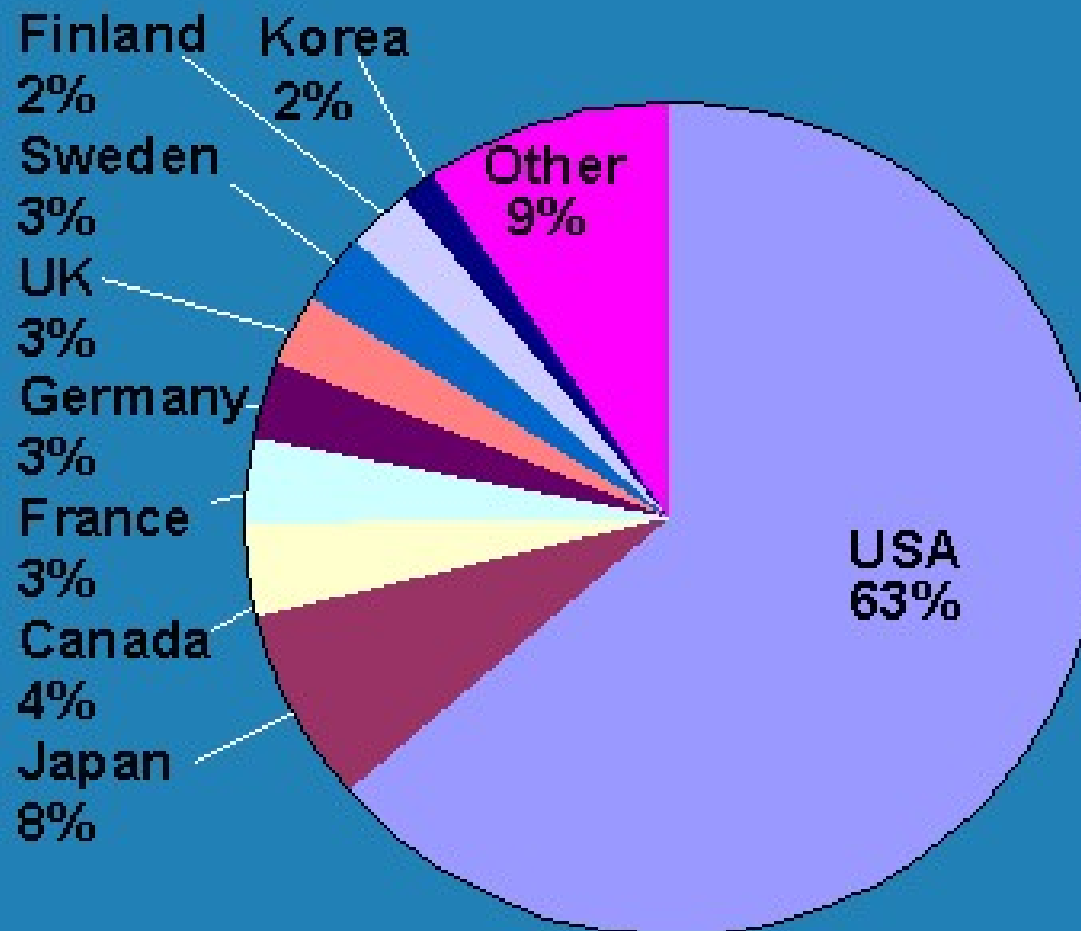
Structure of Internet Standardization
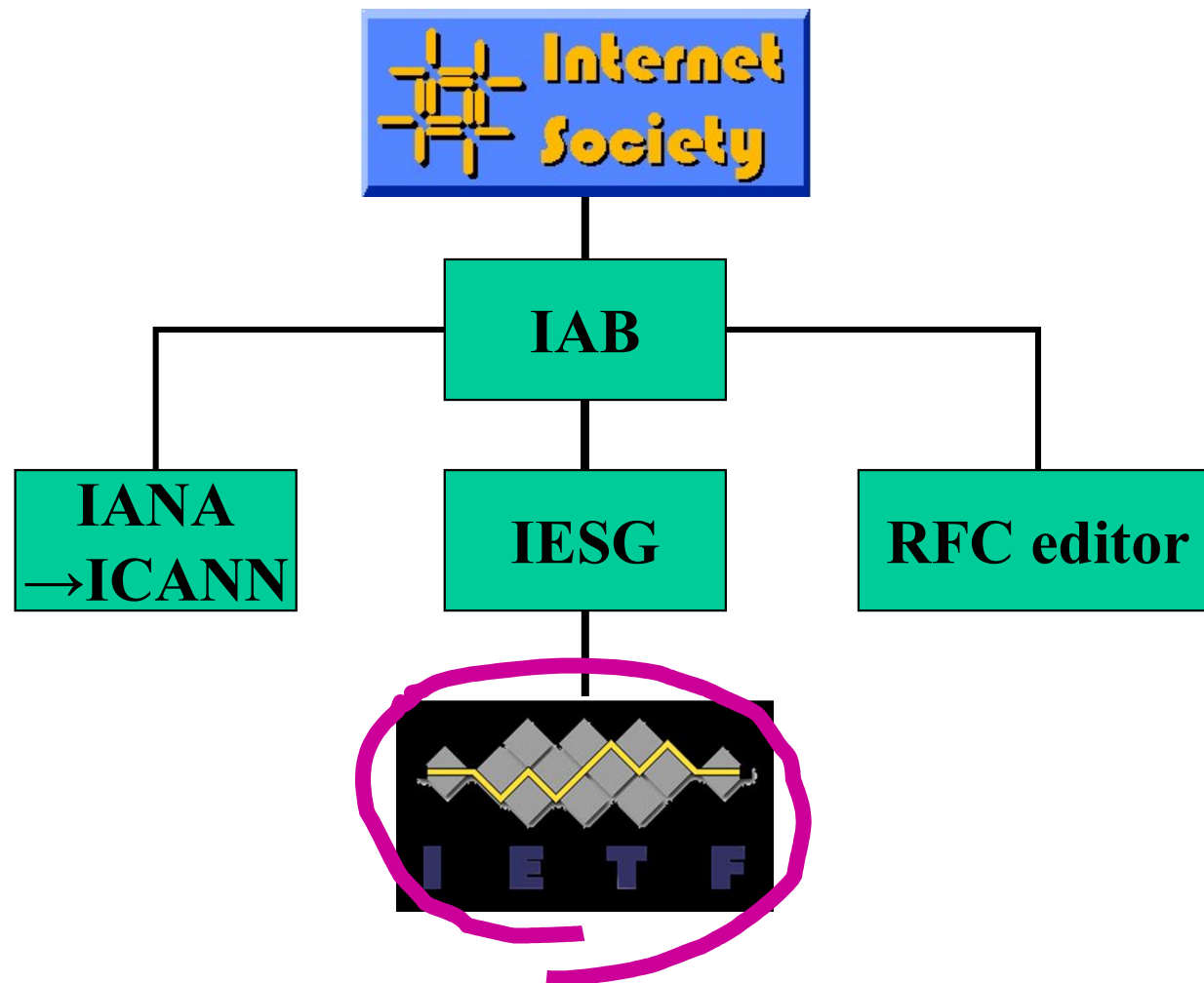
What is IETF

