

The Impact of the Internet Engineering Task Force

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Distinguished Engineer, Cisco Services

Co-Chair, Routing Area Working Group (rtgwg)

Co-Chair, Source Packet Routing in Networking WG (spring)

Chair, IETF-LAC Task Force, LACNOG





standards
global
innovation
Internet
infrastructure
volunteers
researchers
IETF
engineers
OPEN
participation
processes
collaborating
scientists

*No one is in charge,
anyone can contribute
and everyone can
benefit.*

IETF Organization: Areas

General Area (gen)

- ...activities focused on supporting, updating and maintaining the IETF standards development process.

Applications (app)

- ubiquitous application protocols (e.g., email, HTTP, FTP) and protocols used for Internet infrastructure

Internet (int)

- ...IP layer (both IPv4 and IPv6), DNS, mobility, VPNs and pseudowires..., and various link layer technologies.

Operations & Management (ops)

- Network Management, AAA, and various operational issues facing the Internet such as DNS operations, IPv6 operations, operational security and Routing operations.

Real-time Applications and Infrastructure (rai)

- ...develops protocols and architectures for delay-sensitive interpersonal communications...

Routing (rtg)

- ...responsible for ensuring continuous operation of the Internet routing system...

Security (sec)

- ...focused on security protocols...services: integrity, authentication, non-repudiation, confidentiality, and access control...key management is also vital.

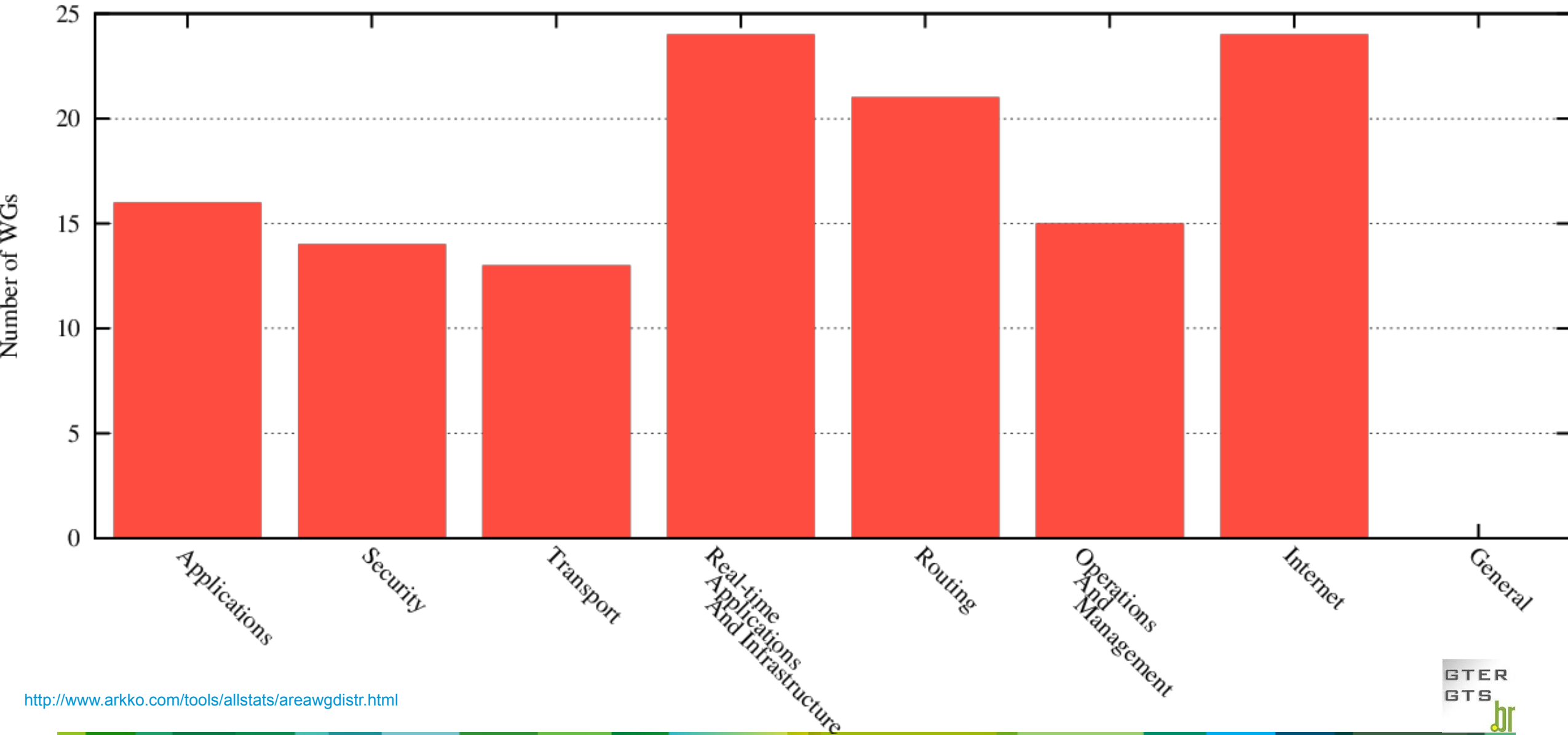
Transport Services (tsv)

- ...works on mechanisms related to end-to-end data transport...

