Robust Header Compression (ROHC)

54th IETF
Yokohama, July 2002

Chairs:

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54th IETF: Pre-Agenda

- **WG chair admonishments**
- **Real agenda**

✓Blue sheets
✓Scribe

Hello! This is an IETF Working Group

- **We are here to make the Internet work (Fred Baker)**
  - Together! (Harald Alvestrand)
- **Rough Consensus and Running Code (Dave Clark)**
- **Working Group is controlled by**
  - IETF Process (RFC2026, RFC2418) – *read it!*
  - Area Directors (ADs): Alison Mankin, Scott Bradner
  - Charter (http://www.ietf.org/html.charters/rohc-charter.html)
  - Working Group Chairs: Lars-Erik Jonsson, Carsten Bormann
  - Technical Advisor: Erik Nordmark
- **Work is done on email list: rohc@ietf.org**
  - And on IETF meetings, interim meetings, informal meetings
  - Mailing list is official channel, though

RFC 2026: Internet Standards Process

- **Standards track RFCs:**
  - **WG consensus (as judged by WG chairs)**
  - **WG last call**
  - **IESG approval (based on AD recommendation)**
    - Quality control!
  - **IETF last call**
- **Informational RFCs**
- **BCP (best current practice) RFCs**

RFC 2026: IPR issues (1)

- **(10.2) No contribution that is subject to any requirement of confidentiality or any restriction on its dissemination may be considered […]**

- **Where the IESG knows of rights or claimed rights […] the IETF Executive Director shall attempt to obtain from the claimant […] a written assurance that upon approval by the IESG of the relevant Internet standards track specification(s), any party will be able to obtain the right to implement, use and distribute the technology […] based upon the specific specification(s) under openly specified, reasonable, non-discriminatory terms.**

RFC 2026: IPR issues (2)

- **Contributions (10.3.1(6)):**
  "The contributor represents that he has disclosed the existence of any proprietary or intellectual property rights in the contribution that are reasonably and personally known to the contributor."

- **I.e., if you know of a patent application for a technology you are contributing, you have to tell.**
  Or just shut up entirely!

54th IETF: ROHC WG Agenda, 1(3)

0900 - Chair admonishments and agenda   Bormann (10)

0910 - WG and document status update   Jonsson (10)

0920 - Signaling compression
    0920 - User guide   Price (15)
    0935 - Static Dictionary for SIP/SDP   Bormann (10)
    0945 - Next steps   Bormann (5)

54th IETF: ROHC WG Agenda, 2(3)

0950 - ROHC RTP, Draft Standard preparations

0950 - ROHC architecture document	Jonsson (5)
0955 - MIB	Quittek (10)
1005 - A ROHC profile for IP only	Jonsson (5)
1010 - Implementer's guide	Jonsson (5)
1015 - Implementation status	Jonsson (5)
1020 - Way forward	Jonsson (10)

54th IETF: ROHC WG Agenda, 3(3)

1030 - Generic HC notation   **West (40)**

1110 - TCP profile   **Zhang (20)**

WG Status, Goals and Milestones 1(3)

- ✓ I-D on Requirements for IP/UDP/RTP header compression.
- ✓ I-D of layer-2 design guidelines.
- ✓ I-D(s) proposing IP/UDP/RTP header compression schemes.
- ✓ I-D of Requirements for IP/TCP header compression.
- ✓ Requirements for IP/UDP/RTP header compression submitted to IESG for publication as Informational.
- ✓ Requirements for IP/TCP header compression submitted to IESG for publication as Informational.
- ✓ Resolve possibly multiple IP/UDP/RTP compression schemes into a single scheme.
- ✓ Submit I-D on IP/TCP header compression scheme.
- ✓ IP/UDP/RTP header compression scheme submitted to IESG for publication as Proposed Standard.
- ✓ Possible recharter of WG to develop additional compression schemes

> ✓ DONE
> **LATE**
> **ONGOING**
> **TO DO**

WG Status, Goals and Milestones 2(3)

✓ **Jan 02** - Requirements and assumptions for signaling compression

✓ **Jan 02** - Signaling compression scheme submitted to IESG for publication as Proposed Standard, including security approach for SIP compression usage.

✓ **Jan 02** - Layer-2 design guidelines submitted to IESG for publication as Informational.

- **Apr 02 - LLA mapping examples submitted to IESG for publication as Informational.**

❑ **Apr 02 - I-Ds of ROHC IP/UDP/RTP bis, framework and profiles separated.**

❑ **May 02 - ROHC MIB submitted to IESG for publication as Proposed Standard.**

- **Aug 02 - ROHC UDP Lite schemes submitted to IESG for publication as Proposed Standard.**

✓ DONE
LATE
ONGOING
TO DO
❑ DS related

WG Status, Goals and Milestones 3(3)

❑ **Sep 02 - ROHC IP/UDP/RTP schemes submitted to IESG for publication as Draft Standard.**

• **Sep 02 - Requirements for IP/TCP compression submitted to IESG for publication as Informational.**

❑ **Sep 02 - ROHC framework submitted to IESG for publication as Draft Standard.**

• **Sep 02 - IP/TCP compression scheme submitted to IESG for publication as Proposed Standard.**

• **Dec 02 - Requirements for IP/SCTP compression submitted to IESG for publication as Informational.**

• **Dec 02 - IP/SCTP compression scheme submitted to IESG for publication as Proposed Standard.**

• **Dec 02 - Possible recharter of WG to develop additional compression schemes.**

> ✓ **DONE**
> **LATE**
> **ONGOING**
> **TO DO**
> ❑ **DS related**

Document status update, 1(2)

- **Published:**
  - **RFC 3095: Framework and four profiles
    (was: draft-ietf-rohc-rtp-09.txt)**
  - **RFC 3096: RTP requirements
    (was: draft-ietf-rohc-rtp-requirements-05.txt)**
  - **RFC 3241: ROHC over PPP   NEW!
    (was: draft-ietf-rohc-over-ppp-04.txt)**
  - **RFC 3242: LLA RTP   NEW!
    (was: draft-ietf-rohc-rtp-lla-03.txt)**
  - **RFC 3243: 0-byte RTP requirements   NEW!
    (was: draft-ietf-rohc-rtp-0-byte-requirements-02.txt)**

Document status update, 2(2)

- **In RFC editor queue**
  - draft-ietf-rohc-sigcomp-07.txt
  - draft-ietf-rohc-sigcomp-extended-04.txt
  - draft-ietf-rohc-signaling-req-assump-06.txt

- **Tentatively approved by the IESG:**
  - draft-ietf-rohc-rtp-lower-layer-guidelines-03.txt
  - draft-ietf-rohc-rtp-lla-r-mode-02.txt

- **Submitted to IESG (passed IESG last-call):**
  - NONE!