- group to discuss standards related to IP
- established in 1986 under IAB
- no formal membership
  - decision making by "rough consensus"
- 8 areas (Applications, Internet, Operations and Management, Routing, Security, Sub-IP, Transport, User Services), and 133 working groups (Jan. 02)
- three meetings in a year (was twice in US)

Changed IETF composition and roles

Attendance by company (the big ones)
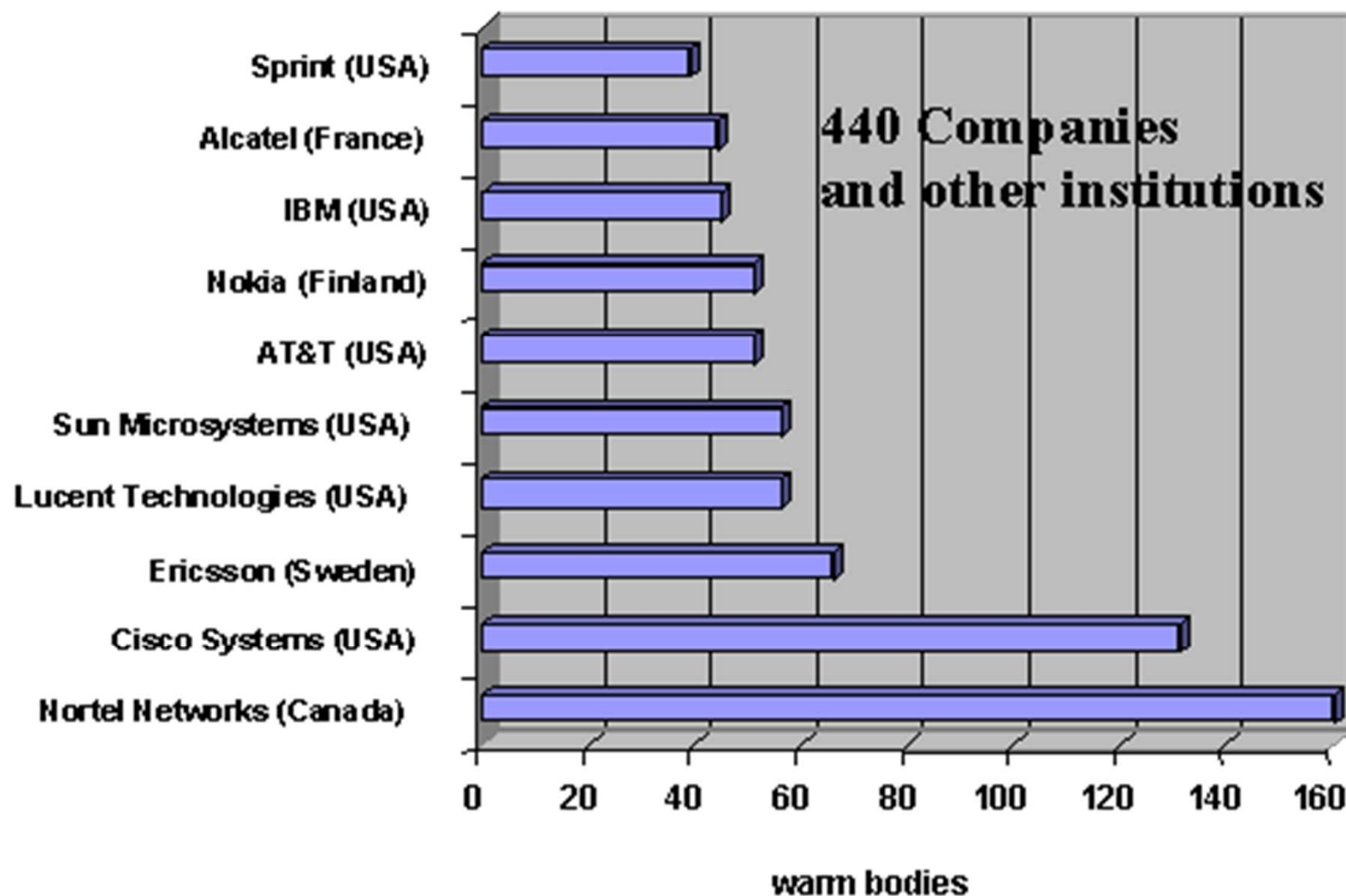

440 Companies and other institutions

Chart: warm bodies

- Sprint (USA): ~40
- Alcatel (France): ~48
- IBM (USA): ~48
- Nokia (Finland): ~55
- AT&T (USA): ~55
- Sun Microsystems (USA): ~58
- Lucent Technologies (USA): ~58
- Ericsson (Sweden): ~68
- Cisco Systems (USA): ~133
- Nortel Networks (Canada): ~162

X-axis: 0 20 40 60 80 100 120 140 160

warm bodies

Structure of a WG (Working Group)

Area Director

_____

WG Chair(s)

WG Editor(s)

remaining others

BoFs Held in 52nd at Saltlake

IRNSS	Internet Resource Name Search Service
OPS-NM	Configuration Management requirements BOF
INCH	Extended Incident Handling BOF
INTLOC	Internationalization and Localization of Internet Protocols BOF
ROI	RDMA over the Internet Protocol Suite BOF
OPES	Open Pluggable Edge Services BOF
MPLSOAM	MPLS Maintenance Mechanisms
NDMP	Network Data Management Protocol BOF
DCP	Datagram Control Protocol BOF
DNSMEAS	DNS Research Measurements BOF
NMSEC	Security Requirements for Management Protocols BOF
IEPREP	Internet Emergency Preparedness BOF
CDI	Content Distribution Internetworking BOF
IPPT	IP Path Tracing BOF

RFC (Request For Comments)

- formal documents for the internet (not necessarily standards)
- idenfitied by serial numbers (RFCxxxx)
- various types
  - Informational
  - Standard Track
  - Best Current Practice
  - For Your Information
  - Historic

