The Impact of Transport Header Encryption on Operation and Evolution of the Internet

draft-fairhurst-tsvwg-transport-encrypt

Gorry Fairhurst – University of Aberdeen (MAMI)

Colin Perkins – University of Glasgow

measurement and architecture for a middleboxed internet

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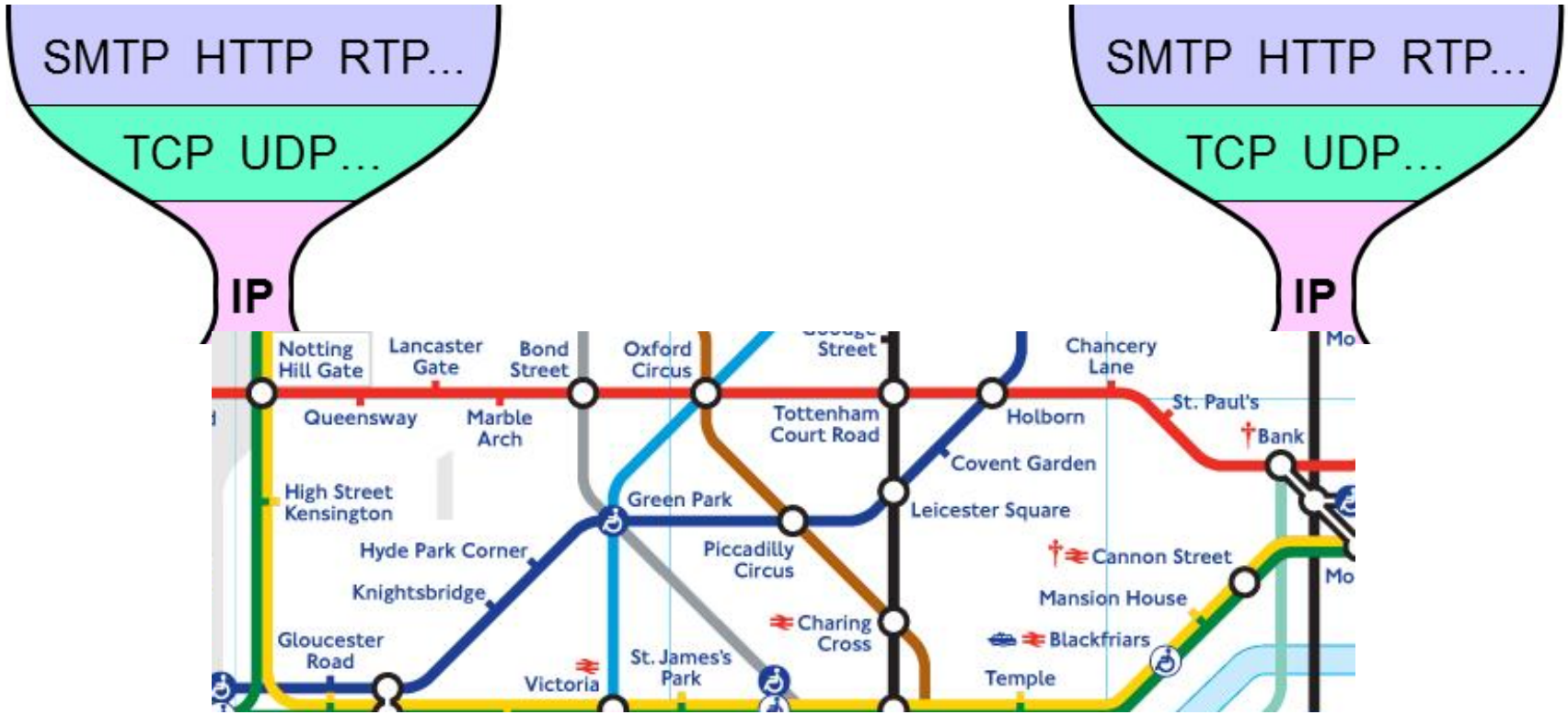
My view of transport