SigComp

User Guide

Richard Price

(richard.price@roke.co.uk)

SIEMENS

Overview of User Guide

- Informational companion to SigComp RFC

- Guidelines for implementation decisions at compressor

  - Choice of compression algorithm

  - Optional SigComp-specific enhancements

  - Bytecode for corresponding decompressor

- Other useful information for implementers

  - Test message sequences

  - Hints on optimising performance

  - Worked examples to clarify SigComp RFC (if needed)

  - Pointers to additional resources such as example code

Mnemonic Language

- Simplifies the creation of new UDVM bytecode

```
:input_bit_order          .pad 2
:decompressed_pointer     .pad 2

.align 64

:udvm_memory_size = 8192
:state_length = udvm_memory_size – 64

MULTILOAD (64, 4, circular_buffer,
udvm_memory_size, 0, circular_buffer)
```

Padding

Labels

Instructions

- Several minor open issues related to mnemonic language
    - Parsing method (line-oriented vs. terminating symbol)
    - Forward-referencing of labels
    - Trade-off between complexity and functionality

3

Compression Algorithms

- User Guide gives bytecode for a number of algorithms
    - LZ77
    - LZSS
    - LZW
    - DEFLATE
    - LZJH
    - EPIC
- Each algorithm offers different benefits and drawbacks
    - Compression ratio
    - Processing and memory requirements
    - Code size and implementation complexity
    - IPR considerations

SIEMENS

SigComp-Specific Enhancements

- Mechanisms specific to the SigComp environment
    - Techniques for providing robustness
    - Methods for improving the compression ratio
- User Guide gives bytecode for several such mechanisms
    - Acknowledging a state item
    - Static dictionary
    - CRC checksum
    - Announcing additional resources
    - Shared compression
- Mechanisms are add-ons for a compression algorithm
    - All of the above mechanisms can be used in parallel

Next Steps

- Resolve the open issues
    - Syntax and scope of mnemonic language
    - Any other issues?
- Add any useful topics not already covered
    - Taking advantage of extra resources at decompressor
    - Complete test message flows
    - Bytecode to test UDVM error handling
    - Hints for optimising implementation performance
    - Pointers to additional resources
    - Adapting SigComp for new environments
    - Any other topics?

Static Dictionary for SIP/SDP (1)

- **Most likely strings in SIP/SDP exchanges**

- **Useful for LZ77 and LZ78 based compressors**
  - **3855 bytes of Strings (combined)**
  - **offset/length table: 1410 bytes (3 * 470)**

- **Partitioned into 5 *priorities***

- **STATE-ACCESS (%ps, 6, 0, 0x0F0F, %sa, 0),**
  - **%ps points to UDVM memory containing 0xc7b611506144**
  - **Can also access subsets (e.g., prio 1 = 171 bytes)**

- **draft-ietf-sipping-sigcomp-sip-dictionary-03.txt**

Static Dictionary for SIP/SDP (2)

To do for –04:

- **Track recent SIP document changes**

- **Find a way to accommodate P-Headers**

  Proposal: Just put in "words":

  - **[CRLF]P-**

  - **Access-, Associated-, Called-, Charging-, Function-, Party-, Visited-, Network-**

  - **Adresses:[SP], URI:[SP], ID:[SP], Info:[SP], Vector:[SP]**

- **(State id will continue to change until publication)**

SigComp: next steps

- **Clarify sigcomp integration into SIP**
  - **draft-camarillo-sip-compression-01.txt**
  - **How to obtain a sip:cabo@tzi.org;comp=sigcomp URI?**
  - **May need to invent another DHCP option for SIP (☹)**
  - **Discuss at SIP meeting 1300-1500 today**
- **Do an Interop**
  - **Lots of informal interop around sigcomp user guide**
    - Fairly good confidence on UDVM interoperability
    - Need to complete test set with less likely cases, though
  - **Interop still needed for SIP integration**
    - Virtual interop?

ROHC RTP, Draft Standard preparations

- **RFC 3095 published in July 2001, its time for DS**
- **Interoperability**
- **MIB**
- **Framework vs. Profiles separation**
- **IP profile**
- **Clarifications**

The ROHC architecture document, 1(2)

- *draft-jonsson-rohc-architecture-00.txt*
- **Simplify ROHC understanding, MIB development and implementation**
- **Identify ROHC entities and relationships**
- **Establish common terminology**
  - **ROHC compressor and decompressor instances**
  - **ROHC channels and ROHC feedback channels**
  - **etc**
- **Clarify ROHC feedback**

The ROHC architecture document, 2(2)

- *PLEASE READ IT AND COMMENT!!*

- The document will be updated based on received comments and made available as a WG draft during August

- Unclear whether this should be a separate RFC or included in the ROHC framework Draft Standard

- The ROHC MIB will refer to the architecture

ROHC-MIB-RTP

<draft-ietf-rohc-mib-rtp-02.txt>

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Overview

- New MIB structure: 2 MIB modules
  - Generic ROHC-MIB: instance, channel
  - RTP-specific ROHC-RTP-MIB: compressor/decompressor context
- Revision of statistics
- Open Issues
  - Cutting line between MIB modules
  - Are the statistics appropriate?
  - Compliance with architecture I-D
  - Conformance

New MIB Structure
4 Object Groups in 2 MIB modules

- **ROHC-MIB**

  - **Instance group (`rohcInstanceGroup`)**
    - running instances, used IP interfaces
  - **Channel group (`rohcChannelGroup`)**
    - used channels, supported decompressor profiles

