TCMTF: Tunneling, Compressing and Multiplexing Traffic Flows

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I. Is there a problem?

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Is there a problem?

Problem: Inefficiency of real-time flows

- High frequency implies:
  - Small payloads
  - IPv4/UDP/RTP headers: 40 bytes
Is there a problem?

Problem: Inefficiency of real-time flows

- High frequency implies:
  - Small payloads
  - IPv6/UDP/RTP headers: 60 bytes

One IPv6/TCP packet 1500 bytes
η = 1440/1500 = 96%

One IPv6/UDP/RTP packet of VoIP with two samples of 10 bytes
η = 20/80 = 25%
Is there a problem?

- Ten years ago: **Question:** Can we _improve efficiency_ when a number of flows share the same path?

- **Answer:** TCRTP (RFC 4170) _2005_: _Best current practice._
  - Audio/Video _Transport_ (avt) (concluded WG) of RAI Area: it was designed for RTP
Is there a problem?

TCRTP for IPv4

Payload
ECRTP

RTP
UDP
IP

PPP Mux
PPP
L2TP
IP

VoIP

One IPv4/UDP/RTP VoIP packet with two samples of 10 bytes
\( \eta = \frac{20}{60} = 33\% \)

Five IPv4/UDP/RTP VoIP packets with two samples of 10 bytes
\( \eta = \frac{20}{60} = 33\% \)

One IPv4 TCMTF Packet multiplexing five two sample packets
\( \eta = \frac{100}{161} = 62\% \)

40 to 6-8 bytes compression

saving
Is there a problem?

IPv6

TCRTP saves bandwidth, but what has happened since its publication in 2005?
Is there a problem?

1) Outbreak of wireless access networks*

* http://www.wiseharbor.com/forecast.html
2) Publication of ROHC (RFC 4995), 2007*: Designed for robustness when dealing with high RTT, packet loss. Typical in wireless scenarios.

- Able to compress: **RTP/UDP/IP, UDP/IP, TCP/IP**
- Robust: it is able to maintain context synchronization
- Drawback: Implementation complexity

- May 2010: RFC 5856: ROHC over IPSec

*updated by RFC 5795 in 2010
Is there a problem?

3) New real-time services have increased their popularity (e.g. online games)

- Some of them do not use RTP (bare UDP, or TCP)
- They generate tiny packets
- The users are very sensitive to delay
Is there a problem?

So… why not widen TCRTP’s scope in order to:

- Allow other traffics different from RTP
- Allow these new developed header compression techniques
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Is TCMTF a solution to the problem?

TCMTF proposal:
Three layers
1. Tunneling
2. Multiplexing
3. Compressing

Red - real-time traffic

Compression layer

Multiplexing layer

Tunneling layer

Network Protocol

Payload
TCP
IP

Payload
UDP
IP

Payload
RTP
UDP
IP

No compr. / ROHC / IPHC / ECRTP

PPPMux / Other

GRE / L2TP / Other

IP
Is TCMTF a solution to the problem?

New options:

1) Different **traffics**
   - RTP
   - UDP
   - TCP
Is TCMTF a solution to the problem?

Backwards compatibility:

TCRTP is this “branch”
Is TCMTF a solution to the problem?

New options:
2) Different header compression algorithms. The most adequate one can be selected according to:
- Kind of traffic
- Scenario: loss, delay
- Processing capacity
- Etc.
Is TCMTF a solution to the problem?

New options:
3) Different **mux** algorithms
   - Currently: PPPMux
   - New developed ones
Is TCMTF a solution to the problem?

New options:
4) Different tunneling algorithms
   - Currently: L2TPv3
   - GRE
   - others
Is TCMTF a solution to the problem?

Does it work?

First Person Shooter game (UDP)

One IPv4/UDP server-to-client packet of Counter Strike with 9 players
η=160/188=85%

Four IPv4/UDP client-to-server packets of Counter Strike
η=61/89=68%

One IPv4/TCM packet multiplexing four client-to-server Counter Strike packets
η=244/293=83%

Massively Multiplayer Online Role Playing Game (TCP)

Six IPv4/TCP client-to-server packets of World of Warcraft. E[P]=20bytes
η=20/60=33%

One IPv4/TCM packet multiplexing six client-to-server World of Warcraft packets
η=120/187=64%
Is TCMTF a solution to the problem?

