

# Trabalho Recente na IETF

## Resumo da Area de Enrotamento



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A word cloud featuring various terms related to the Internet Engineering Task Force (IETF) and open standards. The words are arranged in a roughly circular pattern around the central text. The colors of the words range from dark green to brown. The most prominent words are 'IETF' and 'OPEN'.

**IETF**

**OPEN**

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

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

# Internet Engineering Task Force (IETF)

- **Mission: to make the Internet work better.**
- **Role and Scope**
  - *‘above the wire and below the application’*
    - IP, TCP, email, routing, IPsec, HTTP, FTP, ssh, LDAP,
    - SIP, mobile IP, ppp, RADIUS, Kerberos, secure email,
    - streaming video & audio, ...

# Working Groups

- Working Groups are focused by charters
- no defined membership; just participants
- *“Rough consensus and running code...”*
  - no formal voting (can not define the constituency)
  - does not require unanimity
  - chair determines if there is consensus
  - disputes resolved by discussion
  - mailing list and face-to-face meetings
  - final decisions must be verified on mailing list

# IETF Organization: Areas

## General Area (gen)

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

## Security (sec)

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

## Applications and Real Time (art)

- Protocols for delay-sensitive communications, and building blocks to be used across a wide variety of applications.

## Operations & Management (ops)

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

## Transport Services (tsv)

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

## Routing (rtg)

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

## Internet (int)

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

# 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, and bug fixes in a timely manner.”**

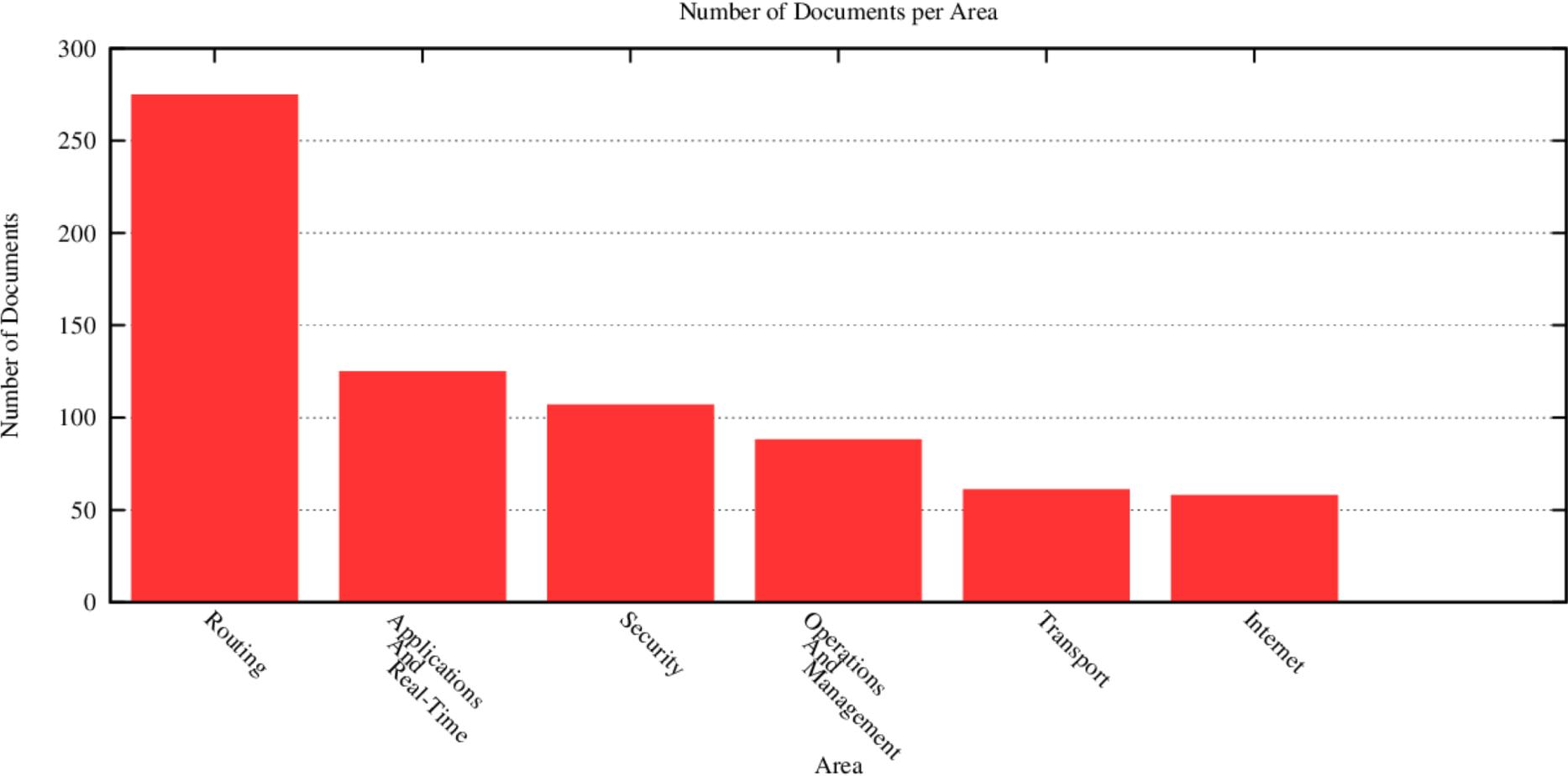
- **24 WGs**
- **3 Area Directors**

<https://datatracker.ietf.org/wg/#rtg>

# The Routing Area in Numbers

Top 6 WGs (in the IETF!):

- idr
- bess
- bier
- teas
- lsr
- lisp



# RTG WGs

- **Babel Routing Protocol (babel)**
- **BGP Enabled Services (bess)**