- **ROHC-RTP-MIB**

  - **Compressor context group (`rohcCompressorGroup`)**
    - compressor properties and statistics
  - **Decompressor context group (`rohcDecompressorGroup`)**
    - compressor properties and statistics

Issue Concerning the Separation

- **Shall we move the table of supported profiles into the RTP module?**
  - **Profiles are references by their number**
    - **Will profile numbers be unique among different ROHC technologies?**

Changes in Statistics (1)

- **Removed statistics group**
  - **Moved table of outgoing packet counters to compressor**
  - **Moved table of incoming packet counters to decompressor**
  - **Moved table of error counters to decompressor**

- **Statistics per channel: 6 counters**
  - **total number of de/compressed flows**
  - **number of de/compressed current flows**
  - **number of de/compressed packets**

Changes in Statistics (2)

- **Statistics per compressor:**
  - **total compression ratio**
  - **total mean size**
  - **current (last 16 packets) compression ration**
  - **current (last 16 packets) means size**
  - **number of packets, IRs, IR-DYNs**
  - **number of ACKs, NACKs, SNACKs**
- **Statistics per decompressor:**
  - **number of decompressor failures**
  - **number of context repairs**
  - **number of packets, IRs, IR-DYNs**
  - **number of ACKs, NACKs, SNACKs**

List of Open Issues

- **Which is the right cutting line between the general and the specific MIB module?**
- **Are the statistics OK?**
  - **Mean compressed packet size or mean compressed header size, or both?**
  - **PLEASE PROVIDE YOUR INPUT**
- **Compliance with architecture I-D**
  - **several differences, to be harmonized**
  - **replace section on architectural assumptions by a reference to Lars-Erik's text**
- **MIB conformance statements**
  - **Are statistics mandatory or optional?**

Is anyone planning
to implement the MIB?

A ROHC profile for IP only, 1(2)

- **RFC 3095 defines profiles for Uncompressed, IP/UDP, IP/UDP/RTP and IP/ESP**
- **People have asked for a profile for compression of IP only, which sounds like a reasonable request**
  - ▪ **Useful for simplified ROHC implementations**
  - ▪ **Can be used for transports not supported by ROHC**

- ***draft-jonsson-rohc-ip-only-00.txt***
- **Similar to the IP/UDP profile, basically the same with the UDP part excluded**
- **Technical content less than one (1) page !!!**

A ROHC profile for IP only, 2(2)

- **Issues:**
  - **Is the termination point clear?**
  - **CRC does not cover the sequence number, is that a problem?**
    - Issue applies also to the ROHC UDP profile
    - Should not be a problem (?)
- **What now:**
  - **Add to charter**
  - **Recycle to address issues raised and turn it into a WG draft**
  - **Issue WG last-call**
  - **Submit for publication as Proposed Standard**
- **Goal:**
  - **Have the IP profile included in the profiles part of RFC3095bis**

ROHC RTP implementer's guide

- **Minor modifications since last version, based on mail list discussions**

- **Scope of the document**
  - **Clarifies RFC 3095**
  - **Exception: Provides enhanced mode transitions, compatible with the ones described in RFC 3095. No protocol change!!**

- **What's next**
  - **Most (all?) content will go into RFC3095bis**
  - **Will stay as an Internet Draft until the DS work is completed**

ROHC RTP implementation status, 1(2)

- **Three interoperability test events have been held**

- **Achievements at "Arctic ROHC", Luleå, May 2002**
  - Participants from Effnet, Ericsson, Nokia, Panasonic and RokeManor/Siemens
  - Tests carried out between almost all parties
  - First IPv6 tests successfully performed
  - "ROHC over PPP" tested (last night hotel room trial)

ROHC RTP implementation status, 2(2)

- **Another interop in November? No host yet...**

- **Encourage new parties to join**
  - ROHC interop participants mail list

- **RFC 3095 test document**
  - Specify test cases
  - Collect interoperability test status

ROHC RTP DS, next steps

- **Finalize the IP profile (Proposed Standard)**
- **Finalize the architecture document (Informational?)**
- **Finalize the MIB (Proposed Standard)**
- **Produce an initial version of the test list document**
- **Get the next interop scheduled**
- **Produce an "RFC3095 surgery plan"**

ROHC Generic/Formal Notation(s)

Mark West

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What's the point?

- The aim is to allow us to capture the behavior of a protocol stack in a generic way

- This description can be used as the basis for generating the compressed header formats

- Because this generation process can be automated, we can think about compression at a higher level

- So, how does it work..?

Describe compressing a header…

9 4	8 1	2 A 0 0
9 C 0 6		8 8 0 a
d e a d b e e f		

Identify the fields

| 9 4 | 8 1 | 2 A 0 0 |

| 9 C 0 6 | | 8 8 0 a |

| d e a d b e e f |

Generate meta-data

NBO?