Standardization Process for RFCs
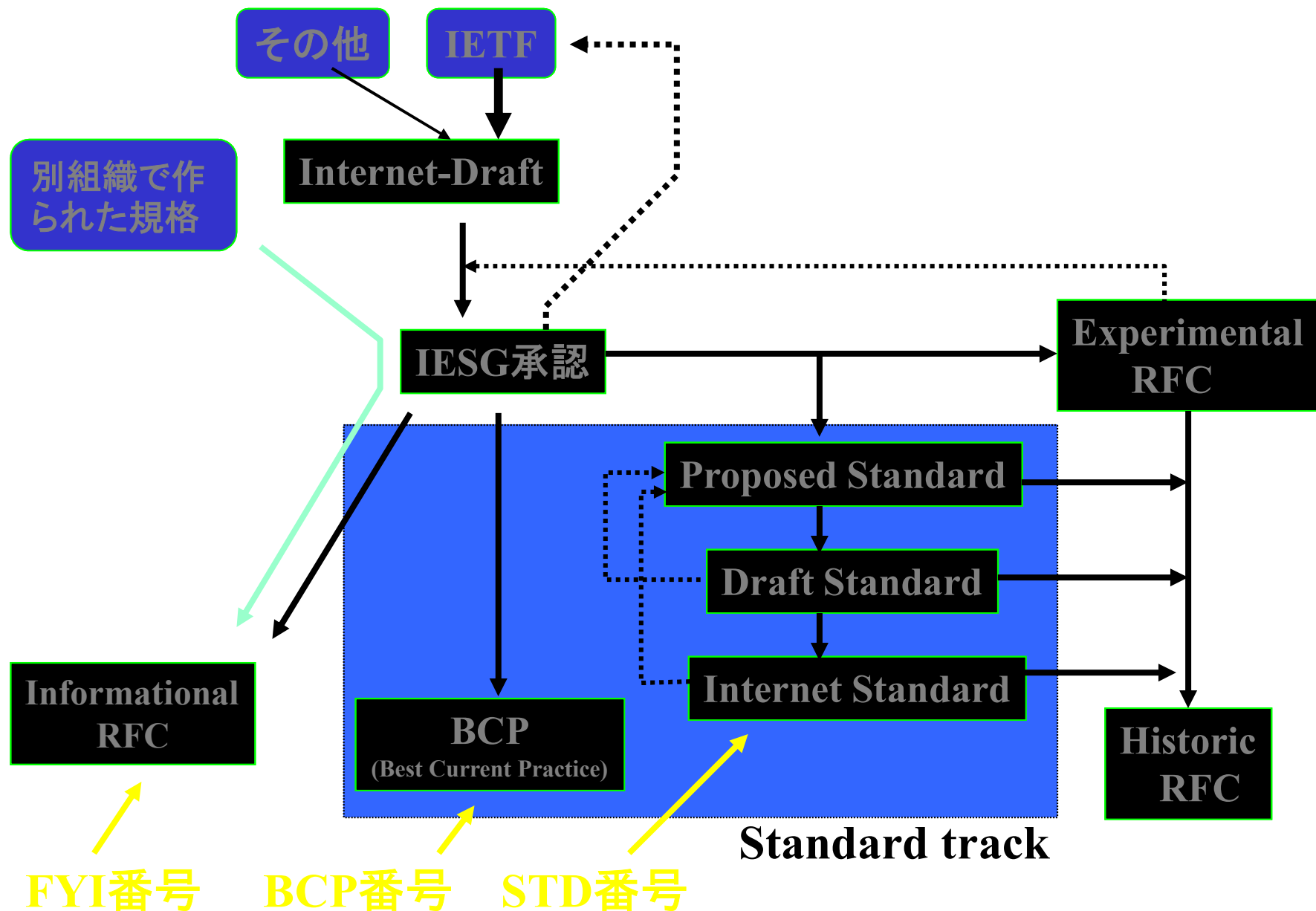
# Requirements for Standardization Process

from Proposed Standard (PS) to Draft Standard (DS)

- at least 6 months passed after PS

- existence of two or more independent implimentations

- enough operational experiences

from Draft Standard (DS) to Internet Standard

- at least 4 months passed after PS

- have IETF meeting at least once after becoming DS

- enough operational experiences

Structure of Internet Standardization
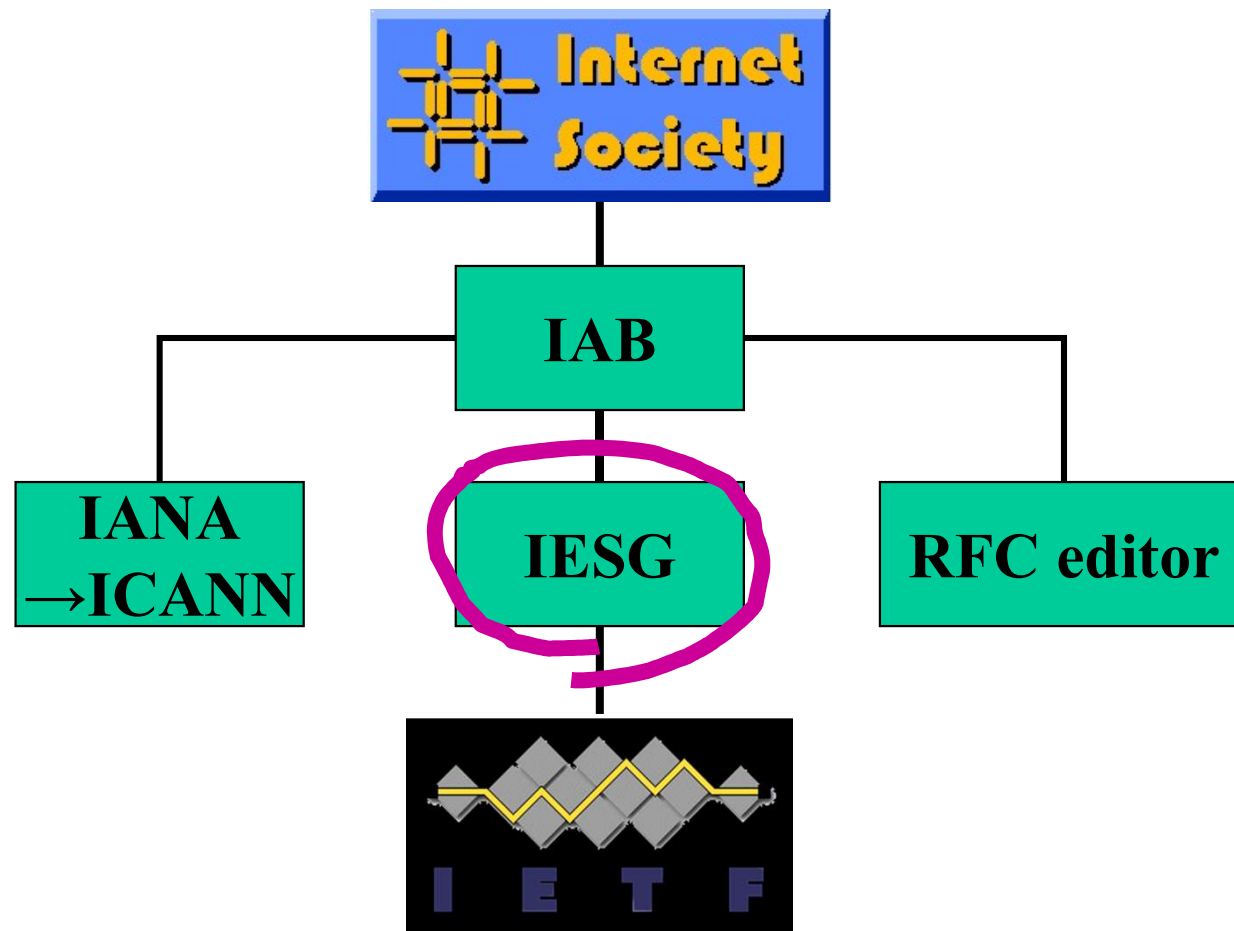
Role of IESG

