

Requirements for VoIP Header Compression over Multiple-Hop Paths

(draft-ash-e2e-voip-hdr-comp-rqmts-01.txt)

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Outline

(draft-ash-e2e-voip-hdr-comp-rqmts-01.txt)

- ❑ AVT WG charter extension
- ❑ motivation, problem statement, & goals for VoIP header compression over multiple-hop paths
- ❑ example scenarios
- ❑ requirements for VoIP header compression over multiple-hop paths
- ❑ issues
 - ❖ protocol extensions for cRTP, RSVP-TE, RFC2547 VPNs
 - ❖ resynchronization & performance of cRTP/'simple' mechanisms
 - ❖ scalability of VoIP header compression over MPLS multiple-hop paths applied CE/HC --> CE/HD
 - ❖ LDP application as the underlying LSP signaling mechanism
- ❑ next steps

AVT WG Charter Extension

- these milestones have been added to the AVT charter
 - ❖ Nov 2003 Initial draft requirements for ECRTTP over MPLS; discuss with MPLS WG
 - ❖ Mar 2004 Finish requirements for ECRTTP over MPLS; re-charter for subsequent work

Motivation, Problem Statement, & Goals for VoIP Header Compression over Multiple-Hop Paths (draft-ash-e2e-voip-hdr-comp-rqmts-01.txt)

❑ motivation

- ❖ carriers evolving to converged MPLS/IP backbone with VoIP services
 - enterprise VPN services with VoIP
 - legacy voice migration to VoIP

❑ problem statement

- ❖ VoIP typically uses voice/RTP/UDP/IP/ encapsulation
 - voice/RTP/UDP/IP/MPLS with MPLS labels added
- ❖ VoIP typically uses voice compression (e.g., G.729) to conserve bandwidth
 - compressed voice payload typically no more than 30 bytes
 - packet header at least 48 bytes (60% overhead)

❑ goals

- ❖ VoIP header compression over multiple-hop paths (compressor to decompressor) to reduce overhead & improve scalability

Motivation, Problem Statement, & Goals for VoIP Header Compression over Multiple-Hop Paths (draft-ash-e2e-voip-hdr-comp-rqmts-01.txt)

□ goals

- ❖ reduce overhead for more efficient voice transport
 - important on access links where bandwidth is scarce
 - important on backbone facilities where costs are high (e.g., some global cross-sections)
 - E.g., for large domestic network with 300 million voice calls per day
 - consume 20-40 gigabits-per-second on backbone network for headers alone
 - save 90% bandwidth capacity with VoIP header compression
- ❖ increase scalability of VoIP header compression to a very large number of flows
 - avoid multiple compression-decompression cycles for a given flow on multiple-hop paths
- ❖ not significantly degrade packet delay, delay variation, or loss probability
- ❖ allow efficient signaling of header context from compressor to decompressor.

Example Scenarios for VoIP Header Compression over Multiple-Hop Paths (draft-ash-e2e-voip-hdr-comp-rqmts-01.txt)

❑ Scenario B

- ❖ many VoIP flows originated from customer sites such as CE1/HC to several large customer call centers served by PE2
 - call centers served by PE2 include CE2/HD, CE3/HD, and CE4/HD
- ❖ essential that PE2-CE2/HD, PE2-CE3/HD, and PE2-CE3/HD hops all use header compression
 - to allow a maximum number of simultaneous VoIP flows to call centers
- ❖ to allow PE2 processing to handle the volume of simultaneous VoIP flows
 - desired to use multi-hop header compression for these flows
 - with multi-hop header compression, PE2 does not need to do header compression/decompression for flows to call centers
 - enables more scalability of number of simultaneous VoIP flows with header compression at PE2

Requirements for VoIP Header Compression over Multiple-Hop Paths

(draft-ash-e2e-voip-hdr-comp-rqmts-01.txt)

- ❑ allow VoIP header compression from compressor to decompressor over multiple-hop paths
 - ❖ possibly through an MPLS network
 - ❖ avoid hop-by-hop compression/decompression cycles
- ❑ compress RTP/UDP/IP headers by at least 50%
 - ❖ provide for efficient voice transport
- ❑ allow VoIP header compression over multiple-hop paths with delay not to exceed 400 ms. from compressor to decompressor [Y.1541, G.114]
- ❑ allow VoIP header compression over multiple-hop paths with delay variation not to exceed 50 ms. from compressor to decompressor [Y.1541, G.114]
- ❑ allow VoIP header compression over multiple-hop paths with packet loss not to exceed 0.001 from compressor to decompressor [Y.1541, G.114]
- ❑ support various voice encoding supported by [RTP] (G.729, G.723.1, etc.)
- ❑ be scalable to up to 20,000 simultaneous flows (e.g., HC --> HD)