9 4	8 1	2 A 0 0

1

9 C 0 6	8 8 0 a

d e a d b e e f
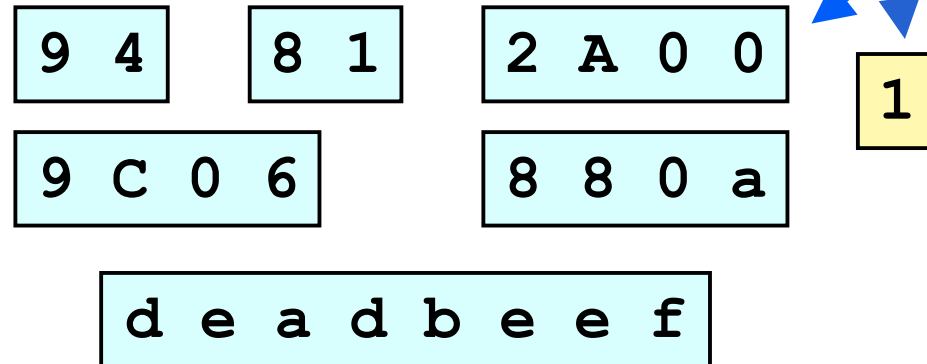
Identify field relationships
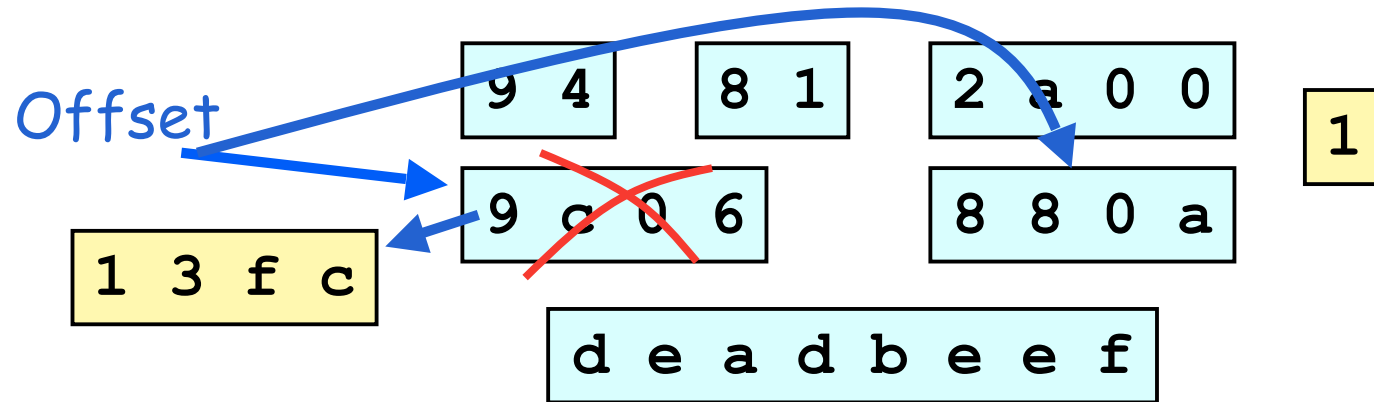