- **Bidirectional Forwarding Detection (bfd)**
- **Bit Indexed Explicit Replication (bier)**
- **Common Control and Measurement Plane (ccamp)**
- **Deterministic Networking (detnet)**
- **Interface to the Routing System (i2rs)**
- **Inter-Domain Routing (idr)**
- **Locator/ID Separation Protocol (lisp)**
- **Link State Routing (lsr)**
- **Link State Vector Routing (lsvr)**
- **Mobile Ad-hoc Networks (manet)**
- **Multiprotocol Label Switching (mpls)**
- **Network Virtualization Overlays (nvo3)**
- **Pseudowire And LDP-enabled Services (pals)**
- **Path Computation Element (pce)**
- **Protocol Independent Multicast (pim)**
- **Reliable and Available Wireless (raw)**
- **Routing In Fat Trees (rift)**
- **Routing Over Low power and Lossy networks (roll)**
- **Routing Area Working Group (rtgwg)**
- **Service Function Chaining (sfc)**
- **Source Packet Routing in Networking (spring)**
- **Traffic Engineering Architecture and Signaling (teas)**

# Core Routing Protocols

- These are the protocols that are fundamental to how the Internet works today
  - The working groups are mostly “mature”
  - New work is treated with a high degree of caution
- Inter-Domain Routing (idr)
  - Link State Routing (lsr)
  - Protocol Independent Multicast (pim)
  - Bit Indexed Explicit Replication (bier)
  - Source Packet Routing in Networking (spring)

# IDR

## Inter-Domain Routing

- The Border Gateway Protocol (BGP) is sometimes described as the glue that holds the internet together
  - The WG is probably the most conservative of all IETF WGs
  - Requires two independent and interoperable implementations before any protocol extension is published as an RFC
- BGP Administrative Shutdown Communication (rfc8203)
- Extended Message Support for BGP (rfc8654)
- Dissemination of Flow Specification Rules (draft-ietf-idr-rfc5575bis)
- Distribution of Link-State and Traffic Engineering Information Using BGP (draft-ietf-idr-rfc7752bis)

# LSR

## Link State Routing

- Groups the two SPF IGPs in wide use: OSPF and IS-IS.
- Extensions for a wide range of features: routing metrics, link characteristics, SR, etc.
- IS-IS Application-Specific Link Attributes (rfc8919)
- OSPF Application-Specific Link Attributes (rfc8920)
- IGP Flexible Algorithm (draft-ietf-lsr-flex-algo)
- Dynamic Flooding on Dense Graphs (draft-ietf-lsr-dynamic-flooding)