Does it work?: UDP First Person Shooter

First Person Shooters: Can a Smarter Network Save Bandwidth without Annoying the Players?, "IEEE Communications Magazine, vol. 49, no.11, pp. 190-198, November 2011
Is TCMTF a solution to the problem?

Does it work?: TCP MMORPG

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Is TSVWG the correct place to solve it?

- This is **cross-area work**. It relates to RAI, Transport, and Internet.
  - L2TPv3: **Internet Area** (RFC 3931, March 2005)
  - PPPMux: **Internet Area** (RFC 3153, August 2001)
  - ECRTP: **RAI Area** (RFC 3545, July 2003)
  - ROHC: **Transport Area**, although it can also compress RTP (RFC 5795, March 2010)
- RAI Area: It does not fit, because RTP is only a particular case of the solution.
- Internet or Transport Area?
Is TSVWG the correct place to solve it?

- **RFC 1122:**
  - **Transport Layer:** “The transport layer provides end-to-end communication services for applications”.
  - **Internet Layer:** “All Internet transport protocols use the Internet Protocol (IP) to carry data from source host to destination host. IP is a connectionless or datagram internetwork service, providing no end-to-end delivery guarantees”.

- **TCMTF** is an **end-to-end solution**, requiring some knowledge of the traffic to multiplex, and a synchronization of the context on both sides.
So, why not TSVWG?

Thank you
Is there a problem?

Ten years ago: Question: Can we improve efficiency when a number of flows share the same path?
- Does this scenario exist?
- Are the added delays reasonable?
Is there a problem?

Does this scenario exist?

- An enterprise with different offices
- A number of calls share a common path: they can also share the common header
Is there a problem?

Other non-RTP scenarios

- Proxies of a game-provider or access network
- Internet café
- Satellite link: Reducing pps: Compressing ACKs of different flows
- A group of users of a remote desktop system (webRTC)
Is there a problem?

Are the added delays reasonable?
Is there a problem?

3) New real-time services have increased their popularity (e.g. online games)

- Some of them do not use RTP (bare UDP, or TCP)
- They generate tiny packets
- The users are very sensitive to delay
- They use wireless access networks
- Supporting infrastructures are critical. They MUST work 24/7.

- Over-provisioning?. Multiplexing tradeoff: in the rush hour, we can save bandwidth at the cost of adding small delays: flexibility
Is there a problem?
Is there a problem?

Is there a problem?

Does this scenario exist?

Quintum’s PacketSaver technology multiplexes small voice/fax-over-IP packets into larger packets to increase network efficiency, thereby reducing the total amount of packet “overhead” required to transmit voice and fax over IP networks.
Is there a problem?

1) Outbreak of wireless access networks
Is there a problem?

As inter-packet time is not fixed, we would need a policy to select the packet to multiplex.
Is TCMTF a solution to the problem?

Does it work?: RTP VoIP

"Evaluating the Influence of Multiplexing Schemes and Buffer Implementation on Perceived VoIP Conversation Quality,"
Computer Networks (Elsevier). http://dx.doi.org/10.1016/j.comnet.2012.02.004
Is TCMTF a solution to the problem?

Bandwidth saving IPv4

- IPv4 10 ms 5 players
- IPv4 10 ms 20 players
- IPv4 reached
- IPv4 theoretical

Games:
- Quake 2
- Unreal Tournament
- Counter Strike 1
- Quake 3
- Enemy Territory
- Counter Strike 2
- Halo 2
- Quake 4
Is TCMTF a solution to the problem?

Bandwidth saving IPv6

- IPv6 10 ms 5 players
- IPv6 10 ms 20 players
- IPv6 reached
- IPv6 theoretical
Is TCMTF a solution to the problem?

Quake II
Unreal Tournament
Counter Strike I
Quake III
Is TCMTF a solution to the problem?

Wolfenstein: Enemy Territory

Counter Strike II

Halo II

Quake IV