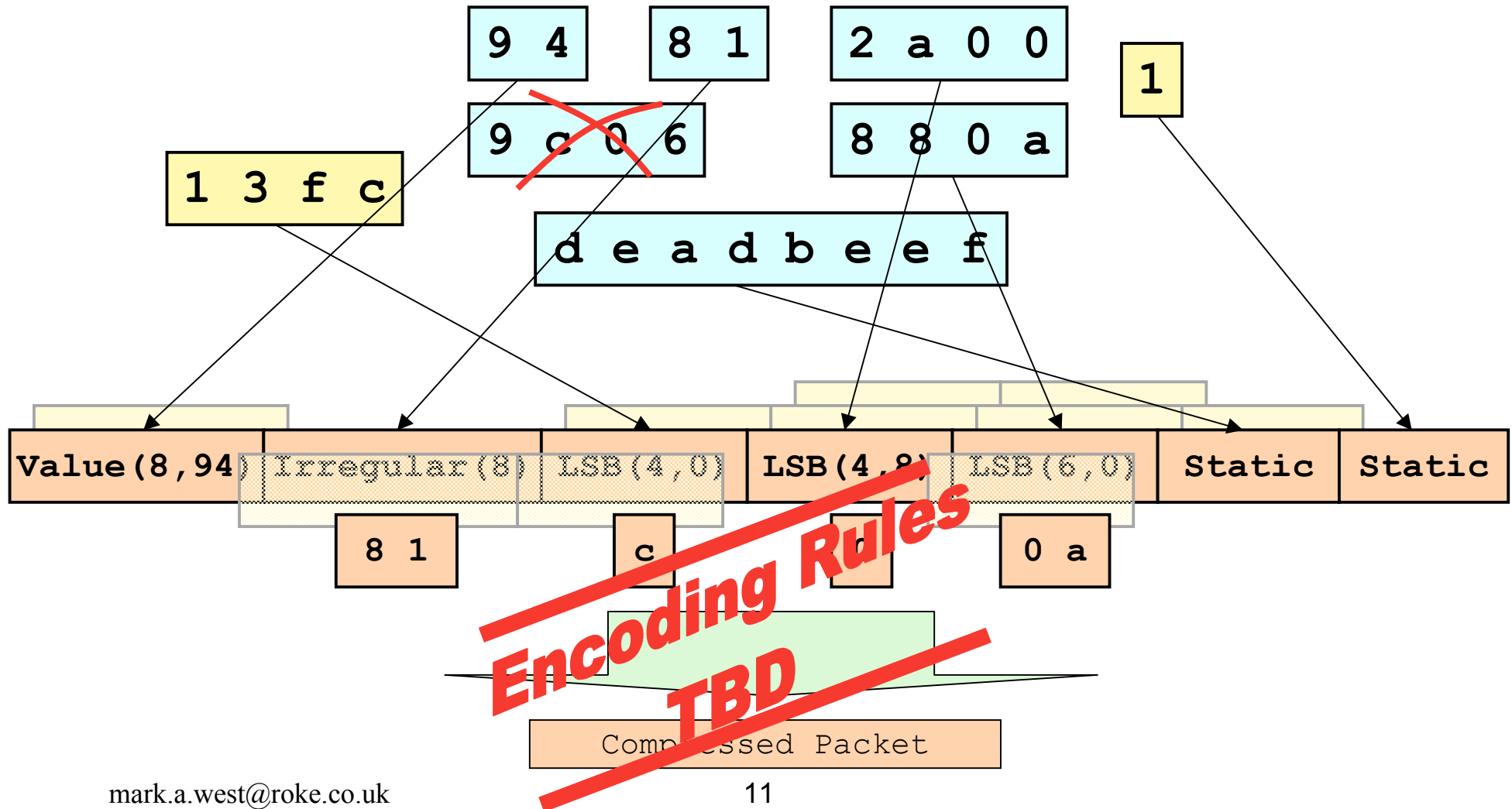
Choose encodings…
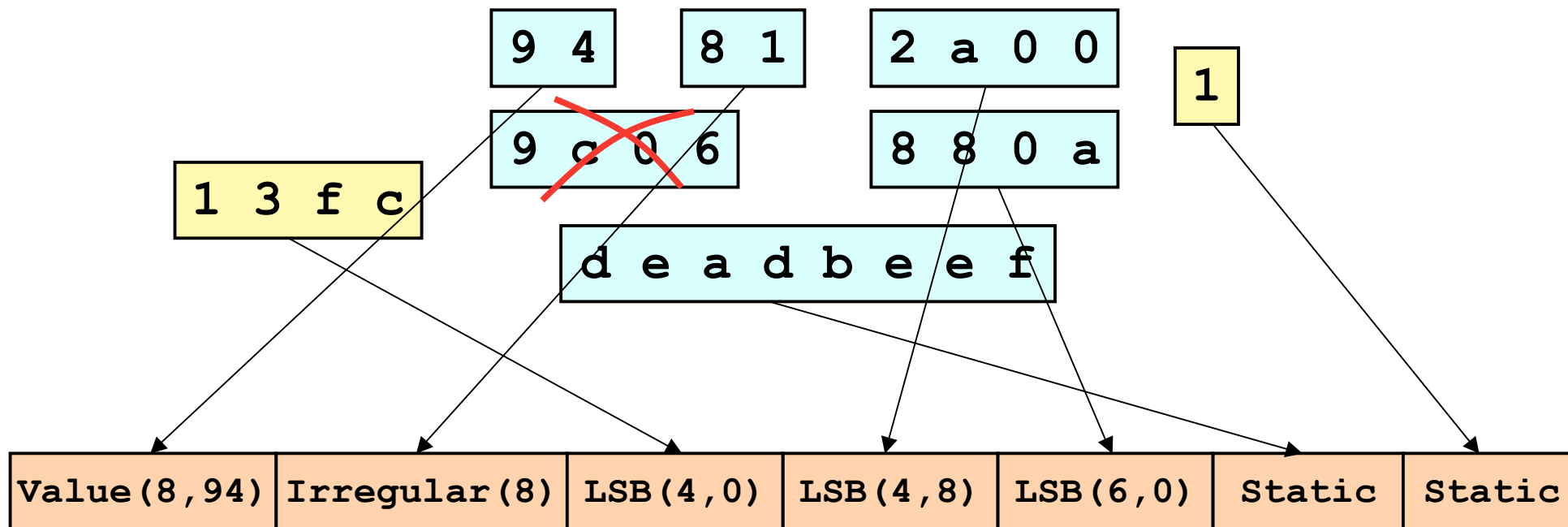
… from available set
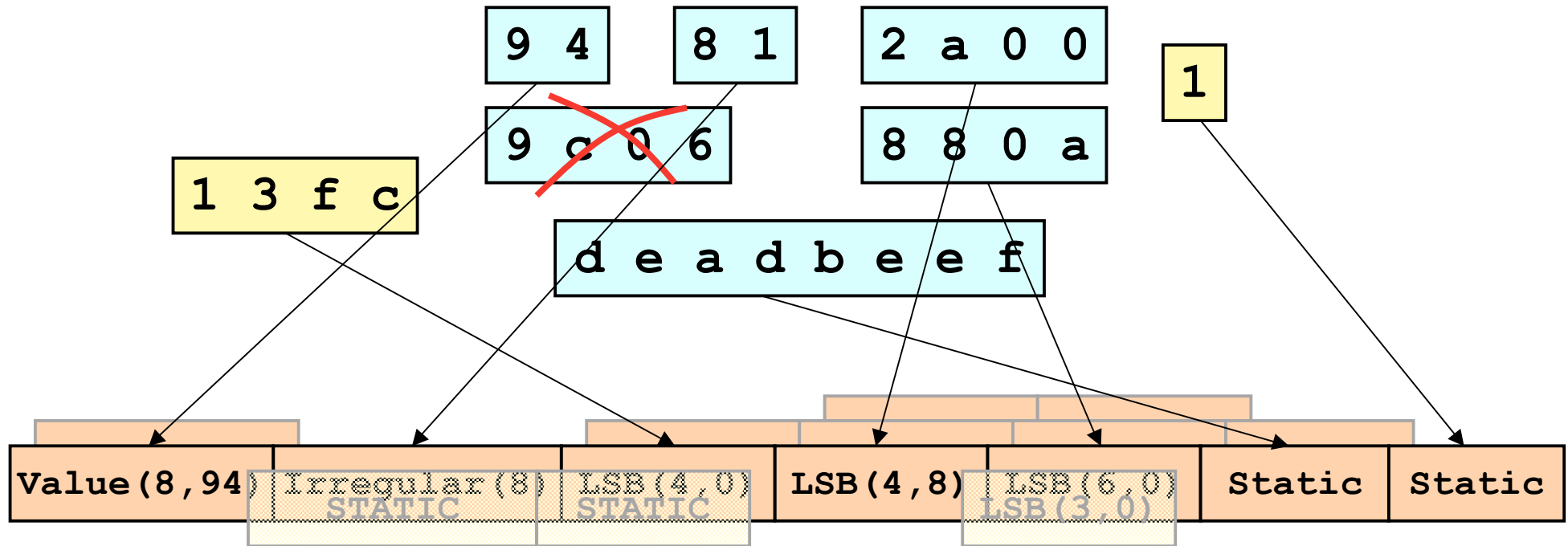