# BIER

## Bit Indexed Explicit Replication

- A new way to do multicast:
  - Give every node in the network a bit in a bitmask
  - Indicate on each packet the intended recipients
  - Use routing protocols to build next-hop trees
  - Replicate packets as necessary
- Multicast Using BIER (rfc8279)
- Encapsulation for BIER in MPLS and Non-MPLS Networks (rfc8296)
- BIER IPv6 Requirements (draft-ietf-bier-ipv6-requirements)

# SPRING

## Source Packet Routing in Networking

- Packet carries the waypoint that it should traverse
- Segment Routing Architecture (rfc8402)
- Segment Routing with the MPLS Data Plane (rfc8660)
- IPv6 Segment Routing Header (SRH) (rfc8754)
- SRv6 Network Programming (draft-ietf-spring-srv6-network-programming)

# Specialist Routing Protocols

- Most routing protocols are general for IP in any environment
  - Some environments demand very specialized routing protocols
  - These specialist problems give rise to working groups targeted at niche environments
- Babel Routing Protocol (babel)
  - Mobile Ad-hoc Networks (manet)
  - Routing Over Low power and Lossy networks (roll)
  - Link State Vector Routing (lsvr)
  - Routing In Fat Trees (rift)
  - Deterministic Networking (detnet)
  - Reliable and Available Wireless (raw)

# BABEL

## Babel Routing Protocol

- Babel focuses on networks where some or all links have unstable metrics. For example, networks in where a wired and wireless mesh networks are combined
  - Babel is a loop-avoiding distance vector protocol
- The Babel Routing Protocol (draft-ietf-babel-rfc6126bis)
- Applicability of the Babel routing protocol (draft-ietf-babel-applicability)

# LSVR

## Link State Vector Routing

- Chartered to develop and document a hybrid routing protocol utilizing a combination of link-state and path-vector routing mechanisms.
  - Uses the existing IPv4/IPv6 transport, packet formats and error handling of BGP-4 (rfc4271), BGP-LS NLRI encoding mechanisms (RFC7752), and a Dijkstra SPF based algorithm.
- Shortest Path Routing Extensions for BGP Protocol (draft-ietf-lsvr-bgp-spf)
- Usage and Applicability of Link State Vector Routing in Data Centers (draft-ietf-lsvr-applicability)
- Layer 3 Discovery and Liveness (draft-ietf-lsvr-l3dl)

# RIFT

## Routing In Fat Trees

- Address the demands of routing in Clos and Fat-Tree networks via a mixture of both link-state and distance-vector techniques colloquially described as 'link-state towards the spine and distance vector towards the leafs'.
  - Focus on networks with regular topologies with a high degree of connectivity, a defined directionality, and large scale.
  
- RIFT: Routing in Fat Trees (draft-ietf-rift-rift)

# DetNet

## DETerministic NETworking

- Focuses on deterministic data paths
  - Provide bounds on latency, loss, and packet delay variation (jitter); and high reliability
  - Data plane will be compatible with the work done in IEEE802.1 Time Sensitive Networking (TSN), which is also being used by 3GPP.
- Deterministic Networking Architecture (rfc8655)
- Deterministic Networking Data Plane Framework (rfc8938)
- Deterministic Networking (DetNet) Data Plane: IP (rfc8939)
- DetNet Data Plane: MPLS (draft-ietf-detnet-mpls)
- DetNet Data Plane: IP over MPLS (draft-ietf-detnet-ip-over-mpls-09)

# RAW

Reliable and Available Wireless

- High reliability and availability for IP connectivity over a wireless medium which presents significant challenges to achieve deterministic properties such as low packet error rate, bounded consecutive losses, and bounded latency.
  - RAW extends the DetNet Working Group concepts to provide for high reliability and availability for an IP network utilizing scheduled wireless segments and other media
- RAW use cases (draft-ietf-raw-use-cases)
- Reliable and Available Wireless Technologies (draft-ietf-raw-technologies)
- L-band Digital Aeronautical Communications System (LDACS) (draft-ietf-raw-ldacs)

# Sub-IP

- Covers routing and signalling protocols for forwarding technologies that lie below IP
  - MPLS
  - Layer 2
  - Optical technologies
- Multiprotocol Label Switching (mpls)
- Traffic Engineering Architecture and Signaling (teas)
- Common Control and Measurement Plane (ccamp)