- manage activities of IETF
  - establish/deestablish WGs
- manage internet standard process
- final approval for internet standards

Members of IESG
(at 2000 or so) http://www.ietf.org/iesg.html

- IETF Chair
  - Harald Alvestrand
- Applications Area (app)
  - Patrik Faltstrom
  - Ned Freed
- Internet Area (int)
  - Erik Nordmark
  - Thomas Narten
- Operations & Management Area (ops)
  - Randy Bush
  - Bert Wijnen

- Routing Area (rtg)
  - Bill Fenner
- Security Area (sec)
  - Jeff Schiller
  - Marcus Leech
- Transport Area (tsv)
  - Scott Bradner
  - Allison Mankin
- User Services Area (usv)
  - April Marine
- Temporary Sub-IP Area (sub)
  - Scott Bradner
  - Bert Wijnen

Structure of Internet Standardization
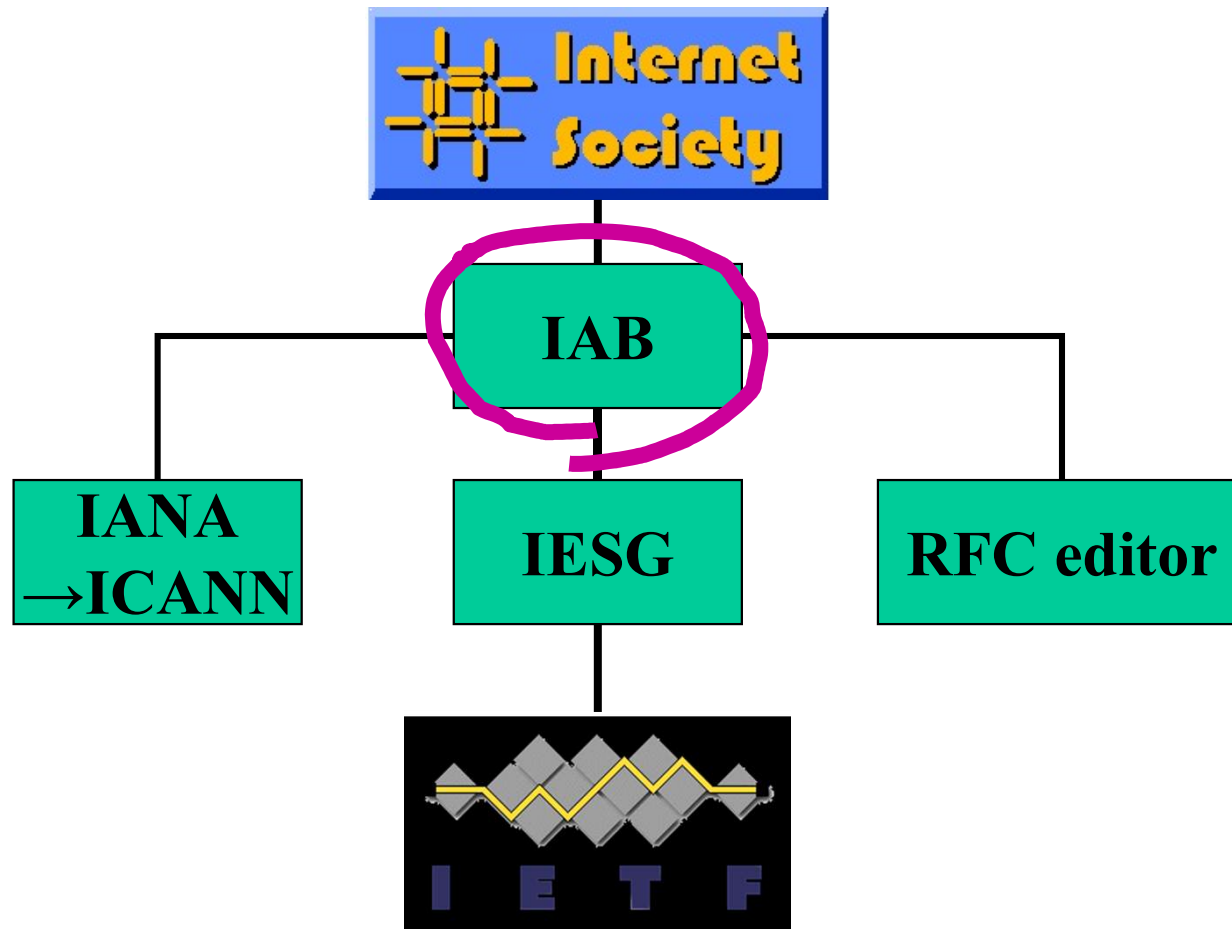
Role of IAB (rfc2850)

- approve IESG members, designate IETF chair
  - from a list created by IETF nominating committee
- architectural oversight
- standards process oversight and appeal
- RFC Series and IANA
- ISOC liaison
- external liaison

Charter of the Internet Architecture Board (IAB) , RFC1601から

History of IAB

1979   ARPA established ICCB (Internet Configuration Control Board)

1982   restructured as IAB(Internet Activities Board)

1986   IETF established under IAB

1992   incorporate ISOC aboe IAB and rename as Internet Architecture Board

Members of IAB

- Harald Alvestrand (IETF/IESG Chair)

  Harald@alvestrand.no

- Ran Atkinson rja@extremenetworks.com

- Rob Austein

  sra@hactrn.net

- Fred Baker

  fred@cisco.com

- Brian Carpenter

  brian@icair.org

- Steve Bellovin (Liaison to the IESG)

  smb@research.att.com

- Jon Crowcroft

  J.Crowcroft@cs.ucl.ac.uk

- Leslie Daigle (IAB Executive Director)

  leslie@thinkingcat.com

- Steve Deering

  deering@cisco.com

- Sally Floyd

  floyd@aciri.org

- Geoff Huston

  gih@telstra.net

- John Klensin (IAB Chair)