Generate bits for encoding
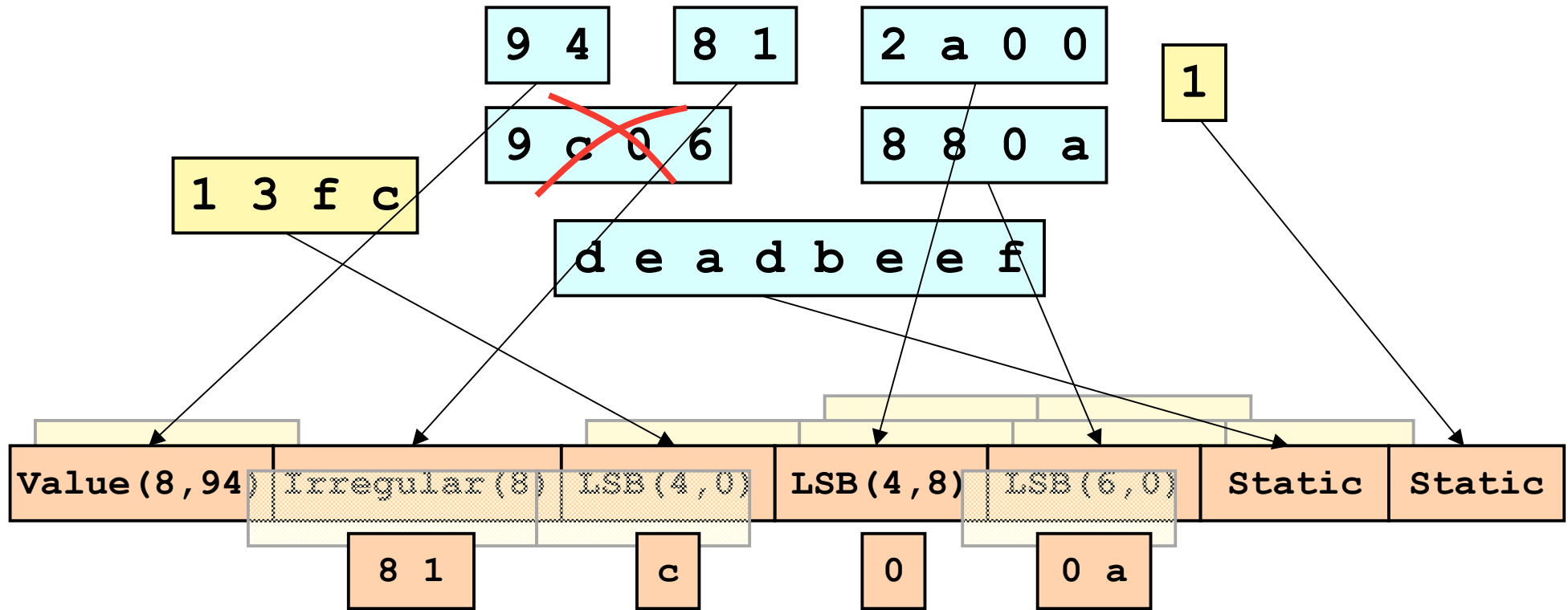
Encode packet
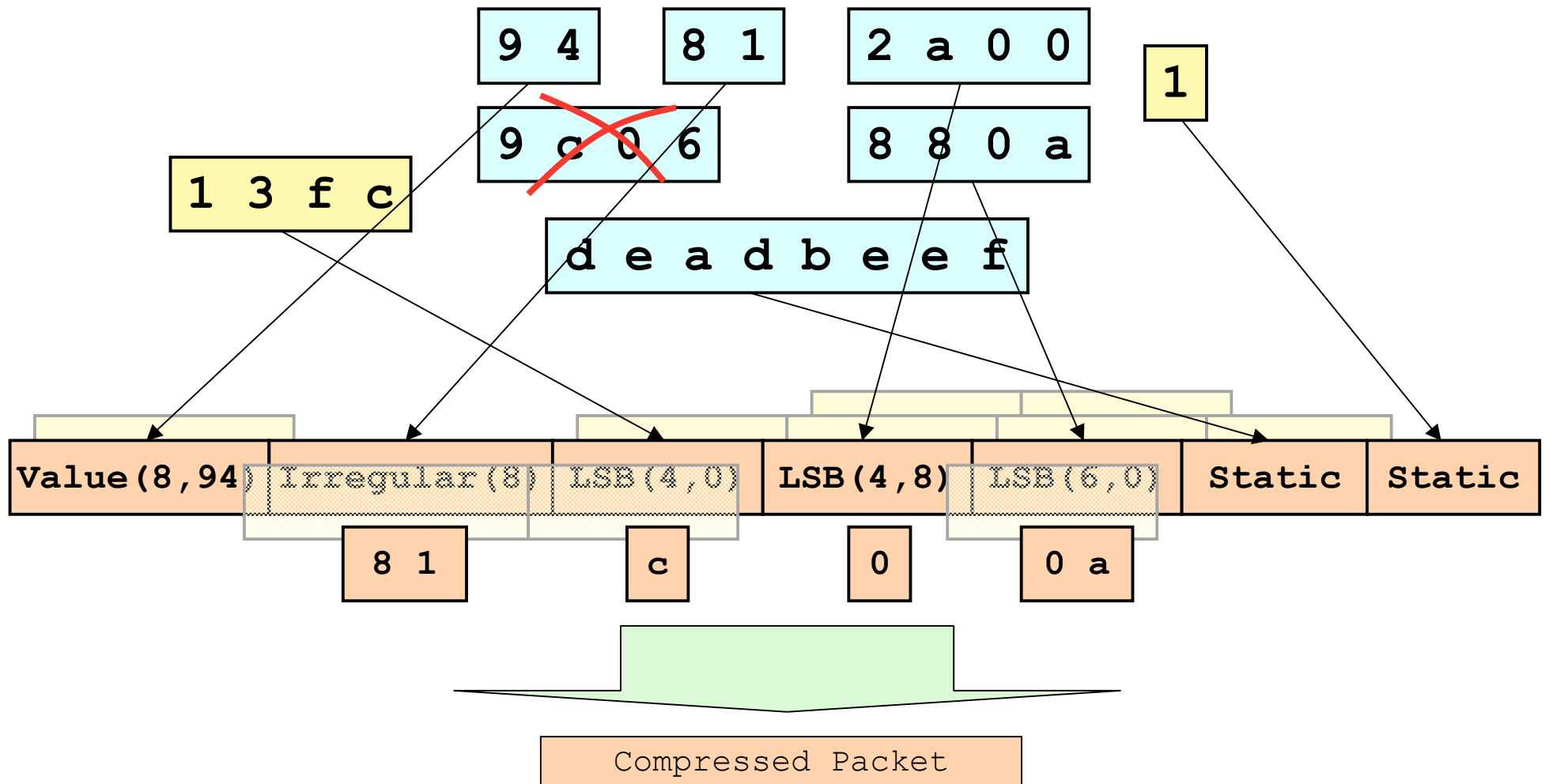
(once we have encoding rules!)