GTER
GTS



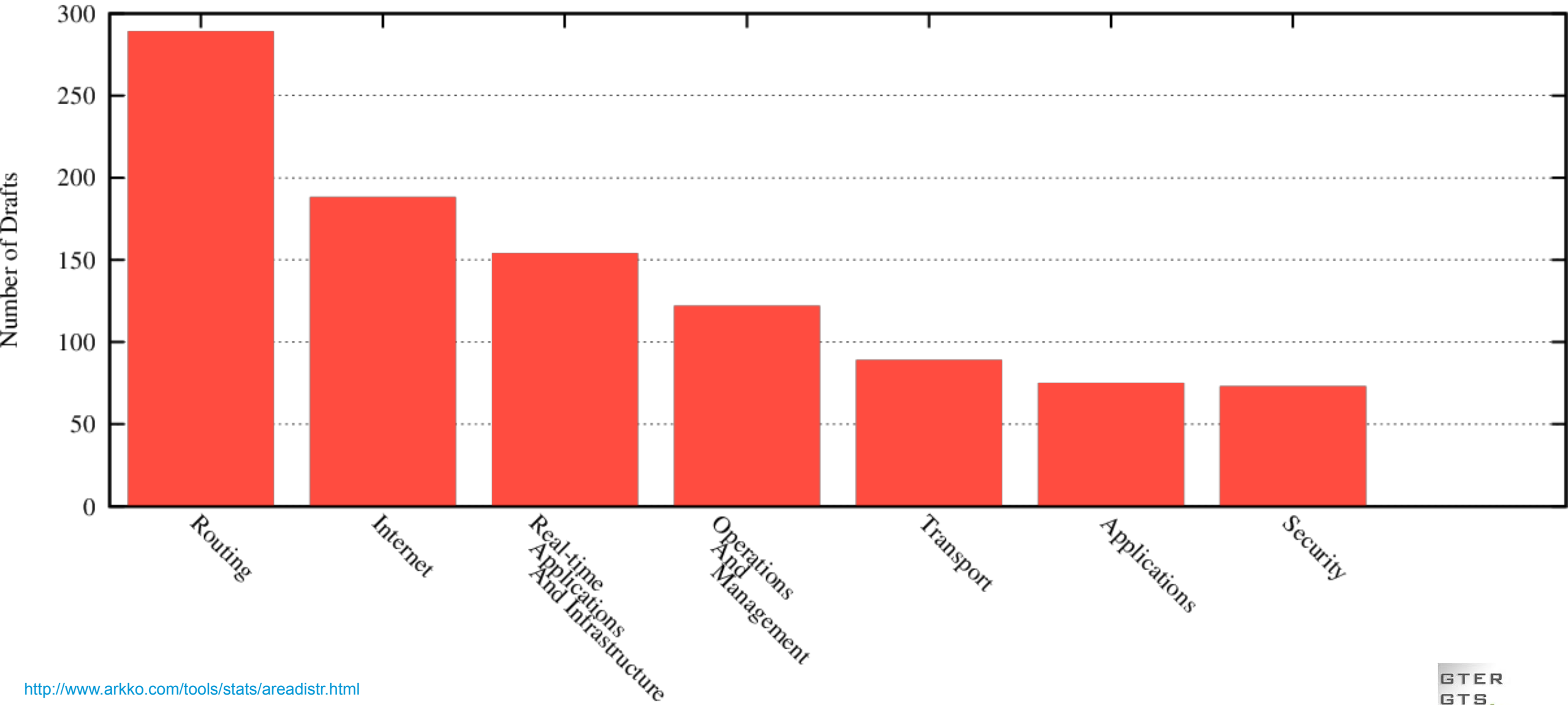
Number of WGs per Area



<http://www.arkko.com/tools/allstats/areawgdistr.html>



Number of Drafts per Area

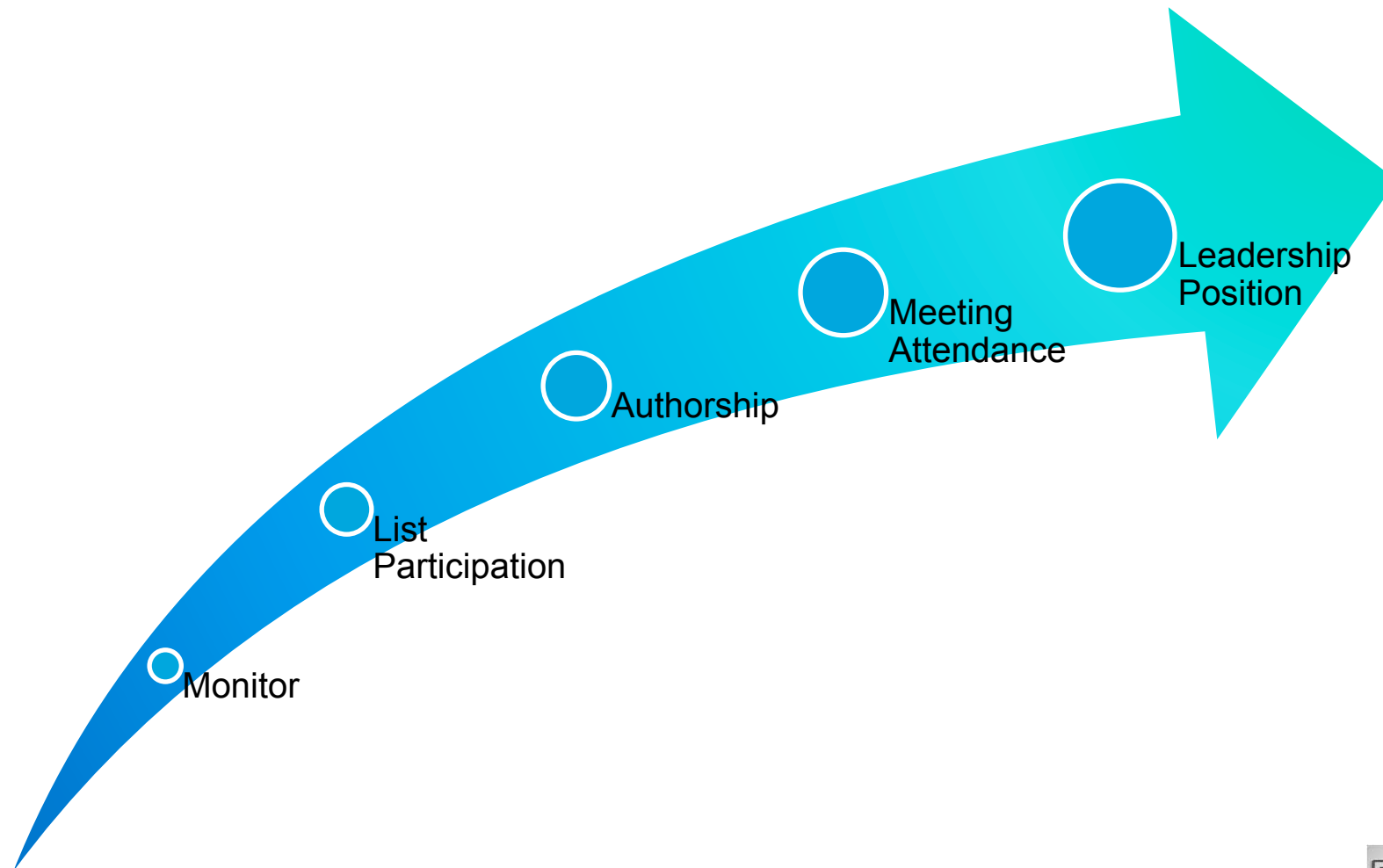


<http://www.arkko.com/tools/stats/areadistr.html>



How to Participate in the IETF?

- Join a mailing list..
- ..start contributing!!



Hot Topics at IETF 89 (London)

- Security: Identity, Trust, Privacy
- Infrastructure Resiliency
- Diversity/Inclusion

Security: Identity, Trust, Privacy

- Technical Plenary (Monday, 1750): Payment Systems
 - "Internet-Scale Payment Systems: Ecosystems & Challenges"
 - "Identity, Payments, and Bitcoin: Big Changes Ahead"
- Related WG/BOF Meetings
 - wpkops (web PKI OPS) WG
 - trans (Public Notary Transparency) WG

 - abfab (Application Bridging for Federated Access Beyond web) WG
 - scim (System for Cross-domain Identity Management) WG
 - stir (Secure Telephone Identity Revisited) WG
 - ace (Authentication and Authorization for Constrained Environments) BoF

 - uta (Using TLS in Applications) WG
 - IRTF Crypto Forum Research Group

Security: Infrastructure Security

- DNS Infrastructure

 - dnsop (DNS Operations) WG

 - dane (DNS-based Authentication of Named Entities) WG

 - epext (Extensible Provisioning Protocol Extensions) WG

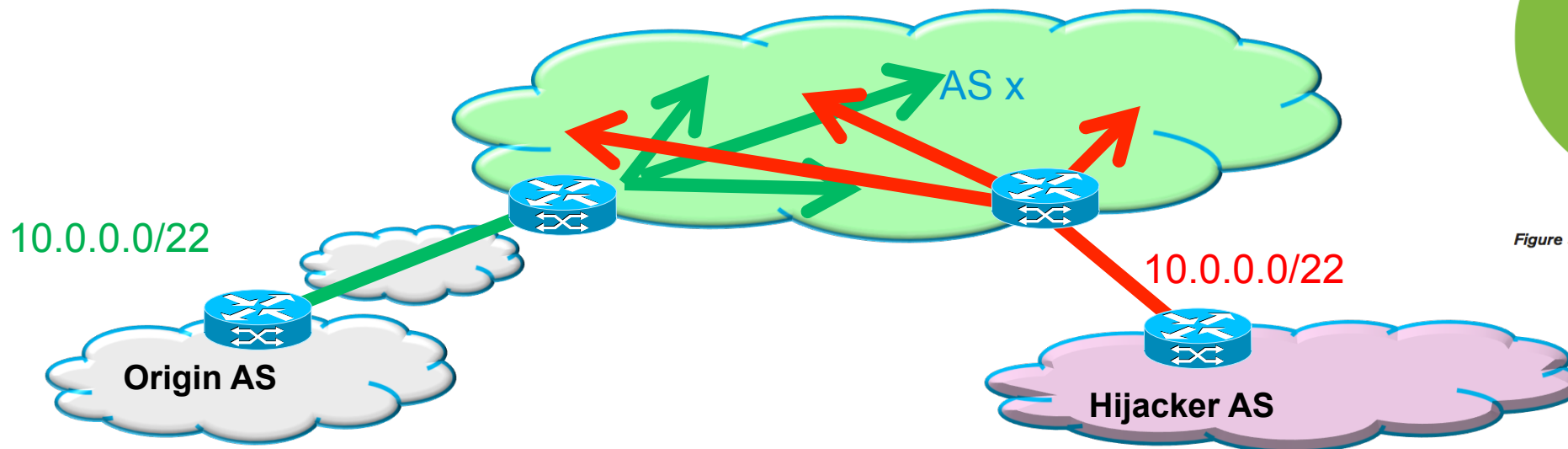
 - dnse (Encryption of DNS request for confidentiality) BOF

 - dbound (Domain Boundaries) BOF

- Routing Infrastructure

 - sidr (Secure Inter-Domain Routing) WG

Prefix Hijack



Monitoring for Route Hijacks

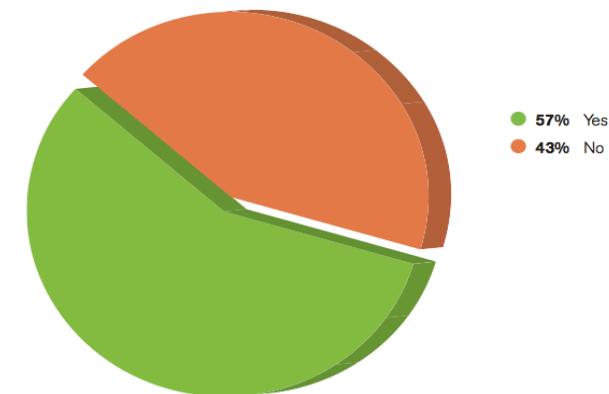


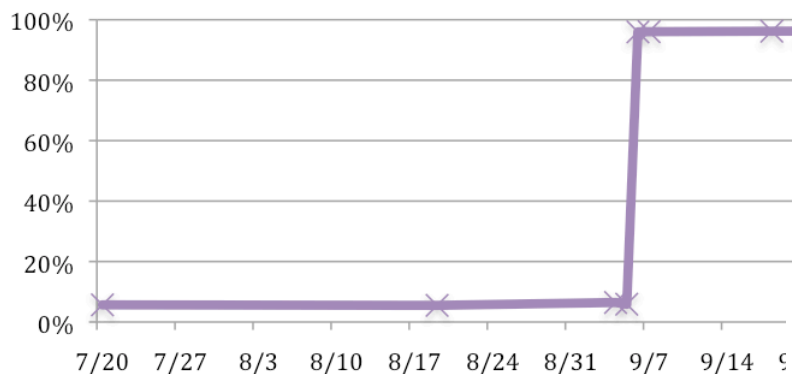
Figure 94 Source: Arbor Networks, Inc.

Six worst Internet routing attacks :
<http://www.networkworld.com/news/2009/011509-bgp-attacks.html>



RPKI-Based Origin Validation Deployment

**RPKI Evolution in Ecuador
% IPv4 Coverage**



RIR	Total	Valid	Invalid	Unknown	Accuracy	RPKI Adoption Rate
AFRINIC	11708 (100%)	48 (0.41%)	49 (0.42%)	11611 (99.17%)	49.48%	0.83%
APNIC	122412 (100%)	243 (0.2%)	288 (0.24%)	121881 (99.57%)	45.76%	0.43%
ARIN	187224 (100%)	752 (0.4%)	256 (0.14%)	186216 (99.46%)	74.6%	0.54%
LACNIC	64267 (100%)	11269 (17.53%)	1172 (1.82%)	51826 (80.64%)	90.58%	19.36%
RIPE NCC	134409 (100%)	9062 (6.74%)	803 (0.6%)	124544 (92.66%)	91.86%	7.34%

<http://tools.ieff.org/html/draft-fmejia-opsec-origin-a-country-00>



Operations and Management Area (ops)



Operations & Management Area (ops)

The primary technical areas covered by the Operations & Management (OPS) Area include: Network Management, AAA, and various operational issues facing the Internet such as DNS operations, IPv6 operations, operational security and Routing operations.

- ADSL MIB (adslmib)
- Benchmarking Methodology (bmwg)
- Diameter Maintenance and Extensions (dime)
- Domain Name System Operations (dnsop)
- Energy Management (eman)
- Global Routing Operations (grow)
- IP Flow Information Export (ipfix)
- Large-Scale Measurement of Broadband Performance (lmap)
- MBONE Deployment (mboned)
- Network Configuration (netconf)
- NETCONF Data Modeling Language (netmod)
- Operations and Management Area Working Group (opsawg)
- Operational Security Capabilities for IP Network Infrastructure (opsec)
- RADIUS EXTensions (radext)
- IPv6 Operations (v6ops)
- Web PKI OPS (wpkops)

Operations & Management Area (ops)

Operational Focus

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IPv6 Operations (v6ops)

- ...develops guidelines for the operation of a shared IPv4/IPv6 Internet and provides operational guidance on how to deploy IPv6 into existing IPv4-only networks, as well as into new network installations.