  klensin+iab@jck.com

- Henning Schulzrinne

  hgs@cs.columbia.edu

EX OFFICIO AND LIAISON
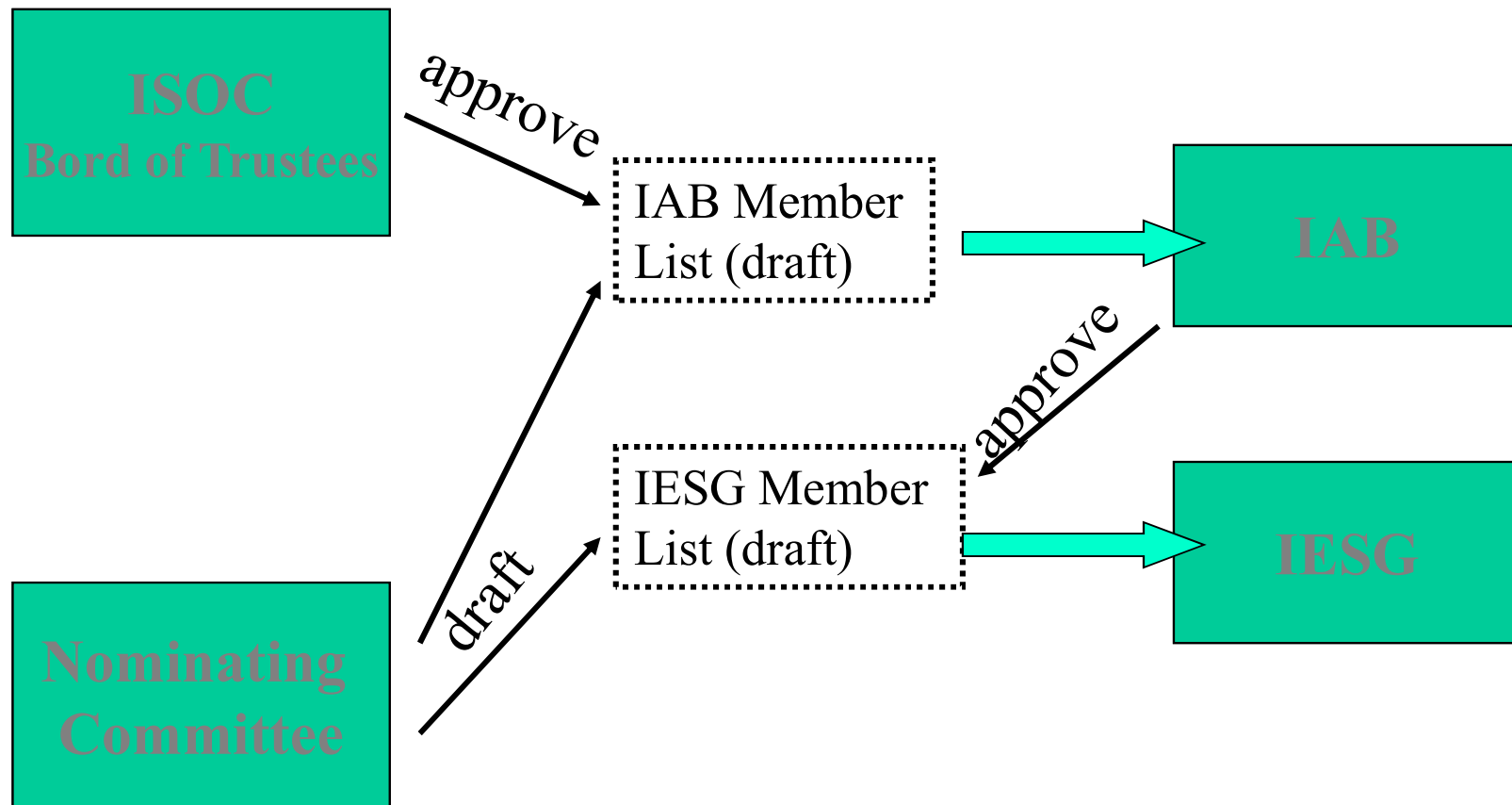- Erik Nordmark (Liaison from the IESG)
  Erik.Nordmark@eng.sun.com
- Erik Huizer (IRTF Chair)
  irtf-chair@cs.twente.nl
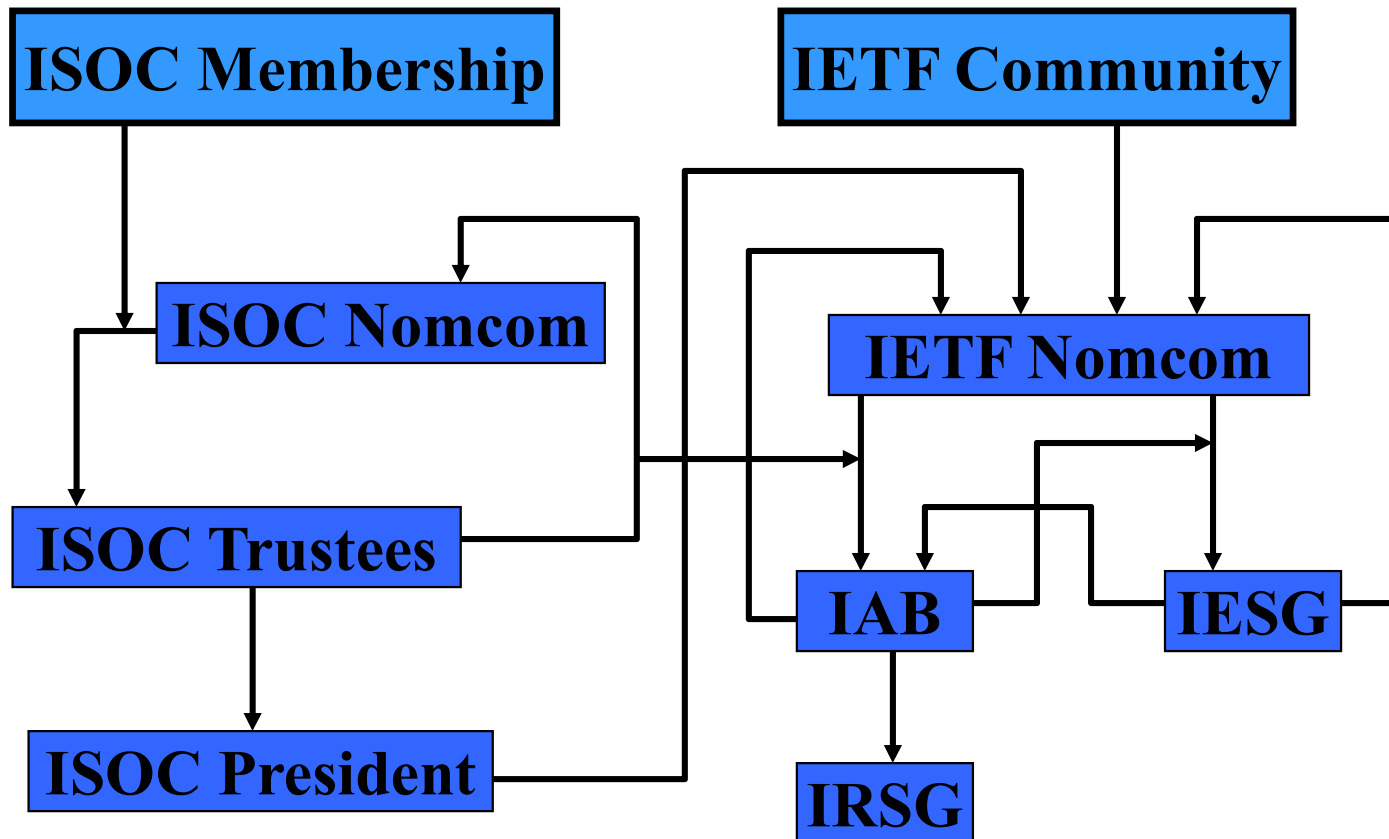- Joyce K. Reynolds (Liaison from the RFC Editor)
  jkrey@rfc-editor.org
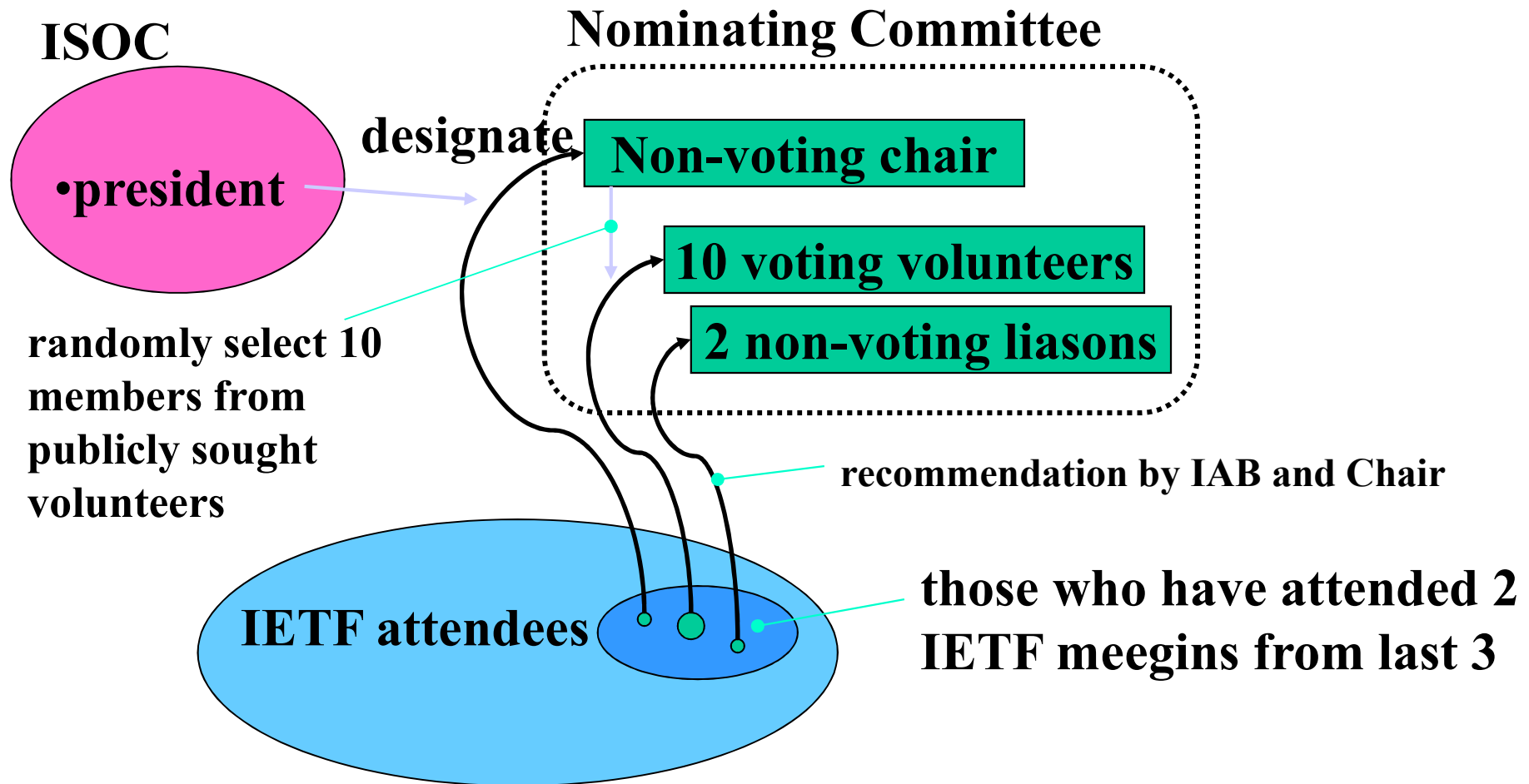- Lynn St.Amour (Liason from ISOC)
  st.amour@isoc.org

