

BANANA  
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BANDwidth Aggregation for interNet Access (BANANA)  
The Data Plane of Bonding Tunnels  
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## Abstract

This memo specifies the encapsulation format for data packets of BANDwidth Aggregation for interNet Access (BANANA).

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[1.](#) Introduction

GRE tunnels are set up over heterogeneous connections between the local BANANA box and the remote BANANA box. These tunnels are bonded together to form a logic single connection for the subscriber. Each tunnel may be used to carry a user's IP packets as payload, which forms a typical IP-over-IP overlay.

This document adopts the GRE header with Key and Sequence Number extensions specified by [[RFC2890](#)]. The Protocol Type of the GRE header is either 0x0800 (listed as "0x800" in [[RFC2784](#)]) or 0x86DD [[RFC7676](#)], which indicates that the inner packet is either an IPv4 packet or an IPv6 packet, respectively. The GRE Key field is set to a unique value for the bonding GRE tunnels between two peering BANANA boxes. The GRE Sequence Number field is used to maintain the sequence of packets transported in all these GRE tunnels.

[2.](#) Acronyms and Terminology

GRE: Generic Routing Encapsulation [[RFC2784](#)] [[RFC2890](#)].

RTT: Round-Trip Time.

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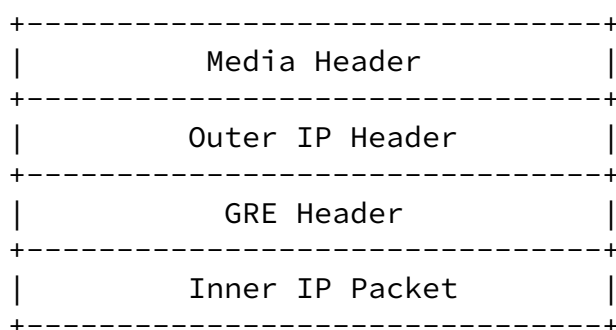
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The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC 2119](#) [[RFC2119](#)].

### [3.](#) Data Encapsulation

Users' IP (inner) packets are encapsulated in GRE packets that are in turn carried in IP (outer) packets. The general structure of data packets of the GRE Tunnel Bonding Protocol is shown below.



#### [3.1.](#) The GRE Header

The GRE header was first standardized in [[RFC2784](#)]. [[RFC2890](#)] added the optional Key and Sequence Number fields.

The Checksum and the Reserved1 fields are not used in this memo; therefore, the C bit is set to 0.

The Key bit is set to 1 so that the Key field is present. The Key field is used as a 32-bit random number. It is generated by the remote BANANA box per bonding connection, and the local BANANA box is notified.

The S bit is set to 1, and the Sequence Number field is present and used for in-order delivery (see [Section 4](#) and [[RFC2890](#)]).

The Protocol Type field in the GRE header MUST be set to 0x0800 for IPv4 or 0x86DD for IPv6. So, the GRE header used by data packets of BANANA has the following format:

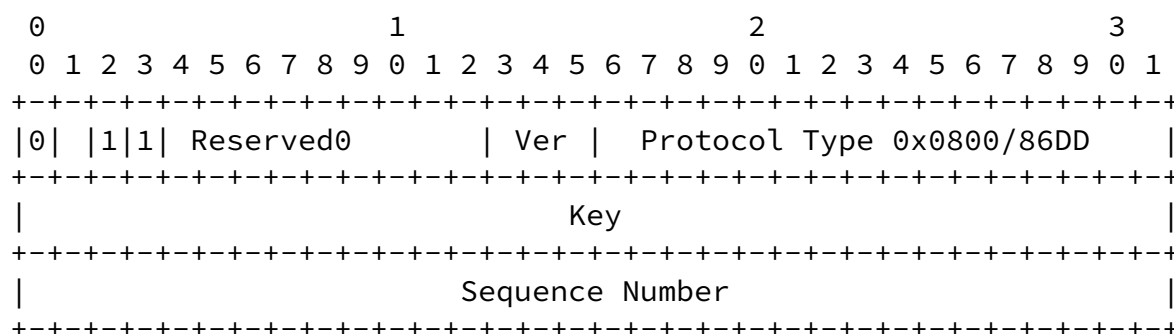


Figure 3: The GRE header for BANANA data packets

#### 4. The Reordering Buffer

The local or remote BANANA box generates sequence numbers to be carried by all incoming packets that need to be distributed into the tunnels. The receiver maintains a small reordering buffer and orders the data packets in this buffer according to the Sequence Number field [[RFC2890](#)] of their GRE header. Packets carried in GRE tunnels that are bonded to the same session (see [Section 5.2](#) of [BANANA-signaling]) enter the same reordering buffer.

Operators may configure the maximum allowed size (see MAX\_PERFLOW\_BUFFER in [[RFC2890](#)]) of the reordering buffer. They may also configure the maximum time (see OUTFORDER\_TIMER in [[RFC2890](#)]) that a packet can stay in the reordering buffer. The OUTFORDER\_TIMER must be configured carefully. Values larger than the difference of the normal Round-Trip Time (RTT) (e.g., 100 ms) of any two connections between the two BANANA boxes are not recommended.

Implementation and deployment experiences have demonstrated that there is usually a large margin for the value of MAX\_PERFLOW\_BUFFER. Values larger than the multiplication of the sum of the line rate of the two connections and the value of OUTOFORDER\_TIMER can be used.

## [5.](#) Security Considerations

As a security feature, the Key field of the GRE header of the data packets is generated as a 32-bit cleartext password. The local BANANA box and the remote BANANA box validate the Key value and the outer source IP address, and they discard any packets with invalid combinations.

See also the Security Considerations section of [[BANANA-signaling](#)] and [[RFC2890](#)].

## [6.](#) IANA Considerations

IANA need not assign anything for this memo. RFC editor: please

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remove this section before publication.

## [7.](#) References

### [7.1.](#) Normative References

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[BANANA-signaling]

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## 7.2. Informative References

[RFC7676] Pignataro, C., Bonica, R., and S. Krishnan, "IPv6 Support for Generic Routing Encapsulation (GRE)", [RFC 7676](#), DOI 10.17487/RFC7676, October 2015, <<http://www.rfc-editor.org/info/rfc7676>>.

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