- RFCs Published in the Last Year

- [RFC 6877](#)

- 464XLAT: Combination of Stateful and Stateless Translation

- [RFC 6883](#)

- IPv6 Guidance for Internet Content Providers and Application Service Providers

- [RFC 7066](#)

- IPv6 for Third Generation Partnership Project (3GPP) Cellular Hosts

- [RFC 7084](#)

- Basic Requirements for IPv6 Customer Edge Routers

IPv6 Operations (v6ops) (2)

- Current Work

Extending an IPv6 /64 Prefix from a 3GPP Mobile Interface to a LAN link (draft-ietf-v6ops-64share)

Balanced Security for IPv6 Residential CPE (draft-ietf-v6ops-balanced-ipv6-security)

IPv6 Operational Guidelines for Datacenters (draft-ietf-v6ops-dc-ipv6)

Enterprise IPv6 Deployment Guidelines (draft-ietf-v6ops-enterprise-incremental-ipv6)

IPv6 Multihoming without Network Address Translation (draft-ietf-v6ops-ipv6-multihoming-without-ipv6nat)

An Internet Protocol Version 6 (IPv6) Profile for 3GPP Mobile Devices (draft-ietf-v6ops-mobile-device-profile)

Monitoring Dual Stack/IPv6-only Networks and Services (draft-ietf-v6ops-monitor-ds-ipv6)

NAT64 Operational Experiences (draft-ietf-v6ops-nat64-experience)

Implementation Advice for IPv6 Router Advertisement Guard (RA-Guard) (draft-ietf-v6ops-ra-guard-implementation)

Recommendations of Using Unique Local Addresses (draft-ietf-v6ops-ula-usage-recommendations)

Routing Area (rtg)



Routing Area (rtg)

...responsible for ensuring **continuous operation of the Internet routing system** by maintaining the scalability and stability characteristics of the existing routing protocols, as well as developing new protocols, extensions...

- Bidirectional Forwarding Detection (bfd)
- Common Control and Measurement Plane (ccamp)
- Forwarding and Control Element Separation (forces)
- Interface to the Routing System (i2rs)
- Inter-Domain Routing (idr)
- IS-IS for IP Internets (isis)
- Keying and Authentication for Routing Protocols (karp)
- Layer 2 Virtual Private Networks (l2vpn)
- Layer 3 Virtual Private Networks (l3vpn)
- Mobile Ad-hoc Networks (manet)
- Multiprotocol Label Switching (mpls)
- Network Virtualization Overlays (nvo3)
- Open Shortest Path First IGP (ospf)
- Path Computation Element (pce)
- Protocol Independent Multicast (pim)
- Pseudowire Emulation Edge to Edge (pwe3)
- Routing Over Low power and Lossy networks (roll)
- Routing Area Working Group (rtgwg)
- Secure Inter-Domain Routing (sidr)
- Service Function Chaining (sfc)
- Source Packet Routing in Networking (spring)

Routing Area (rtg) IP Routing

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MPLS

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Routing Area (rtg)

Mobility / Sensors

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SDN

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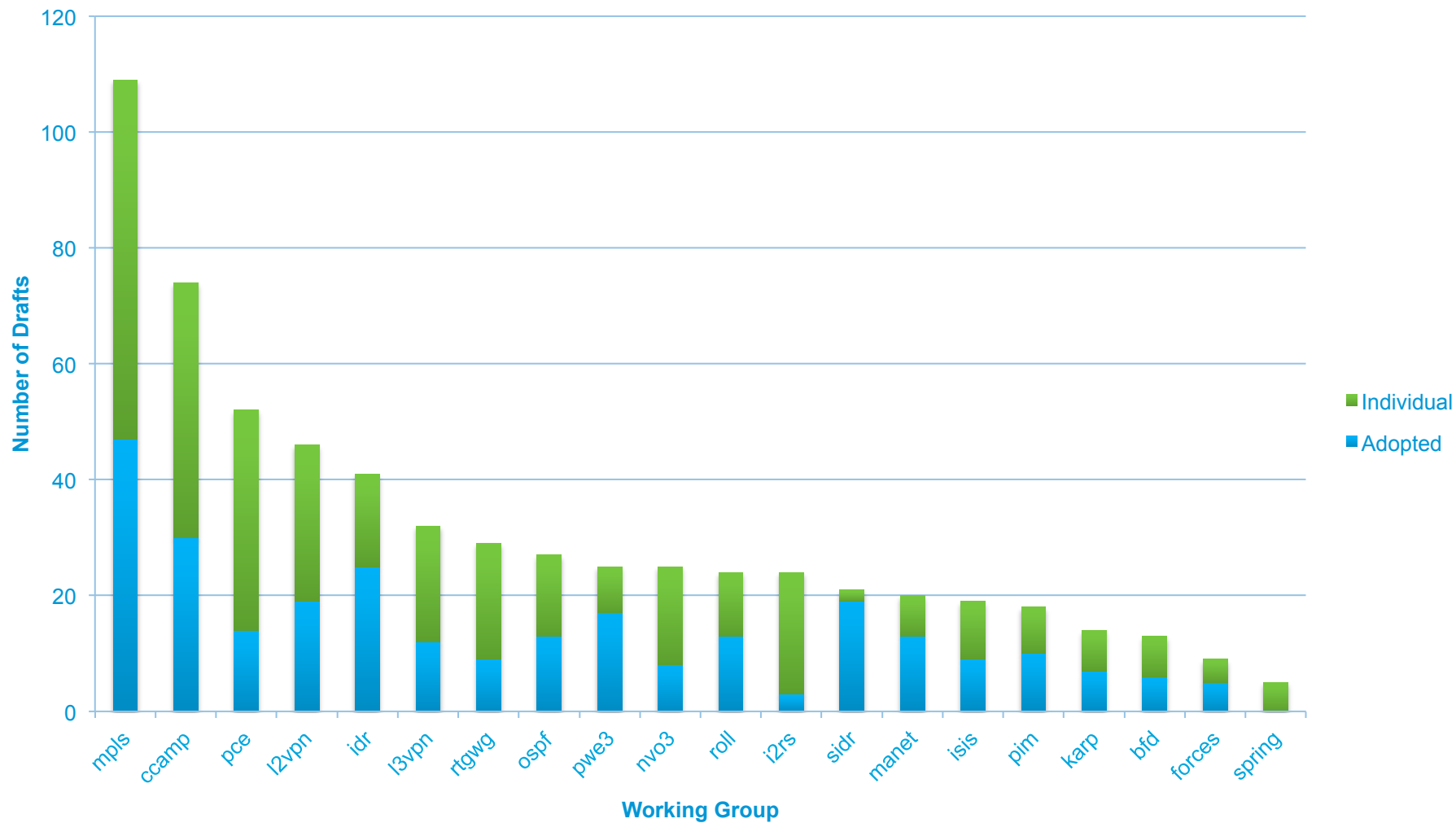
Routing Area (rtg)

General

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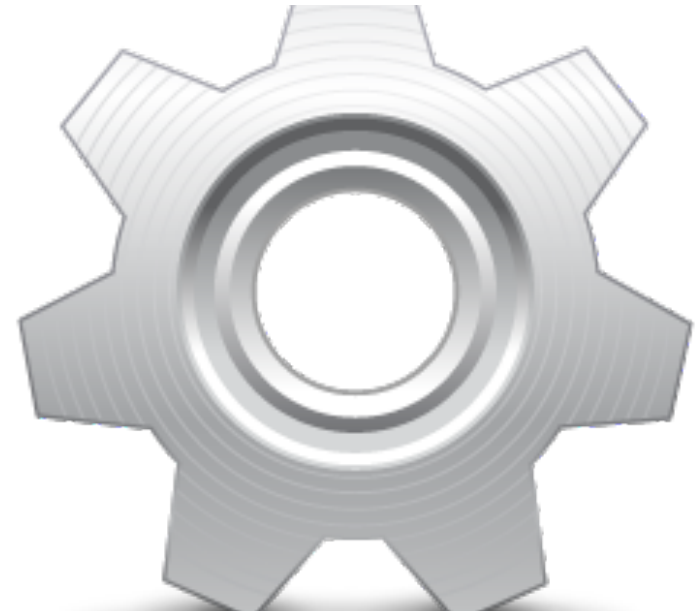
RTG Work Distribution

Number of Drafts per WG (RTG)



The Internet of Things

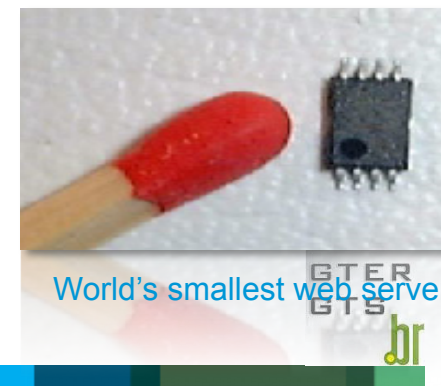
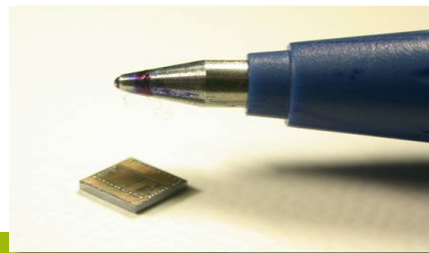
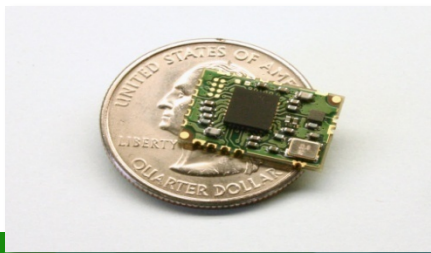
Routing over Low Power and Lossy Networks (roll)



What is a Low Power Lossy Network (LLN)?

- LLNs comprise a large number of highly constrained devices (smart objects) interconnected by predominantly wireless links of unpredictable quality
- LLNs cover a wide scope of applications

Industrial Monitoring, Building Automation, Connected Home, Healthcare, Environmental Monitoring, Urban Sensor Networks, Energy Management, Asset Tracking, Refrigeration



Routing Over Low power and Lossy networks

- roll

- Focused on routing issues for low power and lossy networks.