Requirements for VoIP Header Compression over Multiple-Hop Paths

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- ❑ use standard compress/decompress algorithms (e.g., [cRTP], [ECRTP], [ROHC]) to compress the RTP/UDP/IP headers
- ❑ allow use of standard protocols to make [cRTP] more tolerant of packet loss (e.g., [ECRTP])
- ❑ operate in non-MPLS networks (i.e., without use of MPLS labels)
- ❑ operate in MPLS [MPLS-ARCH] networks, with use of MPLS labels
 - ❖ using either [LDP] or [RSVP] signaling
- ❑ operate in RFC2547 VPN context [MPLS-VPN]
- ❑ allow use of standard protocols to signal context identification & control information (e.g., [RSVP], [RSVP-TE], [LDP])
- ❑ use standard protocols to aggregate RSVP-TE signaling (e.g., [RSVP-AGG])
- ❑ allow use of standard protocols to prioritize packets (e.g., [DIFFSERV, DIFF-MPLS])
- ❑ allow use of standard protocols to allocate LSP bandwidth (e.g., [DS-TE])

Issue 1 - Protocol Extensions for cRTP, RSVP-TE, RFC2547 VPNs

- ❑ extensions to [cRTP] and [cRTP-ENHANCE]
 - ❖ new packet type field to identify FULL_HEADER, CONTEXT_STATE, etc. packets
 - ❖ create 'SCID routing tables' to allow routing based on the session context ID (SCID)
- ❑ new objects defined for [RSVP-TE]
- ❑ extensions to RFC2547 VPNs
 - ❖ SCID routing combined with label switching at PE's
- ❑ extensions need coordination with other WGs (MPLS, L3VPN, etc.)

Issue 2 - Resynchronization & Performance of cRTP/'simple' Mechanisms

- ❑ E2E VoMPLS using cRTP header compression might not perform well with frequent resynchronizations
- ❑ performance needs to be addressed
 - ❖ 'simple' avoids need for resynchronization
 - ❖ cRTP achieves greater efficiency than 'simple' (90% vs. 50% header compression), but requires resynchronization
 - use standard protocols to make cRTP more tolerant of packet loss (e.g., [ECRTP])

Issue 3 - Scalability of VoIP Header Compression over MPLS Multiple-Hop Paths Applied CE/HC-CE/HD

- ❑ RSVP-TE advantages
 - ❖ allows VoIP bandwidth assignment on LSPs
 - ❖ QoS mechanisms
- ❑ if applied CE/HC-CE/HD would require a large number of LSPs to be created
- ❑ concern for CE ability to do necessary processing & architecture scalability
 - ❖ processing & label binding at every MPLS node on path between each CE/HC-CE/HD pair
 - ❖ processing every time resource reservation is modified (e.g., to adjust to varying number of calls on a CE/HC-CE/HD pair)
 - ❖ core router load from thousands of LSPs, setup commands, refresh messages

Issue 4 - LDP Application as Underlying LSP Signaling Mechanism

- ❑ desirable to signal MPLS tunnels with LDP
 - ❖ many RFC2547 VPN implementations use LDP as underlying LSP signaling mechanism
 - ❖ scalable
- ❑ may require extensions to LDP
 - ❖ e.g., LDP signaling of 'VC' (inner) labels for PWs
 - <http://ietf.org/internet-drafts/draft-ietf-pwe3-control-protocol-04.txt>
 - suggests ways to do auto-discovery
 - ❖ this together with LDP capability to distribute outer labels might support CE/HC-CE/HD VoIP header compression LSPs (within the context of RFC 2547)
- ❑ other LDP issues
 - ❖ no bandwidth associated with LSPs
 - ❖ QoS mechanisms limited

Next Steps

- ❑ propose <draft-ash-e2e-voip-hdr-comp-rqmts-01.txt> to become AVT WG draft
- ❑ begin to progress solution I-D's within AVT
 - ❖ with review by other WGs (e.g., MPLS WG)

Backup Slides

Example Scenarios for VoIP Header Compression over Multiple-Hop Paths (draft-ash-e2e-voip-hdr-comp-rqmts-01.txt)