What does the notation look like?

- Generally converged on a BNF-like form
- So previous example could use notation such as:

```
F1 = VALUE(8,94,80%) |
     VALUE(8,12,20%)

F2 = STATIC(90%) | IRREGULAR(8,10%)

F3 = STATIC(50%) | LSB(4,0,30%) |
     IRREGULAR(16,20%)

F4 = LSB(4,8,60%) | LSB(10,512,35%) |
     IRREGULAR(16,5%)

F5 = STATIC(99%) | IRREGULAR(32,1%)

F6 = STATIC(99%) | IRREGULAR(1,1%)
```

What's in the notation?

- What should the notation capture?

  - *Structure* of the packet
    (i.e. splitting it into fields)

  - *Identification* and *generation* of meta-data
    (typically the 'always 100%' rules, e.g. INFERRED-
    OFFSET, SCALE, NBO, …)

  - *Selection* of encoding methods
    (is the field encoded as STATIC, LSB, IRREGULAR,
    VALUE, …)

- The last is a given, but the others have been disputed…

And how many are there?

- If there is more than one aspect of compression represented in the notation, should these:
    - *Combined* into a single, unified notation
    - *Separate*, with separate notation for each component

Some discussion points…

- *Put everything in the notation?*
    - More to standardise
    - Easier to ignore unnecessary data than invent missing…
- *Combined notation?*
    - Makes for quite 'dense' description
    - All information readily to hand
- *Separate notation?*
    - Potential for redundant information
    - Information can be used separately, where you want it

Do you want fries with that?

- Side issue on encoding-rule dependence
- Probabilities are included in encoding methods
    - So what?
    - Completely unnecessary for compression processing!
    - But essential for building efficient compressed packet formats
- May be other information…
    - Desirable for some encoding rules
    - But cannot guarantee that it is universally useful
- Accept that the notation will contain 'hints' for the encoding rules

Encoding rule dependence

- Rule of thumb:

"If a parameter can be ignored by any
set of encoding rules then it is ok.

If it is too suggestive or restrictive to a particular way
of doing things, then it should not be used…"

- The more general, the better
- So, we prefer 'probabilities' over 'indicator bit length', for example…

Other secondary issues…

- Revisit previous discussion point (e.g. use of stack or alternative methods)

  - This depends upon the outcome of the previous discussion topic

- Ongoing discussion about required/useful set of compression methods

  - Various forms of LIST, for example

  - Probably prudent to decide overall form of notation first

  - Especially with constructs such as LIST which affect structure and encoding

Oh yes, about the encoding rules…

- 3 days of testing by RMRL / FESB Uni. Split in May
- Successfully built interoperable (i.e. identical!) packet formats for a set of different protocol descriptions
  - TCP, RTP, SCTP
- Also used protocol description to parameterise compressor and decompressor
  - Large number of compression methods tested (STATIC, IRREGULAR, LSB, NBO, SCALE, INFERRED-SIZE, INFERRED-IP-CHECKSUM, INFERRED-OFFSET, …)
- Successful test flows included
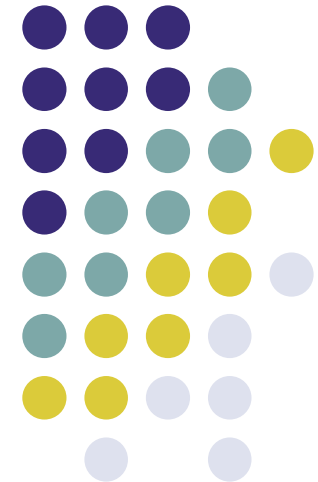 - RTP (as used in ROHC-RTP testing)
  - TCP (including some options)

So, what's the answer
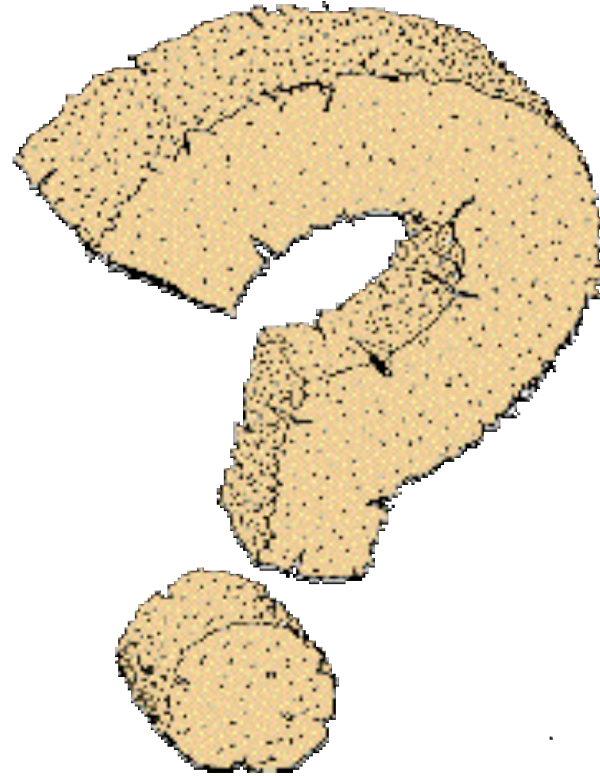
ROHC-TCP: TCP/IP Header Compression for ROHC

Qian Zhang

Microsoft Research

Requirements

- Requirements are stable
- Most important issues had been discussed
- Rest issues are related to the concrete profile presentation
  - IPv6 support
  - Tunnel headers

TCP behavior

- Basically the behavior of each field had been analyzed in the document
- Some observations had been given
  - Short-lived transfers
  - Implicit acknowledgement
  - Master sequence number
  - Shared data
- The detail analysis about the replicable header fields tend to be added/integrated into the document
- Need to work more on mapping the behavior into a profile

ROHC-TCP Update

- Agreements
  - Context replication for short-lived transfers
  - Packet feedback issue
  - Mode transition issue

- Disagreements
  - None. (Great! ☺)

- Open discussions
  - Is mode transition necessary?