- Reading List

RPL: IPv6 Routing Protocol for Low-Power and Lossy Networks (rfc6550)

Routing Metrics Used for Path Calculation in Low-Power and Lossy Networks (rfc6551)

Objective Function Zero for the Routing Protocol for Low-Power and Lossy Networks (RPL) (rfc6552)

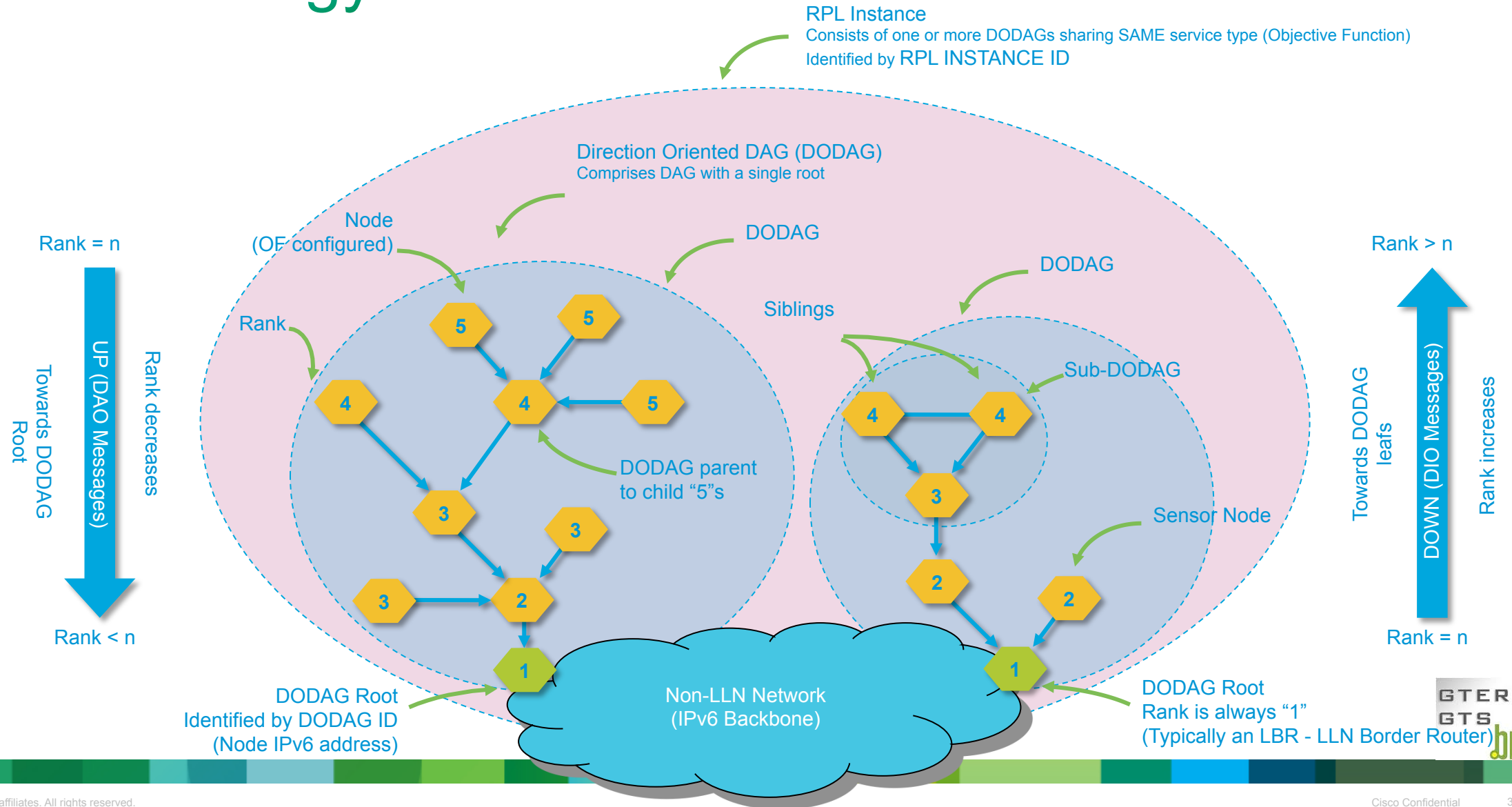
Terminology in Low power And Lossy Networks (draft-ietf-roll-terminology)

Multicast Protocol for Low power and Lossy Networks (MPL) (draft-ietf-roll-trickle-mcast)

Characteristics of Internet vs Smart Object Networks

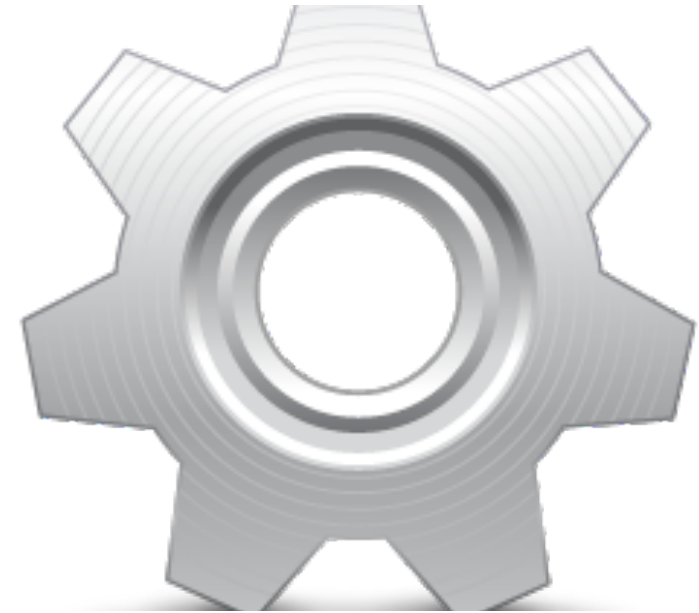
Current Internet	Smart Object Networks
Nodes are routers	Nodes are sensor/actuators and routers
IGP with typically few hundreds of 100 nodes	An order of magnitude larger in nodes
Links and Nodes are stable	Links are highly unstable Nodes fail more frequently
Node and link bandwidth constraints are generally non-issues	Nodes & links are high constrained
Routing is not application aware	Application-aware routing, in-Band processing is a MUST

RPL Terminology



spring Technology

Source Packet Routing In NetworkinG (spring)



Disclaimer: Segment Routing is cisco's Proposal

Operators Ask For Drastic LDP/RSVP Improvement

- **Simplicity**

- less protocols to operate

- less protocol interactions to troubleshoot

- avoid directed LDP sessions between core routers

- deliver automated FRR for any topology

- **Scale**

- avoid millions of labels in LDP database

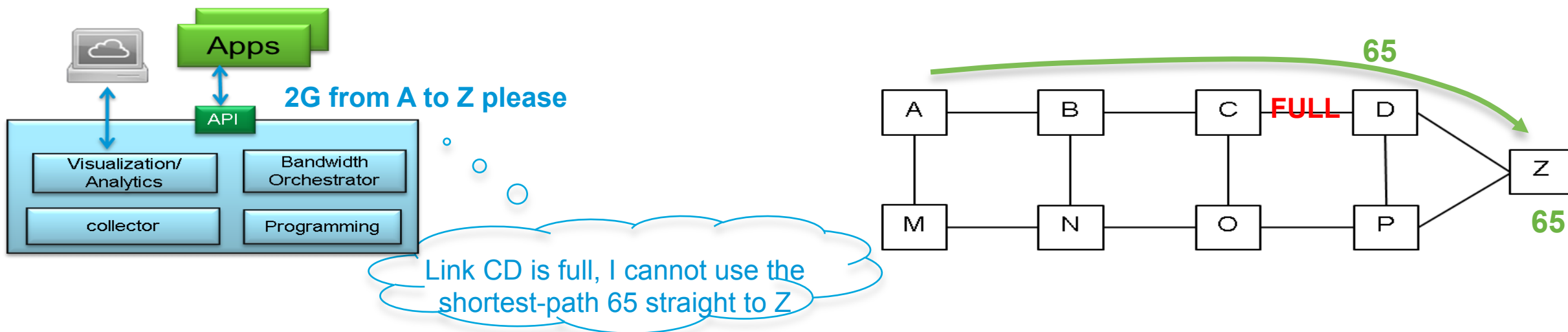
- avoid millions of TE LSP's in the network

- avoid millions of tunnels to configure

Segment Routing

- Source routing based on the notion of a *segment*
- A 32-bit segment can represent any *instruction*
 - Service
 - Context
 - IGP-based forwarding construct
 - Locator
- Ordered list of segments
 - An ordered chain of topological and service instructions
- Per-flow state only at ingress SR edge node
 - Ingress edge node pushes the segment list on the packet

Application controls – network delivers

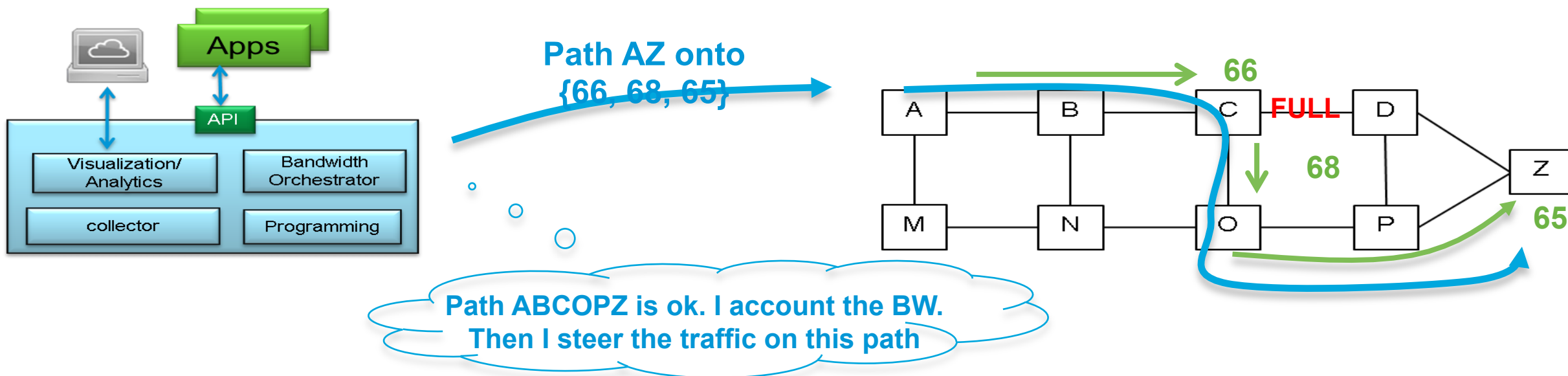


- The network is simple, highly programmable and responsive to rapid changes

The controller abstracts the network topology and traffic matrix

Perfect support for centralized optimization efficiency, if required

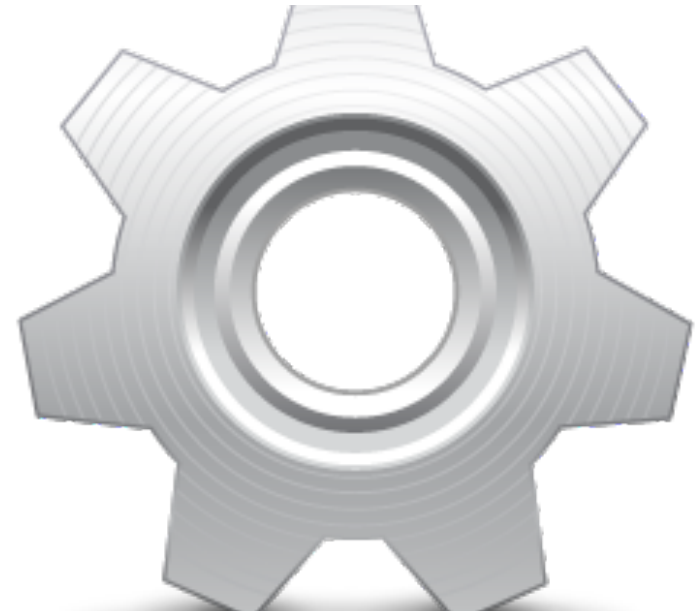
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SDN