Selection of IAB/IESG Members

Selection System

How Nominating Committee Members are Selected

ISOC

Nominating Committee

•president

designate

Non-voting chair

10 voting volunteers

2 non-voting liasons

randomly select 10 members from publicly sought volunteers

recommendation by IAB and Chair

IETF attendees

those who have attended 2 IETF meegins from last 3

Reference Matrials on IETF Standardization

- Masataka Ohta, "IETF and Internet Standard", IEEE Communications Magazine, Sep.1998

- "The Tao of IETF -- A Guide for New Attendees of the Internet Engineering Task Force", http://www.ietf.org/tao.html

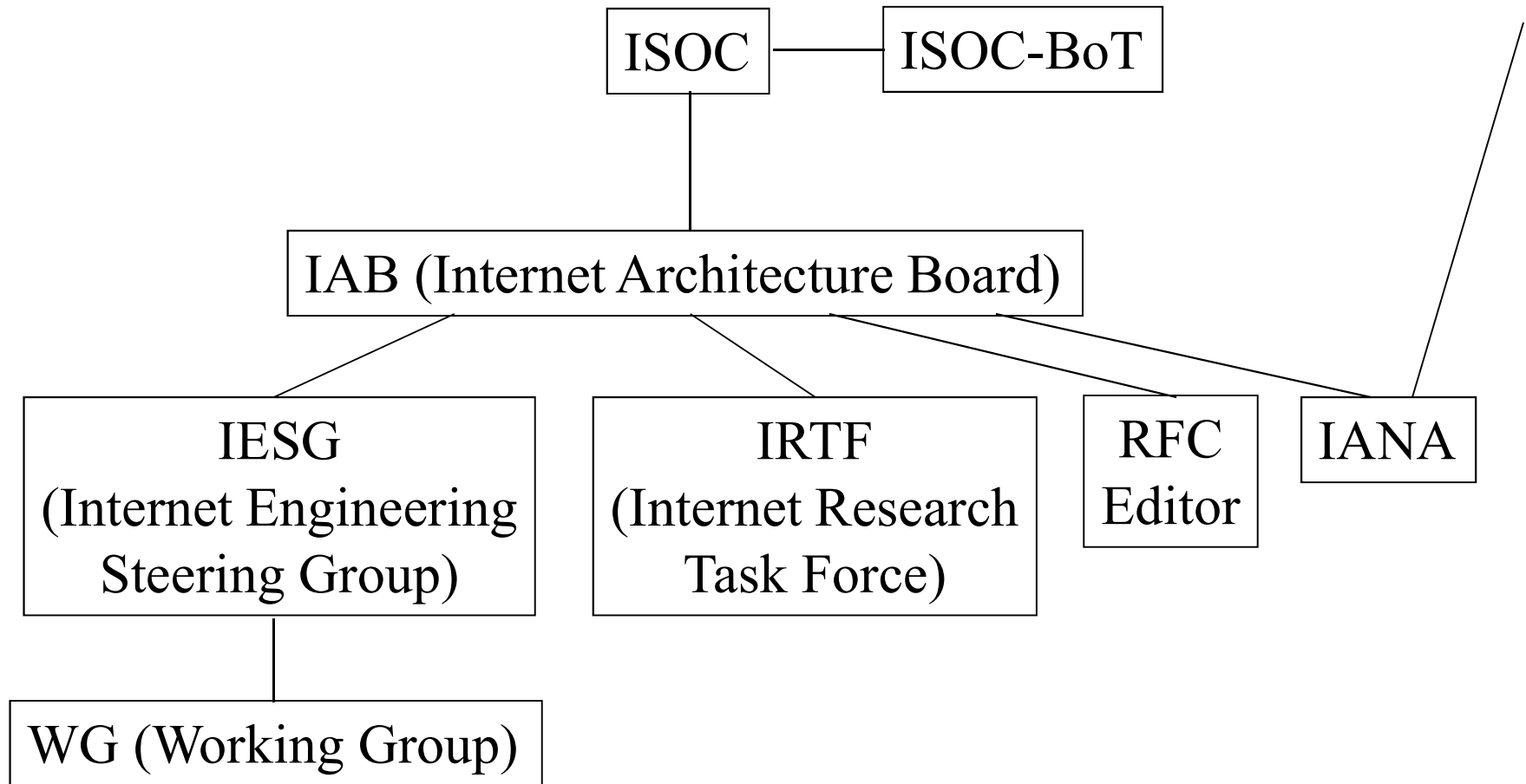- S. Bradner, "The Internet Standards Process --Rev.3", BCP9, RFC2026

