ROHC IMPLEMENTATION COMPATIBILITY

JONATHAN GRAEFE NETWORKS AND SYSTEMS ENGINEER

Collins Aerospace

ROHC

- ROHC – Robust Header Compression (RFC 5795, 5225, 2460, 4995, 3843)
- Concept is most of the IP and UDP headers do not change from one packet to the next, so rather than repeat the redundant information for every packet, simply send a reference ID shared between the compressor and decompressor, allowing the decompressor to replace the static information back into the packet.
- Reduces the overhead signaling for IP/UDP packets over the RF.
- Can be expanded to include TCP/IP, RTP/UDP/IP, UTPLite/IP, etc.
- Currently used by 4G LTE and 5G Cellular Networks
- Can approach 98% effective header compression in ideal situations

ROHC EXAMPLE COMPRESSION

IPv6 (40 Bytes)

Version	Traffic Class	Flow Label	Payload Length	Next Header	Hop Limit	Source Address	Dest Address

UDP Header (8 Bytes)

Source port	Dest port	Length	Checksum

ROHC Compressed

RFC 3843

ROHC Example Header (1 Byte)

Flag	Sequence Number	CRC
1 Bit	4 Bit	3 Bit

This example is 98% header compression

Collins Aerospace

THE EXPERIMENT

- Using two different implementations of ROHC, one representing the aircraft the other the ground. Prove that ROHC compression is still possible.
- Selected ROHC-Lib and didier-barvaux rohc.
  - ROHC-Lib was selected because it has a known non-critical bug. ROHC-lib forces K and N values to be the same, effectively forcing an error message for every missed decompression.
  - Didier-barvaux chosen because it is a more robust implementation of ROHC
- We ran the experiment 3 ways:
  - ROHC-lib on ground and aircraft
  - ROHC-lib on ground with aircraft running Didier-barvaux
  - Didier-barvaux on ground with aircraft running ROHC-Lib

EXPERIMENT PARAMETERS

- IP address of Aircraft and ground randomized for every run
- Packets exchanged per simulation
  - 1 million to represent convergence values.
  - 100 packets to represent a more realistic scenario.
- Simulations ran several times to verify similar results
- The Layer 2 transmission media is imperfect and fails to catch some bit errors.
- Layer 3 BER of 1x10^-4 after compression or one out of every 10,000 packets has at least one bit flipped.
  - Realistically this consistent error rate, would cause suspicion that an offending signal is interfering with safety of flight transmissions.
- Assume both Aircraft and Ground seek to reach ROHC optimistic mode as quickly as possible.

RESULTS

- Two different ROHC implementations can communicate with each other
- Compression ratio stayed the same, regardless of implementation
- Bit errors did cause some degradation in average packet compression gain, this was due to retransmissions, however this only caused a 4% decrease from theoretical in header compression gain.
- Header Compression:
    - Header compression reached 94% in all million packet examples
    - Header compression reached 92% in all 100 packet examples
- In general, the first packet had no compression (Initial state), the second and third had 79% compression (Reliable mode) and all remaining packets approached 94% compression (Optimistic mode)
- Total packet compression (Data + Header): 12-13%
- Average Data size 533 Bytes (Packet length generated randomly)

CONCLUSIONS

- Header compression was possible using mixed implementations of ROHC RFCs
- Given slightly worse than expected normal conditions:
  - 93 - 94% header compression was possible with all implementations
  - 12-13% total packet compression was possible given unusually large average packet size.
- Total Packet compression will be higher with smaller packets.
- Total header compression should go higher with less noise at Layer 3.
- 10X-4 BER at layer 3 is higher than expected if the Layer 2 CRC and integrity checks worked as expected.
- ROHC is possible in the aviation environment with different implementations and will yield 90%+ header compression in less-than-ideal conditions.

RESULTS ROHC-LIB ONLY

BOTH GROUND AND AIR USE ROHC-LIB

- Total Packet Count 1,000,000
- Packet Failed count 2250
- Total Bytes transmitted 526,735,474
- Total Bytes Failed 1,154,286
- Compressed Data loss rate: 2.19X10-3
- Average Header Compression Gain: 94%
- Average Packet Compression Gain: 12%

- Total Packet Count 100
- Packet Failed count: 0
- Total Bytes transmitted: 50587
- Total Bytes Failed: 0
- Compressed Data loss rate: 0
- Average Header Compression Gain: 92%
- Average Packet Compression Gain: 13%

ROHC-LIB AND DIDI

AIR USES ROHC-LIB AND GROUND USES DIDI

- Total Packet Count 1,000,000
- Packet Failed count 2282
- Total Bytes transmitted 526,528,741
- Total Bytes Failed 1,193,598
- Compressed Data loss rate: 2.27X10-3
- Average Header Compression Gain: 94%
- Average Packet Compression Gain: 12%

- Total Packet Count 100
- Packet Failed count: 0
- Total Bytes transmitted: 52855
- Total Bytes Failed: 0
- Compressed Data loss rate: 0
- Average Header Compression Gain: 92%
- Average Packet Compression Gain: 13%

DIDI AND ROHC-LIB

AIR USES DIDI AND GROUND USES ROHC-LIB

- Total Packet Count 1,000,000
- Packet Failed count 2287
- Total Bytes transmitted 526,720,699
- Total Bytes Failed 1,200,287
- Compressed Data loss rate: 2.28X10-3
- Average Header Compression Gain: 94%
- Average Packet Compression Gain: 12%

- Total Packet Count 100
- Packet Failed count: 0
- Total Bytes transmitted: 51729
- Total Bytes Failed: 0
- Compressed Data loss rate: 0
- Average Header Compression Gain: 92%
- Average Packet Compression Gain: 13 %