IETF Involvement



OpenFlow

- Basics

- OpenFlow Components

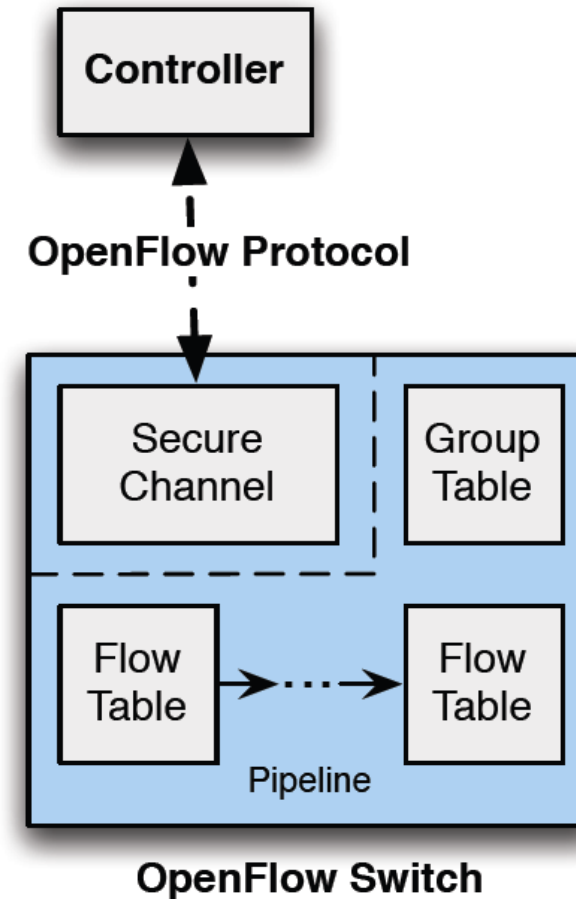
Application Layer Protocol: OF-Protocol

Device Model: OF-Device Model (abstraction of a device with Ethernet interfaces and a set of forwarding capabilities)

Transport Protocol: Connection between OF-Controller and OF-Device*

- Observation:

OF-Controller and OF-Device need pre-established IP-connectivity



* TLS, TCP – OF 1.3.0 introduced auxiliary connections, which can use TCP, TLS, DTLS, or UDP.

Source: OpenFlow 1.3.1 specification, figure 1

Forwarding and Control Element Separation

- forces

- ...define a framework and associated mechanisms for standardizing the exchange of information between the logically separate functionality of the control plane, including entities such as routing protocols, admission control, and signaling, and the forwarding plane, where per-packet activities such as packet forwarding, queuing, and header editing occur.

- Reading List

Requirements for Separation of IP Control and Forwarding (rfc3654)

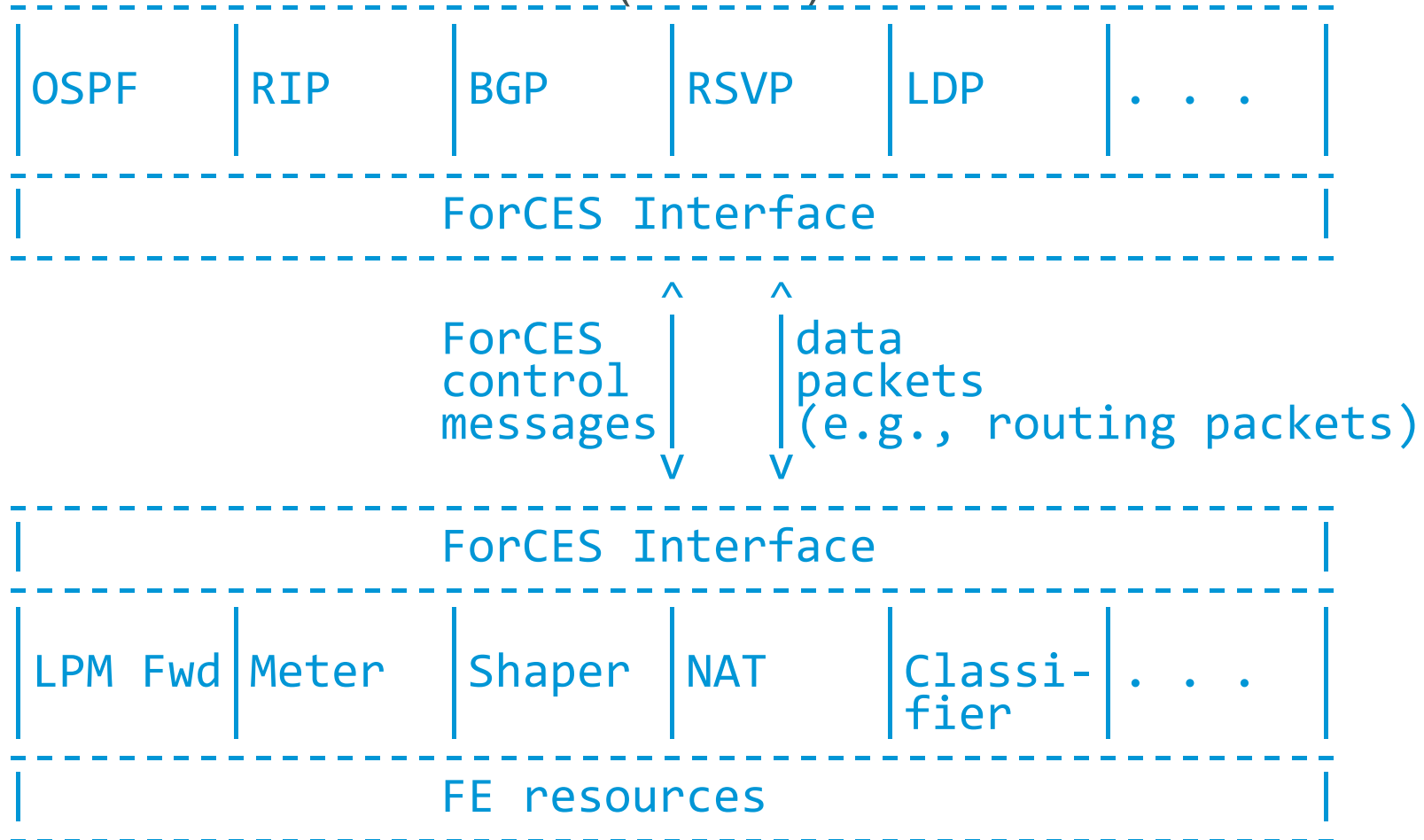
Forwarding and Control Element Separation (ForCES) Framework (rfc3746)

Forwarding and Control Element Separation (ForCES) Protocol Specification (rfc5810)

Forwarding and Control Element Separation (ForCES) Applicability Statement (rfc6041)

ForCES

- Example of CE and FE Functions (rfc3746)

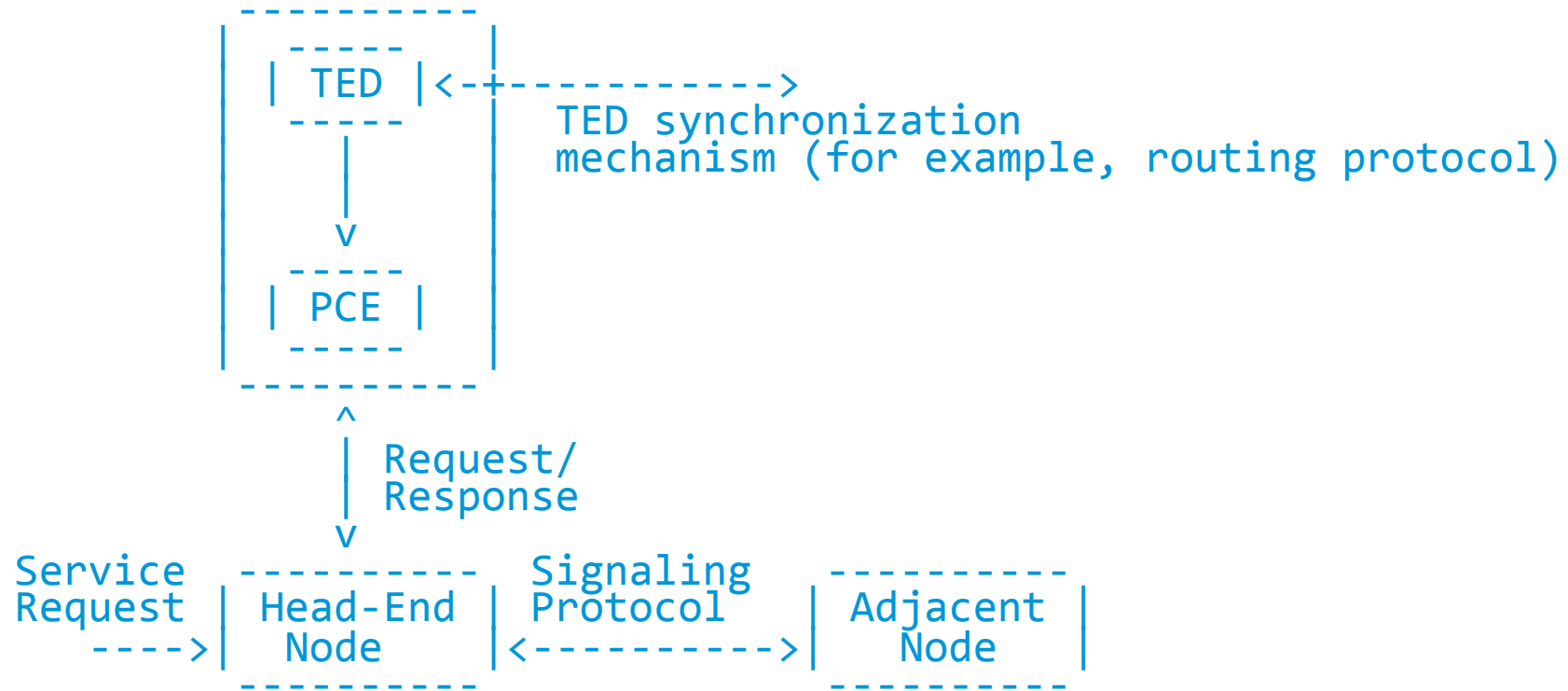


Path Computation Element

- pce
- ...enable a PCE-based architecture for the computation of paths for MPLS and GMPLS Point to Point and Point to Multi-point Traffic Engineered LSPs.
- Reading List
 - A Path Computation Element (PCE)-Based Architecture (rfc4655)
 - Path Computation Element (PCE) Communication Protocol (PCEP) (rfc5440)