❑ Scenario A

- ❖ small customer sites with IP phones or VoIP terminal adapters connect to CE routers serving as header compression gateways
- ❖ VoIP session established from CE1/HC --> PE1 --> P --> PE2 --> CE2/HD
 - CE1/HC is the customer edge (CE) router where header compression (HC) is performed
 - CE2/HD is the CE router where header decompression (HD) is done
- ❖ voice traffic from CE1/HC to CE2/HD is typically small, on the order of only a few simultaneous calls in peak periods
- ❖ cRTP compression of the RTP/UDP/IP header is performed at CE1/HC
 - compressed packets routed from CE1/HC to PE1, P, PE2, to CE2/HD, without further decompression/recompression cycles
 - compressed packets routed using MPLS labels or SCID switching from compressor CE1/HC to decompressor CE2/HD over multiple hop path
 - RTP/UDP/IP header decompressed at CE2/HD & forwarded to other routers, as needed

Example Scenarios for VoIP Header Compression over Multiple-Hop Paths (draft-ash-e2e-voip-hdr-comp-rqmts-01.txt)

❑ Scenario A (continued)

- ❖ cRTP header compression used between end-points
- ❖ in the case of an MPLS path
 - MPLS path appears as a single link-layer to the compressor, even though it traverses several routers
 - MPLS path transports cRTP/MPLS-labels instead of RTP/UDP/IP/MPLS-labels, saving 36 octets per packet
 - MPLS label stack & link-layer headers not compressed
- ❖ additional signaling needed to map the context for the compressed packets
- ❖ performance goals
 - packet loss rate between CE1/HC & CE2/HD not exceed 0.001
 - packet delay variation not exceed 50 ms.
 - packet transfer delay not exceed 400 ms.

Work Items

- ❑ extend cRTP to work from compressor to decompressor over multiple-hop paths with moderate delay (e.g., < 400 ms.) & moderate packet loss (e.g., < 2%)
 - ❖ assume enhanced cRTP (ECRTP) sufficient for now
- ❑ how to directly route cRTP packets using SCID switching
 - ❖ rather than doing a decompression/routing/compression cycle
 - ❖ router can do in isolation, without being observable by upstream or downstream routers
- ❑ how to do ECRTP over an MPLS LSP
 - ❖ RSVP signaling extensions needed
 - ❖ compression between ingress-egress routers of LSP
 - ❖ can be viewed as the MPLS equivalent of RFC 2509
- ❑ how SCID switching can be applied by the ingress router of a compressed MPLS LSP

Background for VoIP Header Compression over Multiple-Hop Paths

- ❑ prior work in MPLS WG by Swallow/Berger on 'simple' mechanism
 - ❖ work accepted by MPLS WG for charter extension (IETF-47, 3/2000)
 - ❖ I-D's expired before charter extended
- ❑ 'simple' header compression
 - ❖ transmit only first order differences
 - ❖ resynchronization not needed with lost packets
 - ❖ ~50% header compression with 'simple'
- ❑ cRTP-based (RFC 2508) link-by-link header compression
 - ❖ algorithms specified in RFC 2508
 - ❖ resynchronization required with lost packets
 - ❖ ~90% header compression

End-to-End VoMPLS Header Compression (draft-ash-e2e-vompls-hdr-compress-01.txt)

□ steps

- ❖ use RSVP to establish LSPs between CE1/GW-CE2/GW
- ❖ use cRTP (or simple HC) to compress header at CE1/GW, decompress at CE2/GW
- ❖ CE1/GW requests session context IDs (SCIDs) from CE2/GW
- ❖ CE1/GW appends CE2/GW label to compressed header
- ❖ header compression context routed from CE1/GW --> PE1 --> P --> PE2 --> CE2/GW
- ❖ route compressed packets with MPLS labels CE1/GW --> CE2/GW
- ❖ packet decompressed at CE2/GW using cRTP (or simple HC) algorithm

□ advantages

- ❖ minimizes PE requirements

□ disadvantages

- ❖ CE/GW's need to run RSVP, possible scalability issue

End-to-End VoIP Header Compression Using cRTP (draft-ash-e2e-crtp-hdr-compress-01.txt)

□ steps

- ❖ use RSVP to establish LSPs between PE1-PE2
- ❖ use cRTP to compress header at CE1/GW, decompress at CE2/GW
- ❖ PE1 requests SCIDs from PE2
- ❖ header compression context routed from CE1/GW --> PE1 --> P --> PE2 --> CE2/GW
- ❖ PE1 & PE2 create 'SCID routing tables' & perform 'SCID switching' for compressed packets (SCID --> MPLS labels)
- ❖ route compressed packets with MPLS labels PE1 --> PE2
- ❖ packet decompressed at CE2/GW using cRTP algorithm

□ advantages

- ❖ minimizes CE/GW requirements

□ disadvantages

- ❖ additional PE requirements (need to create 'SCID routing tables')