- J.Galvin, "IAB and IESG Selection, Confirmation, and Recall Process: Operation of the Nominating and Recall Comittees", BCP10, RFC 2282

Structure of ISOC and IETF

ISOC — ISOC-BoT

IAB (Internet Architecture Board)

IESG
(Internet Engineering
Steering Group)

IRTF
(Internet Research
Task Force)

RFC
Editor

IANA

WG (Working Group)

IANA

- Internet Assigned Number Authority
- maintain assignment numbers used by protocols
  - IP version (4, 6, ...), protocol (6 for tcp, 17 for UDP, ...), default port #(20 for ftp, 25 for smtp, 80 for http, etc.), IP address (delegated to RIRs (Regional Internet Registries), domain names (delegated to TLD (Top Level Domain) registries)

Concession of DNS

- domain names are managed by IANA
  - located at USC (University of South California)
  - supported by USG
  - delegate managements to network solutions
    - became so profitable to network solutions
      - $50/year for a domain name with poor service quality

IAHC (International Ad-Hoc Committee)

- international framework to manage domain names necessary

- members from ISOC, ITU, WIPO, WTA

- DNS registry is by nonprofit organization
  - registrar business is open to any
  - deprive network solutions of profitable business

- network solutions lobbied
  - USG acted against

ICANN

- organization created by USG instead of IAHC
- registration business of TLDs is monopolized by private companies
- govern internet in general?
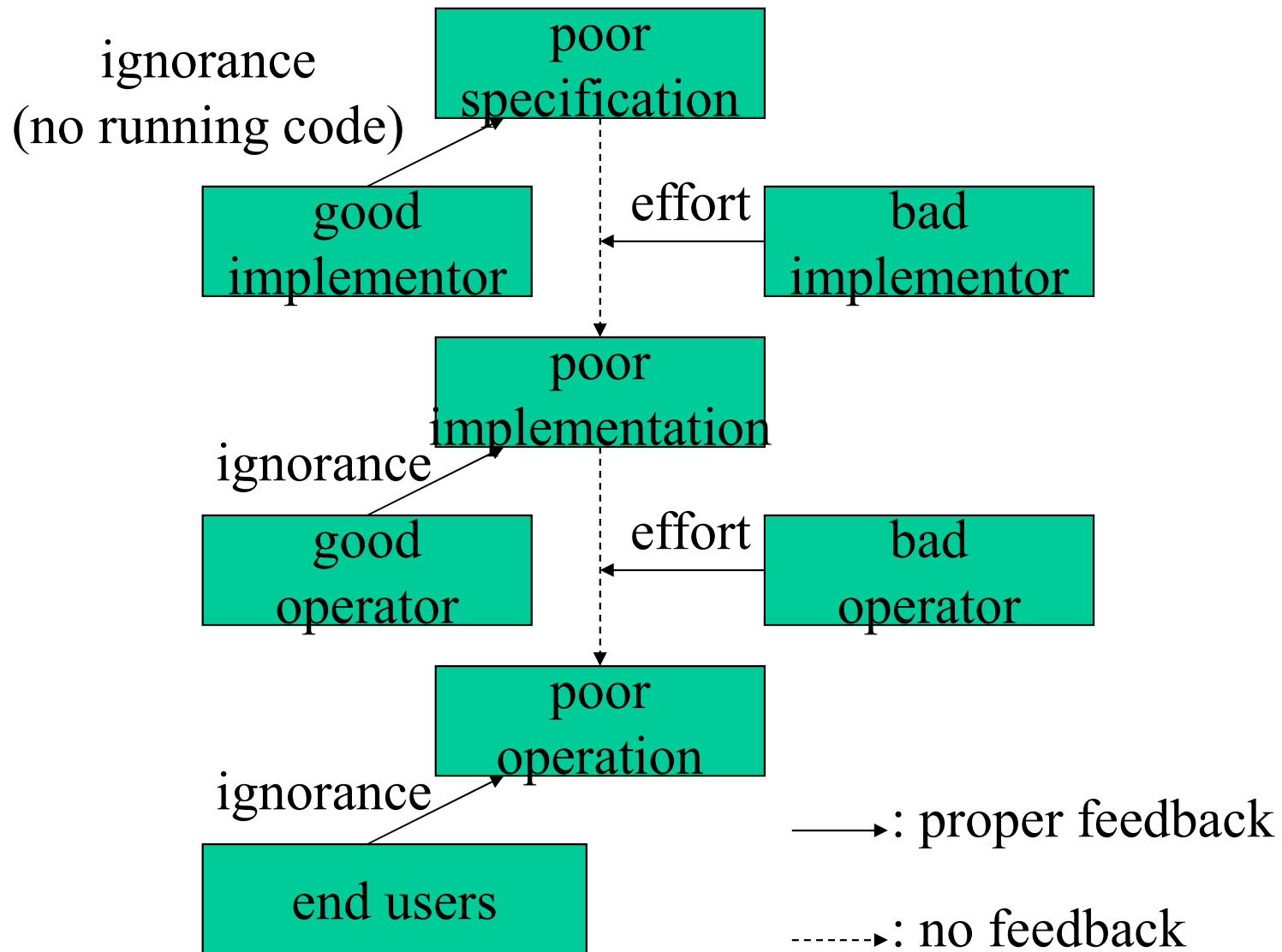- ¥

ISOC, IETF and ICANN?

- ???