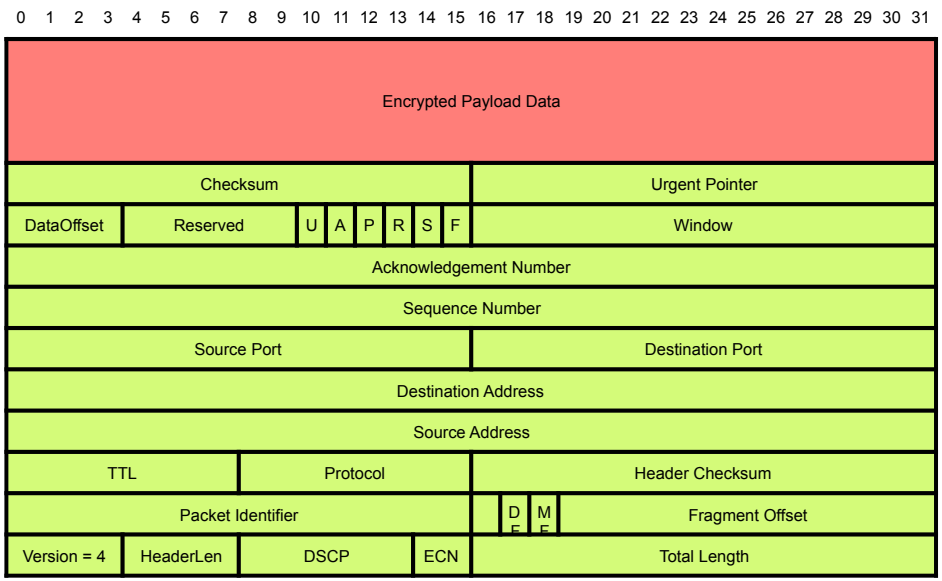
End-to-End functions to ***move*** data

End-to-End ***negotiation*** of features

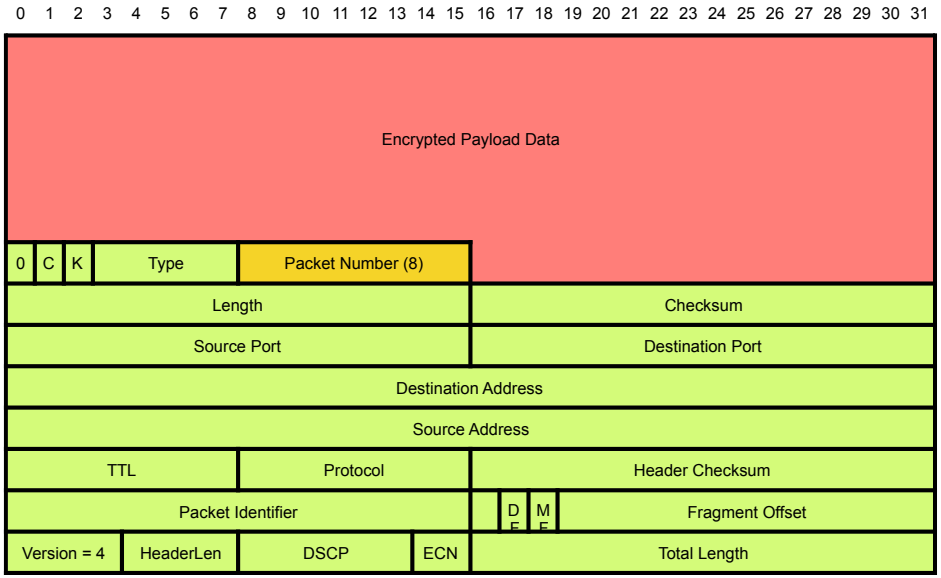
Adaption to the network path

Making this ***work well***

Transport Header Encryption



TCP Transport Header



QUIC Transport Header

In principle, everything above IP and ports ***could*** be encrypted

Eliminates network visibility of the transport headers

An increasing fraction of transport headers ***is being*** encrypted

Benefits of Header Encryption

Reduces information leakage

→ ***enhances privacy***

Harder to infer connection progress/operation

Harder to infer the user or application using the network

Avoids assumptions about the needs of traffic being carried

Prevents middlebox ossification

→ ***flexibility to change transport***

Avoids some spoofing/injection attacks against transport

Benefits are widely reported

Costs of pervasive encryption

Complicates network operations:

- Network operations
- Network trouble-shooting and diagnosis
- Network traffic analysis
- Open and verifiable network data

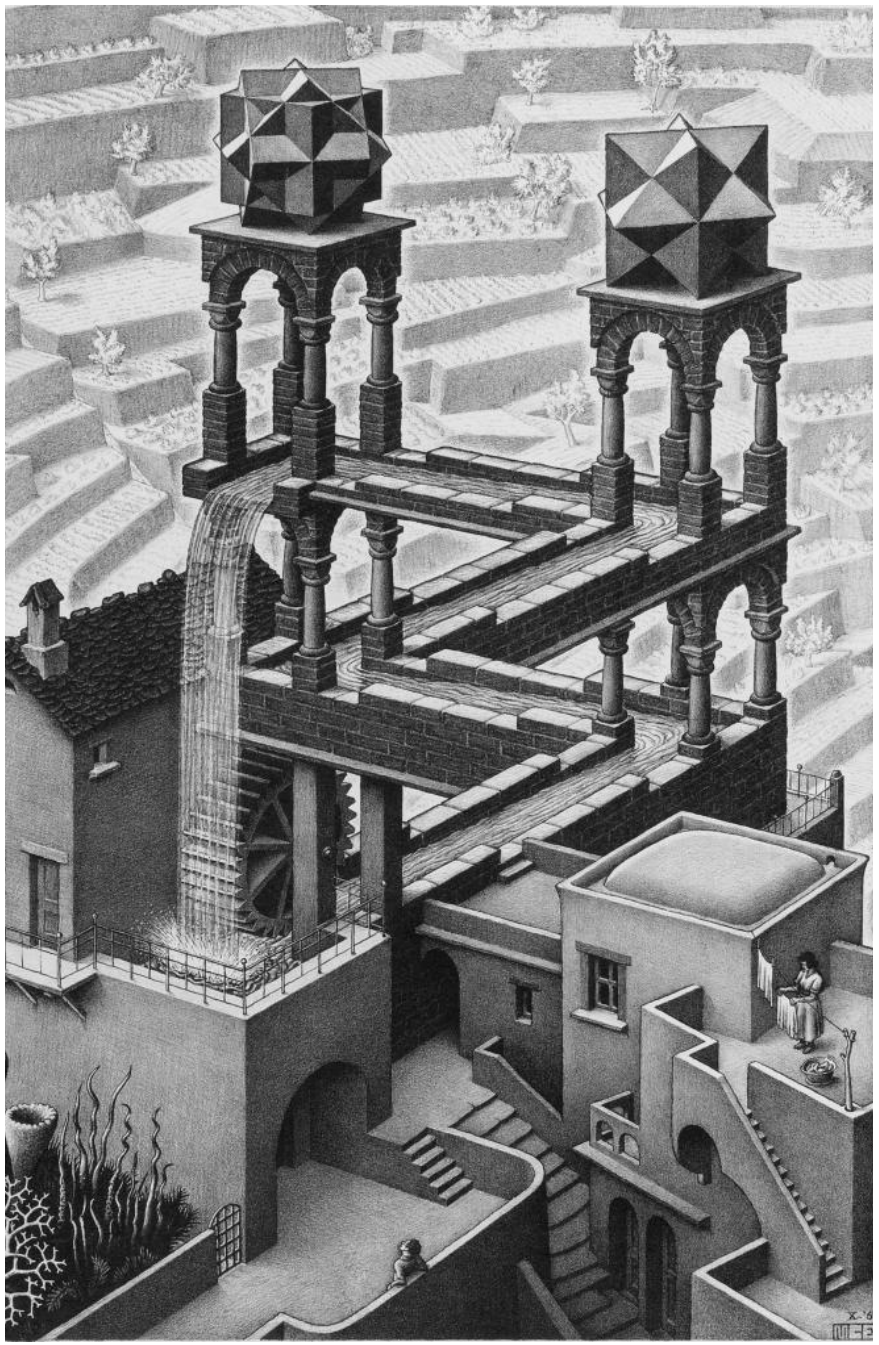
Complicates protocol specification:

- Understanding feature interactions
- Supporting common specifications
- Compliance with operational practice
- Research and development

Perspective Matters

Q1: How are Transport headers being used now?

Q2: What is the best recommended practice for encrypting transport headers?



M.C. Escher, Waterfall, 1961, lithograph

Next Steps

Transport-level encryption offers important benefits – but also has costs for operations, and protocol development

This may be problems for long-term health of standards ecosystem and research support for network protocols

Obstructing operational needs will lead to deploying (multiple) work-arounds, and likely will not increase privacy or consistency

The IETF needs to understand the tradeoffs and seek a balance

Costs of pervasive encryption

Complicates network operations:

Network operations

Network trouble-shoo

Network traffic analys

Open and verifiable r

Complicates protocc

Understanding featur

Supporting common

Compliance with ope

Research and development

Operators can currently analyse performance by observing transport headers:

- help to detect anomalies
- inform capacity planning
- inform traffic engineering
- provide an overview of network health

Other tools needed for encrypted traffic:

- encapsulations to replace missing headers
- active probes, etc

Costs of pervasive encryption

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Understanding featu

Supporting commor

Compliance with op

Research and development

Can't **debug** what cannot be observed

- flows subject to loss, jitter, etc, are indistinguishable from unaffected flows

→ Debugging encrypted traffic requires either:

- active probes: both intrusive and behaviour potentially differs from real traffic
- information from endpoints

Costs of pervasive encryption

Complicates network operations:

- Network operations
- Network trouble-shooting and diagnosis
- **Network traffic analysis**
- Open and verifiable ne

Can't do **traffic engineering** or **analysis** if they cannot see the traffic

Complicates protocol specification:

- Understanding feature interactions
- Supporting common specifications
- Compliance with operational practice
- Research and development

Costs of pervasive encryption

Complicates network operations:

Network operations

Network trouble-shooting and diagnosis

Network traffic analysis

Open and verifiable network data

Complicates protocol

Understanding feature

Supporting common s

Compliance with operational practice

Research and development

Limits **open and verifiable** data on behaviour

- Loss of data to understand operational behaviour of transports
- Can't tell if transport ***behaves as intended***

Costs of pervasive encryption

Complicates network operations:

Network operations

Network trouble-shoo

Network traffic analys

Open and verifiable n

Hinders understanding of **interactions** between transport, applications and networks

- Measurements **need to be in the wild**
  → testbeds don't discover feature interaction problems, anomalies, etc

Complicates protocol specification:

Understanding feature interactions

Supporting common specifications

Compliance with operational practice

Research and development

Costs of pervasive encryption

Complicates network operations:

Network operations

Network trouble-shooting and diagnosis

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Open and verifiable ne

Complicates protocol s

Understanding feature

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Hard to confirm conformance

- Tools need ***to evolve track each version***
- Reduces incentives to conform
  → endpoint telemetry helps, but not necessarily trustworthy

Costs of pervasive encryption

Complicates network operations:

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- **Research and development**

Danger of ecosystem fragmentation:

- While faster innovation is desirable, point solutions are ***fragile***
- ***loss of data*** to inform future developments and understand operational behaviour
- ***removes the checks-and balances***