# TEAS

## Traffic Engineering Architecture and Signaling

- Handles high level architectural views of TE and generic extensions to TE protocols.
- An Architecture for Use of PCE and the PCEP in a Network with Central Control (rfc8283)
- Framework for Scheduled Use of Resources (rfc8413)
- Framework for Abstraction and Control of TE Networks (rfc8453)
- PCE in Native IP Network (draft-ietf-teas-pce-native-ip)
- A Framework for Enhanced Virtual Private Networks (VPN+) Service (draft-ietf-teas-enhanced-vpn)
- Overview and Principles of Internet Traffic Engineering (draft-ietf-teas-rfc3272bis)

# Routing Support and Operation

- Operations, Management, and Administration (OAM) is a set of tools that monitor and report on the behaviour of traffic flows, connections, and links
- Other management tools enable configuration and operation of the routing system through...
  - Bidirectional Forwarding Detection (bfd)
  - Interface to the Routing System (i2rs)
  - Path Computation Element (pce)

# PCE

## Path Computation Element

- The WG mainly works on extensions to the PCE protocol (PCEP)
- PCEP Extensions for Stateful PCE (rfc8231)
- PCEP Extensions for Segment Routing (rfc8664)
- PCEP Extension for Flow Specification (draft-ietf-pce-pcep-flowspec)

# Routing Services

- Many WGs in RTG focus on the use of existing protocols to enable new services
- Historically this has been seen in...
  - Layer 3 VPN
  - Layer 2 VPN
  - Pseudowires
- BGP Enabled Services (bess)
- Pseudowire And LDP-enabled Services (pals)
- Network Virtualization Overlays (nvo3)
- Locator/ID Separation Protocol (lisp)
- Service Function Chaining (sfc)

# BESS

## BGP Enabled Services

- Any service (but especially a VPN) achieved using BGP
  - Major focus is on EVPN, though MVPN still generates work
- Close coordination with IDR for BGP extensions
- Usage and Applicability of BGP MPLS-Based Ethernet VPN (rfc8388)
- Integrated Routing and Bridging in EVPN (draft-ietf-bess-evpn-inter-subnet-forwarding)
- BGP Control Plane for the Network Service Header in Service Function Chaining (draft-ietf-bess-nsh-bgp-control-plane)

# NVO3

## Network Virtualization Overlays

- Develop protocols/protocol extensions that enable network virtualization over IP within a data center
- An Architecture for Data-Center Network Virtualization over Layer 3 (rfc8014)
- Geneve: Generic Network Virtualization Encapsulation (rfc8926)
- Generic Protocol Extension for VXLAN (VXLAN-GPE) (draft-ietf-nvo3-vxlan-gpe)

# LISP

## Locator/ID Separation Protocol

- Originally conceived to handle the explosive growth of the global routing table, it now looks at a large number of “layering” or “overlay” scenarios best typified by VPNs.
- The Locator/ID Separation Protocol (draft-ietf-lisp-rfc6830bis)
- Locator/ID Separation Protocol Control-Plane (draft-ietf-lisp-rfc6833bis)
- LISP-Security (LISP-SEC) (draft-ietf-lisp-sec)

# Catch-All and Specialist Work

- There is important work in the RTG Area that does not fit into any of the WGs just described
- Routing Area Working Group (rtgwg)

# RTG WG

## Routing Working Group

- Some pieces of routing work don't fit comfortably into any existing WG
  - But they may be too small to justify a new working group
- Other pieces of work are highly technical but don't require the development of a new routing protocol
- Remote-LFA Node Protection and Manageability (rfc8102)
- Shortest Path First (SPF) Back-Off Delay Algorithm for Link-State IGPs (rfc8405)
- Enterprise Multihoming using Provider-Assigned IPv6 Addresses without Network Prefix Translation: Requirements and Solutions (rfc8678)
- BGP Prefix Independent Convergence (draft-ietf-rtgwg-bgp-pic)
- Topology Independent Fast Reroute using Segment Routing (draft-ietf-rtgwg-segment-routing-ti-lfa)