PCE

- External PCE Node (rfc4655)



Application-Layer Traffic Optimization (TSV)

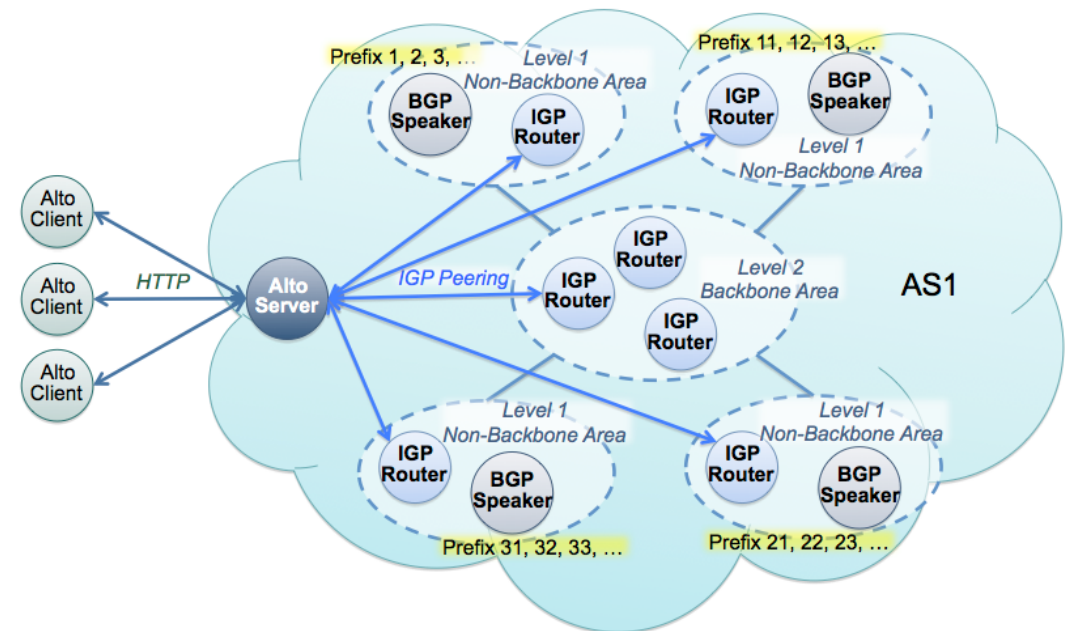
- alto
- ...design and specify an Application-Layer Traffic Optimization (ALTO) service that will provide applications with information to perform better-than-random initial peer selection.
- Reading List
 - Application-Layer Traffic Optimization (ALTO) Problem Statement (rfc5693)
 - Application-Layer Traffic Optimization (ALTO) Requirements (rfc6708)
 - ALTO Deployment Considerations (draft-ietf-alto-deployments)
 - ALTO Protocol (draft-ietf-alto-protocol)

North-Bound Distribution of Link-State and TE Information using BGP

- draft-ietf-idr-ls-distribution
- Motivation: Gain visibility for applications that need complete (inter-area/domain) topology information.
- Solution: Network API to communicate topology information.
- Carrying Link State Information in BGP

new BGP NLRI that describes links and nodes
new BGP path attribute that carries link and node properties and attributes

Use case - Alto Servers: multi-area IGP topology



- ALTO server needs to know all areas topology
- Manually crafting of “IGP peering” topology is tedious and error prone

Interface to the Routing System

- i2rs

- ...interaction with the routing system...allow information, policies, and operational parameters to be injected into and retrieved (as read or by notification)...

- Work Items include tightly scoped key use cases

Interactions with the RIB...but no direct access to the FIB

Control and analysis of the operation of BGP including the setting and activation of policies related to the protocol.

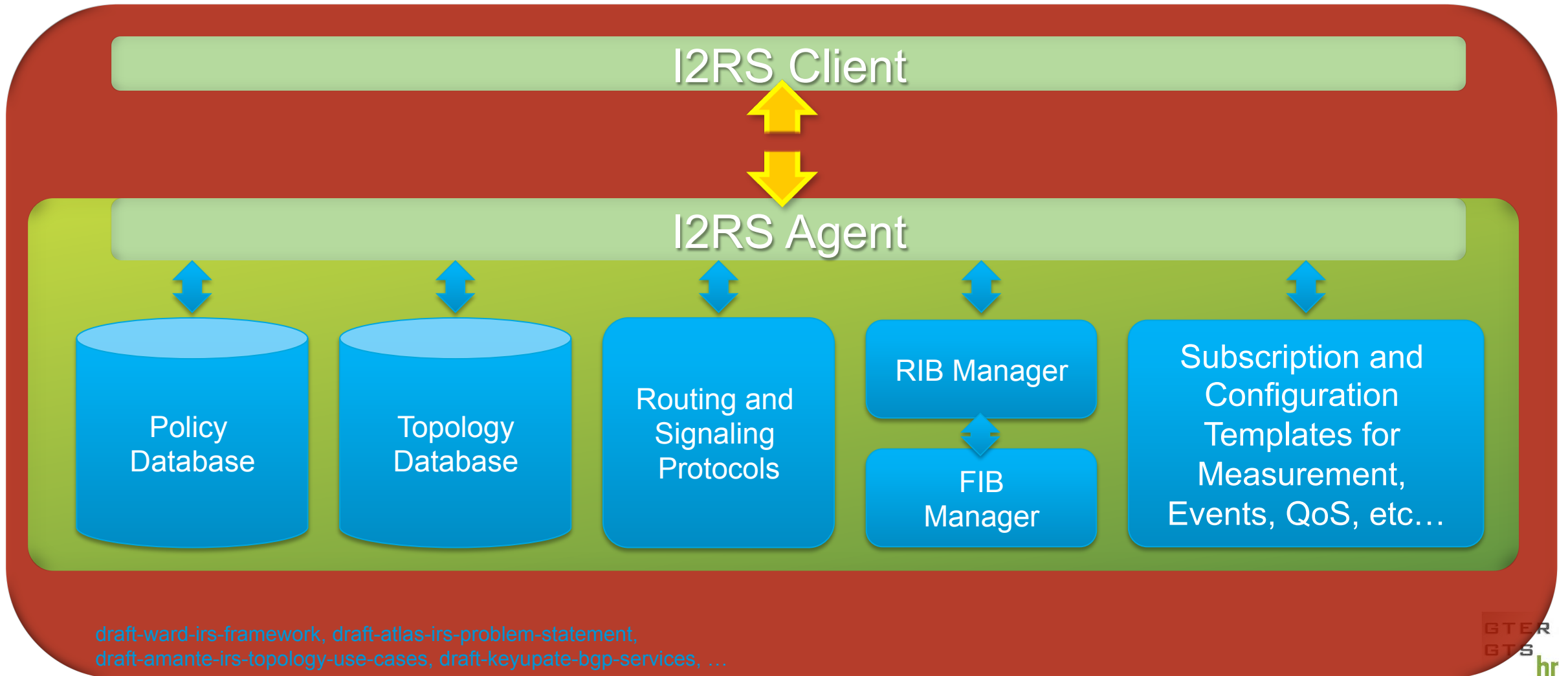
Control, optimization, and choice of traffic exit points from networks based on more information than provided by the dynamic control plane.

Distributed reaction to network-based attacks...

Service layer routing to improve on existing hub-and-spoke traffic.

The ability to extract information about topology from the network.

I2RS Framework



Software-Defined Networking Research Group

- sdnrg (IRTF)
- ... investigates SDN from various perspectives with the goal of identifying the approaches that can be defined, deployed and used in the near term as well identifying future research challenges.
- **Areas of Interest**
 - Classification of SDN models, including
 - SDN model scalability and applicability
 - Multi-layer programability and feedback control systems
 - System Complexity
 - Network description languages, abstractions, interfaces and compilers
 - Security
- **Potential Work Items**
 - Survey of SDN approaches and Taxonomies
 - Open Issues in Software-Defined Networking Research



Internet Research Task Force (IRTF)

Mission

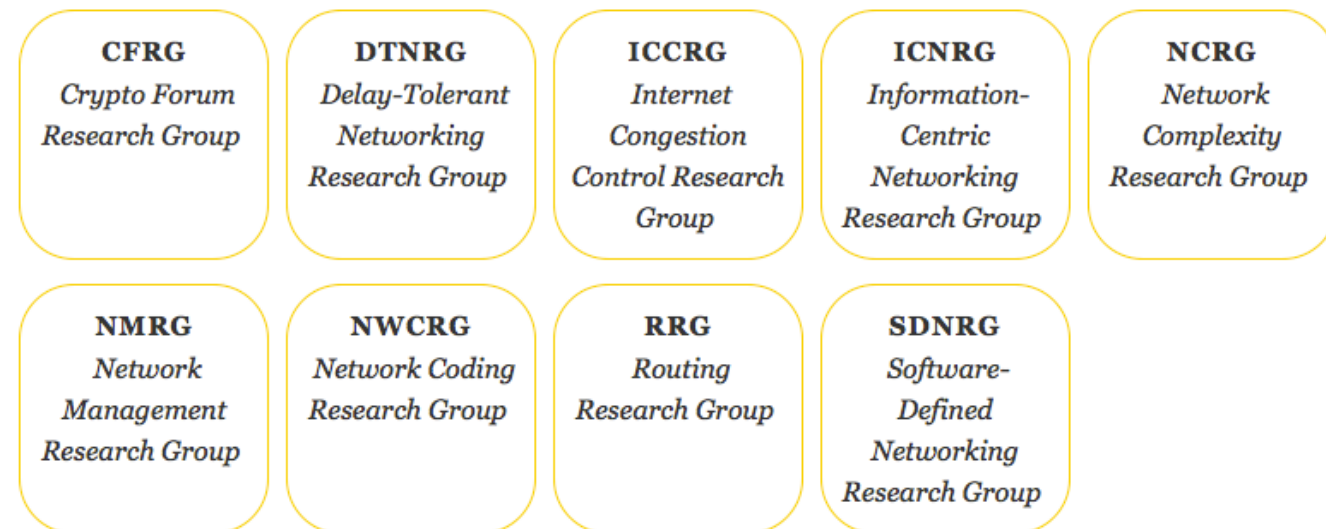
The Internet Research Task Force ([IRTF](#)) promotes research of importance to the evolution of the Internet by creating focused, long-term [Research Groups](#) working on topics related to Internet protocols, applications, architecture and technology.