- Next step
  - Generic notation

Context Replication for Short-Lived Transfers (1)

- Two scenarios
  - Multiple connections between one mobile terminal and the same server simultaneously or near simultaneously
  - Multiple connections between one mobile terminal and different servers simultaneously or near simultaneously

Client

Base Statior

Internet

Server

Client

Base Statior

Internet

Server 1

Server n
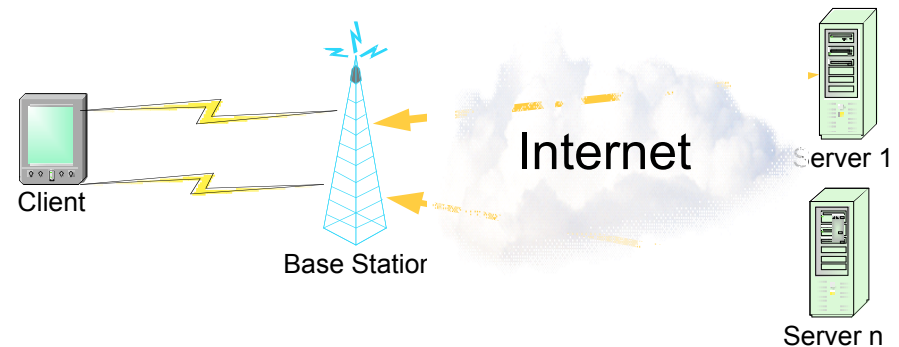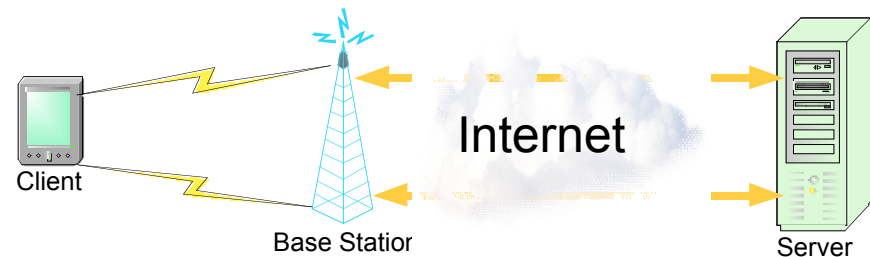
Context Replication for Short-Lived Transfers (2)

- Context replication can be considered as the mechanism which establishes a context based on another valid base-context already created
  - reduce the overhead of context establishment
- Criteria for base context selection
  - choose only the one in FO/SO state and acknowledged by the decompressor

Context Replication for Short-Lived Transfers (3)

- The operation during a context replication:
  - During the context establishment of a context (in IR state), each time an IR/IR-DYN need to be transmitted the compressor will send IR-REPLICATE if there are base context available
  - When the decompressor receives IR-REPLICATE packets, it will decompress it and send feedback accordingly

MSN-based Feedback

- ROHC-TCP introduces a control field called the Master Sequence Number (MSN) field.
  - there is no obvious candidate for a 'master sequence number' in TCP
  - support for re-ordering of compressed packets would require a sequence number external to the compressed packet
- MSN is only required to allow a decompressor to acknowledge packets in B-mode.
  - Such a sequence number would not be required for every packet.
  - This field is present in every m compressed header. The value of m is chosen for the best trade-off between compression efficiency and the acknowledging efficiency.
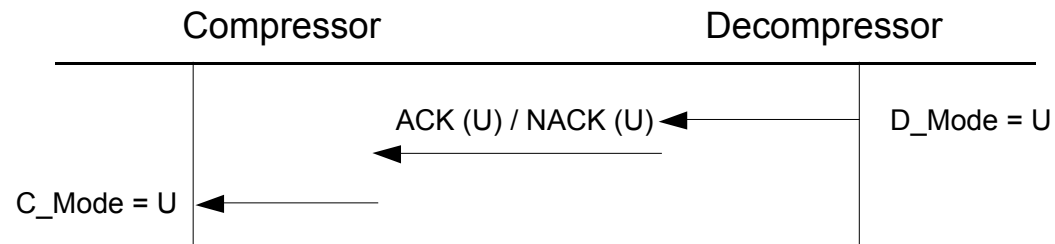
Mode Transitions

- Uniformed packet format for U-mode and B-mode
  - Simple transition between U and B modes
- Transition to Bidirectional mode

Compressor		Decompressor
	ACK (B) / NACK (B) ←	D_Mode = B
	←	
C_Mode = B ←		
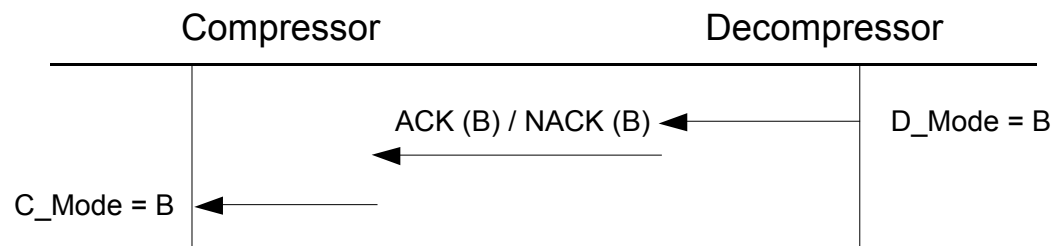
- Transition to Unidirectional mode
  - Timeout for feedback lost

Compressor		Decompressor
	ACK (U) / NACK (U) ←	D_Mode = U
	←	
C_Mode = U ←		

Open Discussions

- Is it necessary to have mode transition?
  - We can blur the mode transition concept
  - Another issue: Should we still have two modes in the state machine?
    - Still need those two modes to make the process of state machine control more clearly
  - A simple way is keep the U/B modes and the mode transition

Next Steps

- Wait for the generic notation for writing the profile
    - What will be the notation looks like?
- May write the basic profile based on the two drafts for the notation