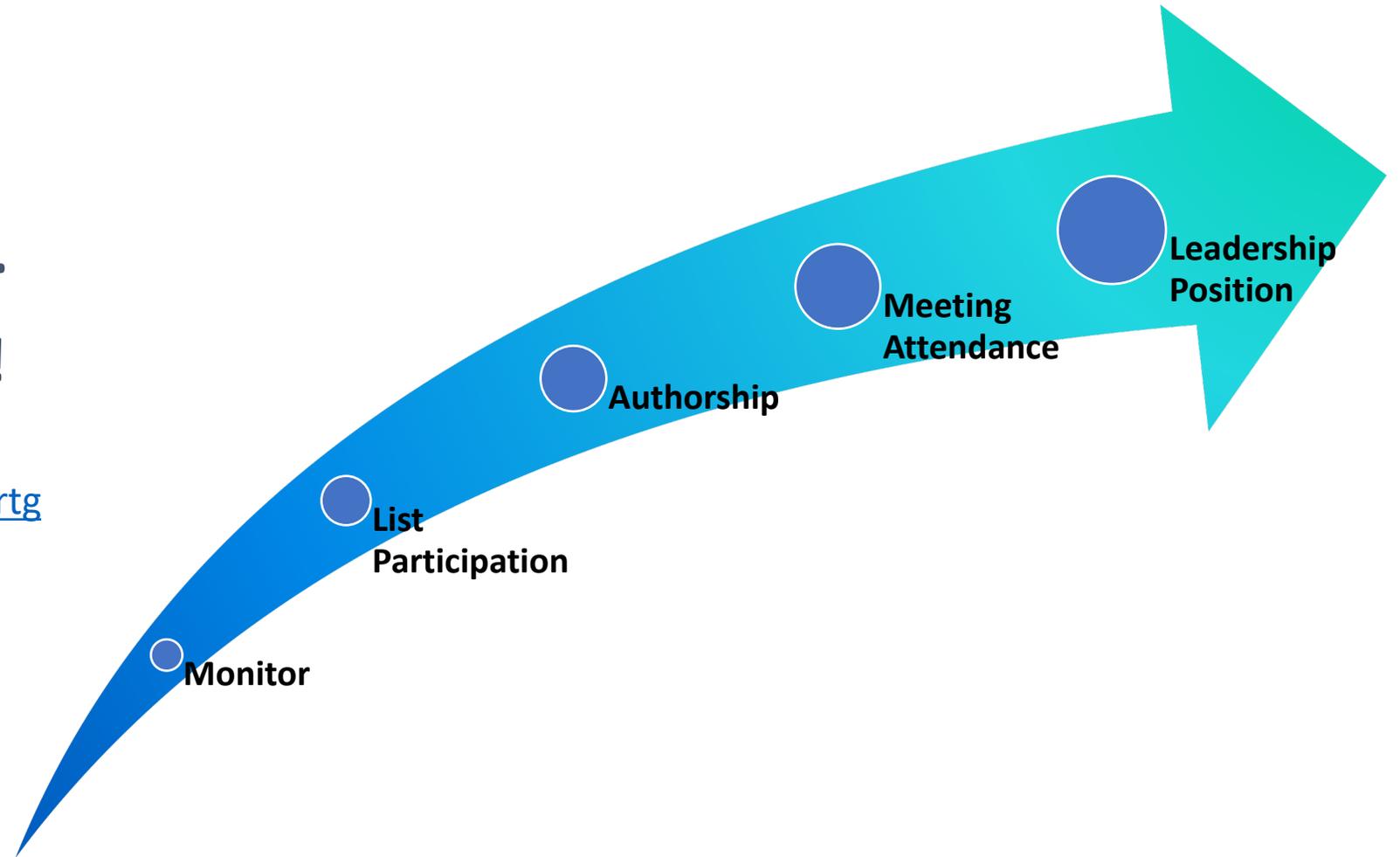
# Routing Work in Other Areas

- OPS Area
  - Global Routing Operations (GROW)
  - MBONE Deployment (MBONED)
  - Secure Inter-Domain Routing Operations (SIDROPS)
- INT Area
  - Home Networking (HOMENET)
  - IPv6 over the TSCH mode of IEEE 802.15.4e (6TISCH)
  - IPv6 over Networks of Resource-constrained Nodes (6LO)
  - IPv6 Maintenance (6MAN)
  - Host Identity Protocol (HIP)
- TSV Area
  - IP Performance Measurement (ippm)

# Participate in the IETF!

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

<https://datatracker.ietf.org/wg/#rtg>



Muito Obrigado!