Overview

The Internet Research Task Force ([IRTF](#)) focuses on longer term research issues related to the Internet while the parallel organization, the Internet Engineering Task Force ([IETF](#)), focuses on the shorter term issues of engineering and standards making.

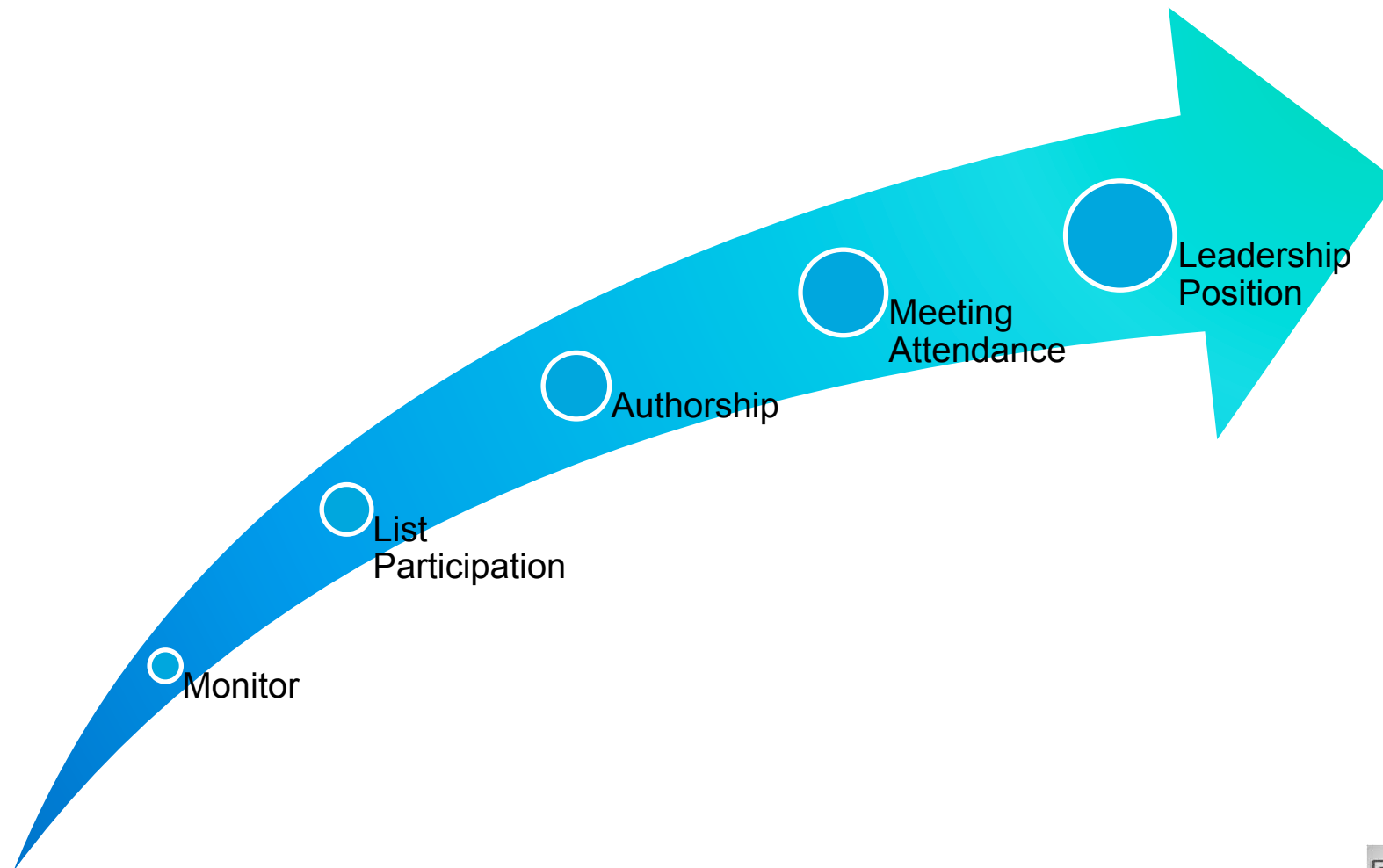
Current Research Groups

These 9 [Research Groups](#) are currently chartered:

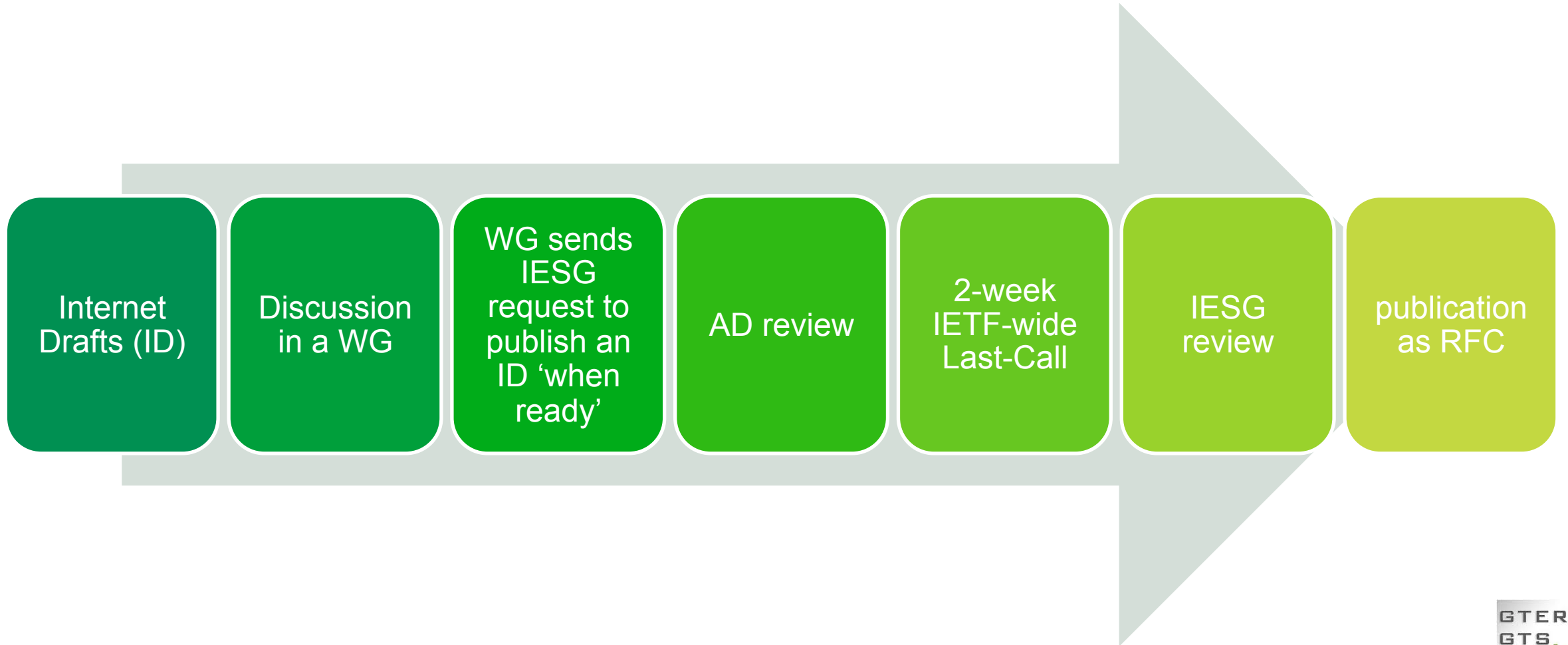


How to Participate in the IETF?

- Join a mailing list..
- ..start contributing!!