Running Code and Rough Concensus

- existence of implementations is important
  - multiple interoperable independent implementations
    - can remove ambiguities and inconsistencies
  - can improve specification by feedback from implementations
  - specifications worked by many implementers
    - meant good quality, before commercialization
    - means profitability for large vendors

Existence of Implementations are Important, but,

- uncritically implement any specification
  - keeps poor specification poor, resulting in poor implementation
- uncritically operate any implementation
  - keeps poor implementation poor, resulting in poor operation
- finally rejected by end users
  - too much time is wasted

ignorance
(no running code)

poor
specification

good
implementor

effort

bad
implementor

poor
implementation

ignorance

good
operator

effort

bad
operator

poor
operation

ignorance

end users

───────▶ : proper feedback

╌╌╌╌╌▶ : no feedback

feedback to poor specifications

Current (?) State of IETF

- lead by big vendors and ISPs by commercialization
  - difficult to make decisions if parties with conflicting interests exist
    - no voting, no concluding result
- other standardization bodies
  - modify process for quick standardization
- discussion of modification
  - difficult to reach concensus

IEEE

- The Institute of Electrical and Electronics Engineers
- IEEE-SA takes care of standardization
  - on Electrical and Electronics matters
    - including lower layers of ICT
  - private and company members

IEEE Standard

- in general, for sale
- 802 standards becomes free 6 months after publication
  - including Ethernet and Wifi ones
- some member moved from IETF to IEEE
  - as Ethernet and Wifi development became hot

Standards and IPR (Intellectural Property Right)

- technology protected by one's IPR (patent)
  - beneficial if used as optional part of standard
    - even more beneficial if mandated part
      - standard is less attractive
        - » must pay licensing fee or licensing may be rejected
      - 自らがIPRを有する技術を

- usually. standardization bodies
  - mandate their members inform existence of IPR and offer fair, reasonable and non-discriminatory (FRAND, RAND) licensing
  - not effective against non-members
    - submarine patents can be very harmful

Joining International Standardization Activities

- as a formal delegate of a country
- as a member of lower level bodies
  - e.g. sector member of ITU sector
- through domestic standardization bodies
  - JIS for ISO, TTC for ITU
- attendance to many meetings important
  - though, these days, mailing list discussions are common

Forum Standardization Activities

- as a company member of a forum

- as a private member of a forum
  - politics is often more important than technology
    - to be known by many others by repeatedly attending meetings
    - often hide real intentions
  - old forums may be inflexible

- may create a forum by yourself

The Standards-Making Universe
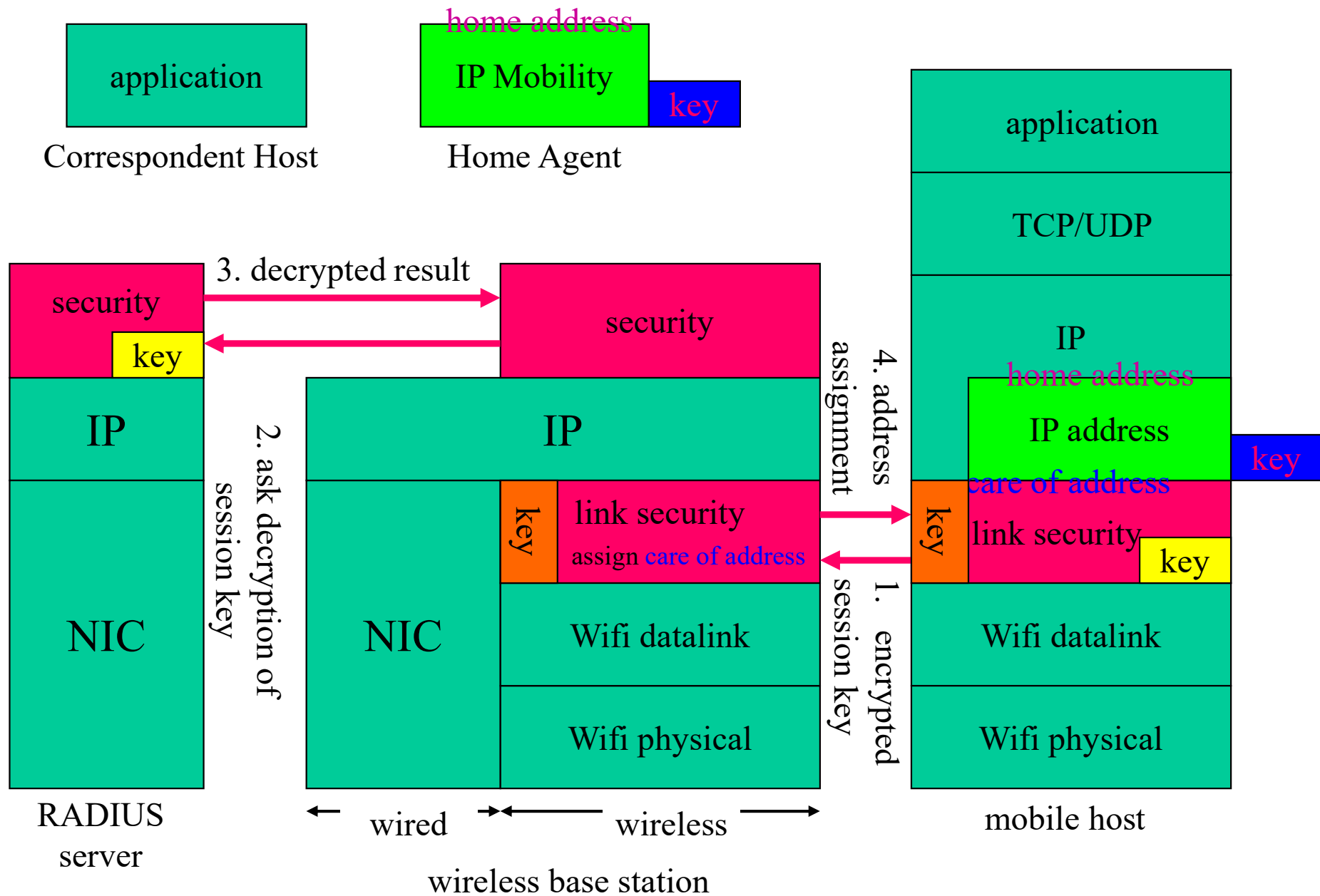
How to Create a Forum

- solicit members (hopefully, internationally)
  - famous researchers
  - riches (rich companies)
- provide secretariat office
  - may be out sourced
- formulate rules
- hold an opening meeting
- may incorporate

Example of a Forum: Mobile Broadband Association

- established Aug. 2001, incorporated Dec. 2009
  - www.mobile-broadband.org
  - was with 28 full, 2 associate and 32 individual members

- to promote mobile broadband

- annual fee for full member: 120,000 JPY
  - operation by volunteers

- standardize really secure/quick 802 (wifi)
  - used by some and modified to be IEEE802.11ai

Correspondent Host

Home Agent
home address
IP Mobility
key

RADIUS server

application

security
key

IP

NIC

2. ask decryption of session key

3. decrypted result

wireless base station

security

IP

key link security
assign care of address

NIC

Wifi datalink

Wifi physical

wired   wireless

4. address assignment

1. encrypted session key

mobile host

application

TCP/UDP

IP
home address
IP address

key link security
key

care of address

key

Wifi datalink

Wifi physical

initial stage of mobile internet service (authentication, share session key, assign address)

Wrap Up

- standardization is important for interoperable products
- standards may be specified standardization bodies or naturally grown
- there are a lot of standardization bodies
- to make and spread good protocols
  - early feedback from implementers important
    - commercialization often makes it difficult