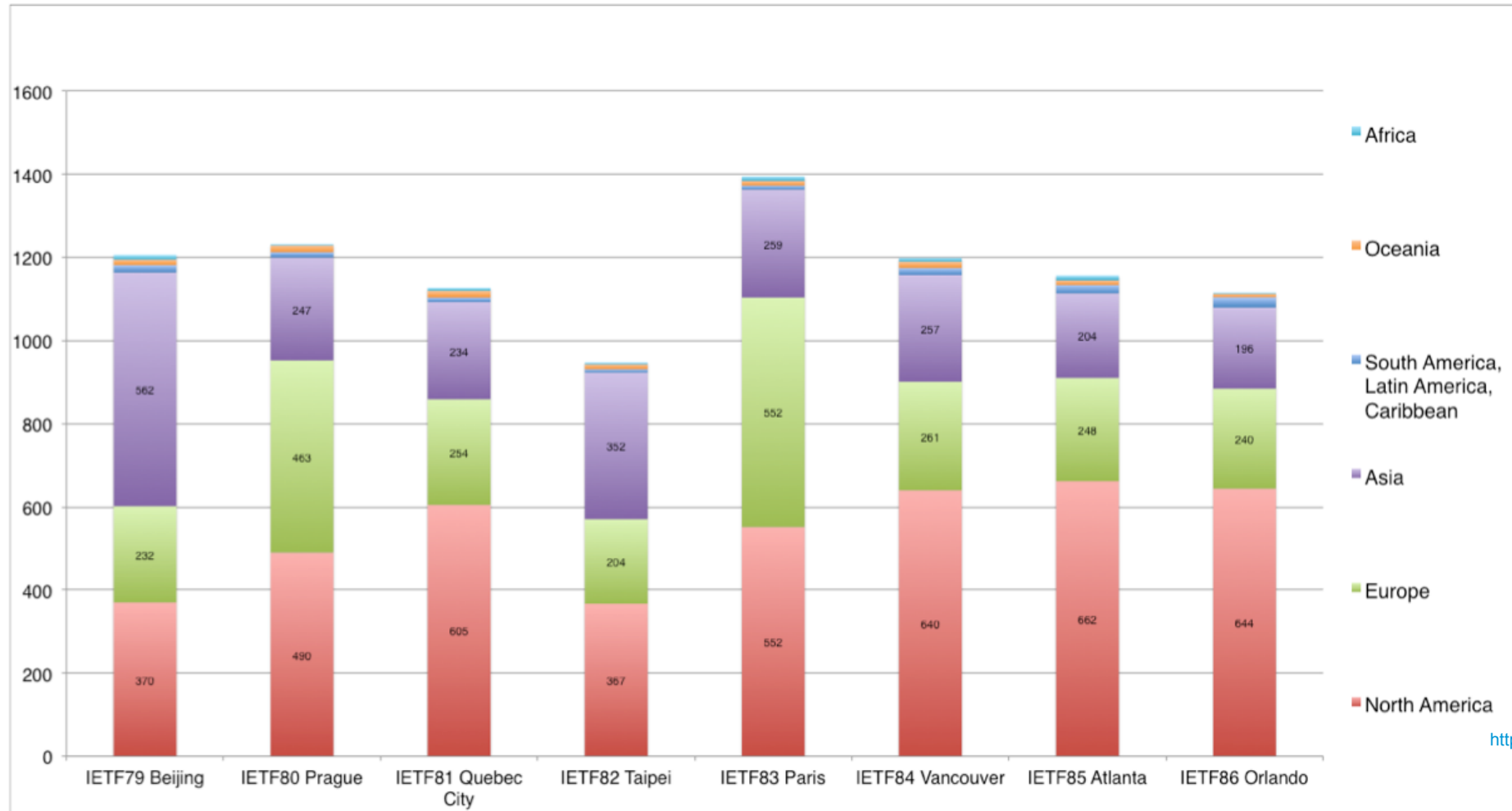
Standards Process



Diversity and Inclusion



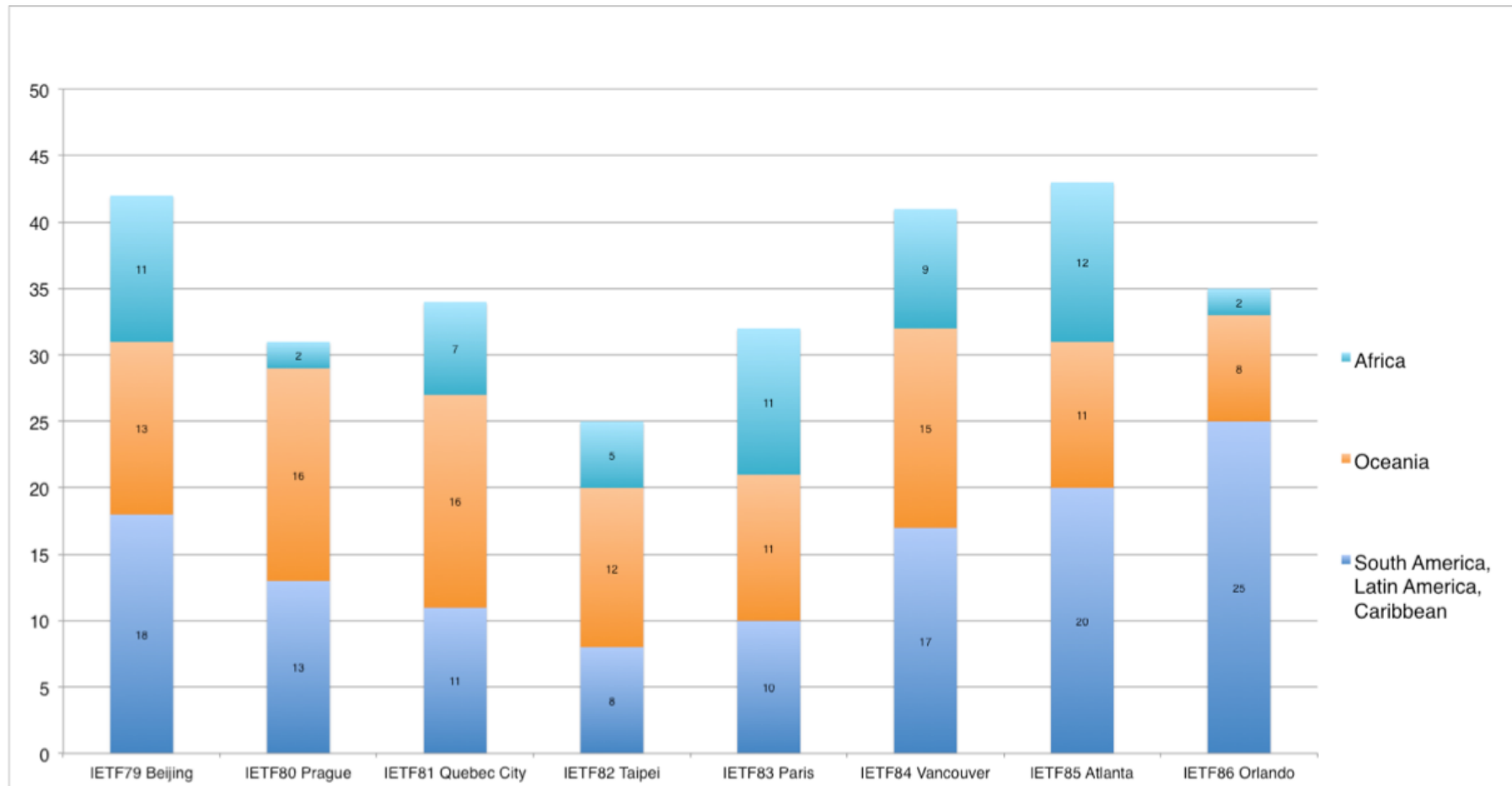
IETF Attendance by Region



<http://www.ietf.org/documents/IETF-Regional-Attendance-00.pdf>



Africa, Oceania, South America/ Latin America/Caribbean



Diversity / Inclusion

- Open Discussions
- Potential IETF Meeting in Latin America (2016)
- Diversity Mailing List

The diversity design team will work on identifying diversity related issues that the IETF faces and making practical recommendations that can help in this regard. This mailing list will be used for obtaining input from the community.

<https://www.ietf.org/mailman/listinfo/diversity>

- Emerging Regions Internet Challenges And Solutions (ericas)

This list provides a discussion forum about the various challenges the Internet is facing in emerging regions, and share experiences and proposals to successfully address some of those challenges.

<https://www.ietf.org/mailman/listinfo/ericas>

IETF LAC Task Force

- LACNOG creó el Grupo de Trabajo IETF LAC en Mayo del 2013 con el objetivo de fomentar la participación de personas de la región en las discusiones y procesos del IETF. Algunas de las metas son:
 - Ser un mecanismo para introducir nuevas personas en el IETF
 - Facilitar la discusión de ideas en el idioma local (Español, Portugués, Inglés)
 - Proveer un lugar en el cual los autores latinos puedan compartir sus drafts y recibir comentarios de sus colegas

<http://mail.lacnic.net/mailman/listinfo/ietf-lac>

Qué se ha hecho hasta ahora?

- ietf-lac@lacnog.org

 - ~ 2000 personas suscritas a la lista

 - Discusiones sobre temas técnicos y no técnicos (lenguaje, apoyo económico, etc.)

- Reuniones Pre-IETF

 - Organizadas antes de las reuniones más recientes del IETF: 87 (Berlín) y 88 (Vancouver).

 - Reunión virtual para discutir temas de interés relacionados con la siguiente reunión.

 - Presentaciones hechas por participantes latinos.

- Educación y Evangelización

 - Presentaciones sobre el IETF y como participar en conferencias regionales: LACNIC/LACNOG, Semana da Infraestrutura, Cisco Live (México), etc..

Resultados

- Internet Drafts

Arturo Servín y Mariela Rocha; Monitoring Dual Stack/IPv6-only Networks and Services (draft-ietf-v6ops-monitor-ds-ipv6)

Antonio Moreiras, Edwin Cordeiro, Arturo Servín y Alejandro Acosta; IPv6 Address Prefixes Reserved for Documentation (draft-moreiras-v6ops-rfc3849bis)

Fabián Mejía, Roque Gagliano, Alvaro Retana, Carlos Martínez y Gerardo Rada; Implementing RPKI-based origin validation one country at a time. The Ecuadorian case study. (draft-fmejia-opsec-origin-a-country)

Álvaro Retana y Ariel Weher; Use of the Cost Community to Propagate BGP Origin Validation State (draft-retana-sidr-origin-validation-cost-community – No Publicado)

- Posiciones de Liderazgo

Juan Carlos Zúñiga: Co-Chair Internet Area WG (intarea)

Inés Robles: Co-Chair Routing Over Low power and Lossy networks WG (roll)

Álvaro Retana: Co-Chair Source Packet Routing in Networking WG (spring)

IETF LAC Fase 2: Enfoque Local

- Reuniones Locales
 - Replicar formato Pre-IETF, con temas de interés local.
 - Planear en paralelo con reuniones de operadores u otros grupos interesados.
- Grupos de Trabajo Locales
 - Enfoque en problemas comunes de la comunidad.
- Programa de Mentores
 - Para dirigir discusiones y guiar hasta publicación el trabajo de Grupos de Trabajo locales.
 - Para guiar y colaborar con participantes nuevos en temas específicos.
- Becas para participar en IETF.
 - Necesario un grupo coordinador.
 - Abrir oportunidades específicas al IETF.
- Identificar organizaciones interesadas en colaborar.
 - Becas, patrocinio de grupos de trabajo, educación y evangelización.

Pasos Siguientes

- Suscríbese a la lista de ietf-lac.
<http://mail.lacnic.net/mailman/listinfo/ietf-lac>
- Suscríbese a listas del IETF.
- Participe en las discusiones.
- Aporte ideas, opiniones, soluciones!
- Participe en los esfuerzos locales.

Muito Obrigado!

