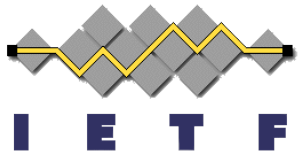
OSPF WG

Security Extensions for OSPFv2 when using Manual Keying



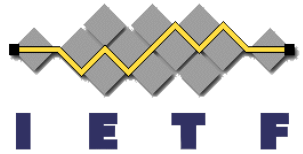
Manav Bhatia, Alcatel-Lucent

Sam Hartman, Painless security

Dacheng Zhang, Huawei

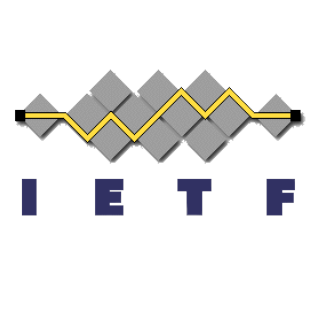
IETF 80, Prague

Current State of Security



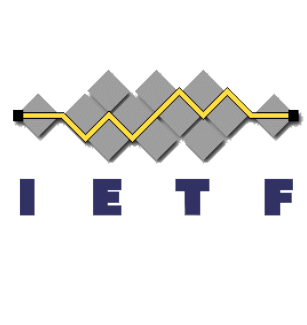
- OPSEC has published RFC 6039 that does an analysis on the vulnerabilities that exist in OSPFv2 despite it using the security and authentication mechanisms described in RFC 2328 and 5709
- draft-ietf-karp-ospf-analysis identifies certain gaps that remain between the current security state and those identified in draft-ietf-karp-threats-reqs

Gaps Identified



- Replay Protection
  - OSPFv2 uses Cryptographic Sequence numbers to prevent intra-session replay attacks
  - Does not help in protecting against inter-session replay attacks
- IP Header Unprotected
  - OSPFv2 uses the source IP to identify the neighbor in some cases
  - IPv4 Header is not protected by the authentication digest

So what does this draft do?

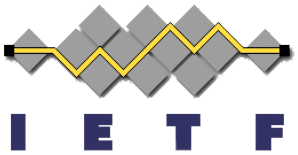


- It fixes the issues identified during the OSPFv2 gap analysis
- Proposes two mechanisms to prevent inter-session replay attacks
  - Extends the Authentication Sequence Number space
  - Introduces the concept of Session ID and Nonce
- Fixes the IP header issue by factoring in the source IP address when computing the crypto digest - thus attacks which change this, will not be successful now

Inter-Session Replay Attack

Router A

Router B



OSPF Hdr: Sequence Num = 10001
OSPF HELLO: Neighbor = B;

OSPF Hdr: Sequence Num = 50001
OSPF HELLO: Neighbor = A;

Router B goes down!

Router A accepts the packet and brings down the adjacency with B!

OSPF Hdr: Sequence Num = 1
OSPF HELLO: Neighbor = 0

OSPF Hdr: Sequence Num = 10010
OSPF HELLO: Neighbor = 0

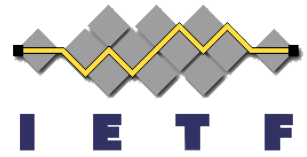
OSPF Hdr: Sequence Num = 2
OSPF HELLO: Neighbor = A

OSPF Hdr: Sequence Num = 10011
OSPF HELLO: Neighbor = B

OSPF Hdr: Sequence Num = 50000
OSPF HELLO: Neighbor = 0

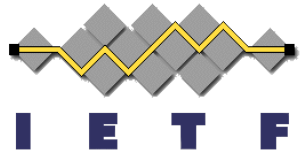
OSPF Hdr: Sequence Num = 10012
OSPF HELLO: Neighbor = 0

So how do we fix this? (1/2)



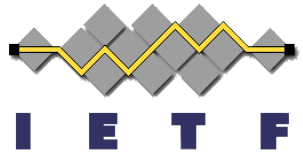
- OSPF authentication mechanism is stateless and oblivious to the session information
  - Router A for example doesn't remember that it once had an OSPF session with B and the last cryptographic sequence number seen from B was 50001
  - Highly un-scalable and also requires B to keeping updating the non-volatile memory each time it increments a sequence number so that it can continue from there.

So how do we fix this? (2/2)



- Change the crypto sequence number generation algorithm at the sender side so that it always generates an increasing number (for both planned and unplanned restarts)
- Implement some algorithm that guarantees freshness of packets
- We describe both in the draft

Changing the crypto sequence number algorithm

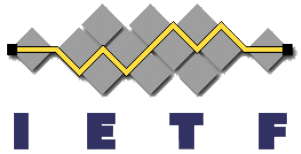


- Currently the sequence number is a 32-bit monotonically increasing entity
- Expand this to 64 bits where:
  - most significant 32-bits increment each time the router cold boots.
  - last 32-bits remain unchanged
- The final sequence number is a concatenation of the above two numbers

So does this help?

Router A

Router B



OSPF Hdr: Sequence Num = 0:10001
OSPF HELLO: Neighbor = B;

OSPF Hdr: Sequence Num = 10:50001
OSPF HELLO: Neighbor = A;

Router B goes down!

Router A rejects this as sequence number < 11:2

OSPF Hdr: Sequence Num = 11:1
OSPF HELLO: Neighbor = 0

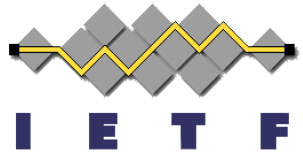
OSPF Hdr: Sequence Num = 0:10010
OSPF HELLO: Neighbor = 0

OSPF Hdr: Sequence Num = 11:2
OSPF HELLO: Neighbor = A

OSPF Hdr: Sequence Num = 0:10011
OSPF HELLO: Neighbor = B

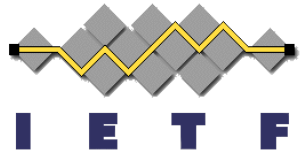
OSPF Hdr: Sequence Num = 0:50000
OSPF HELLO: Neighbor = 0

So where are we?



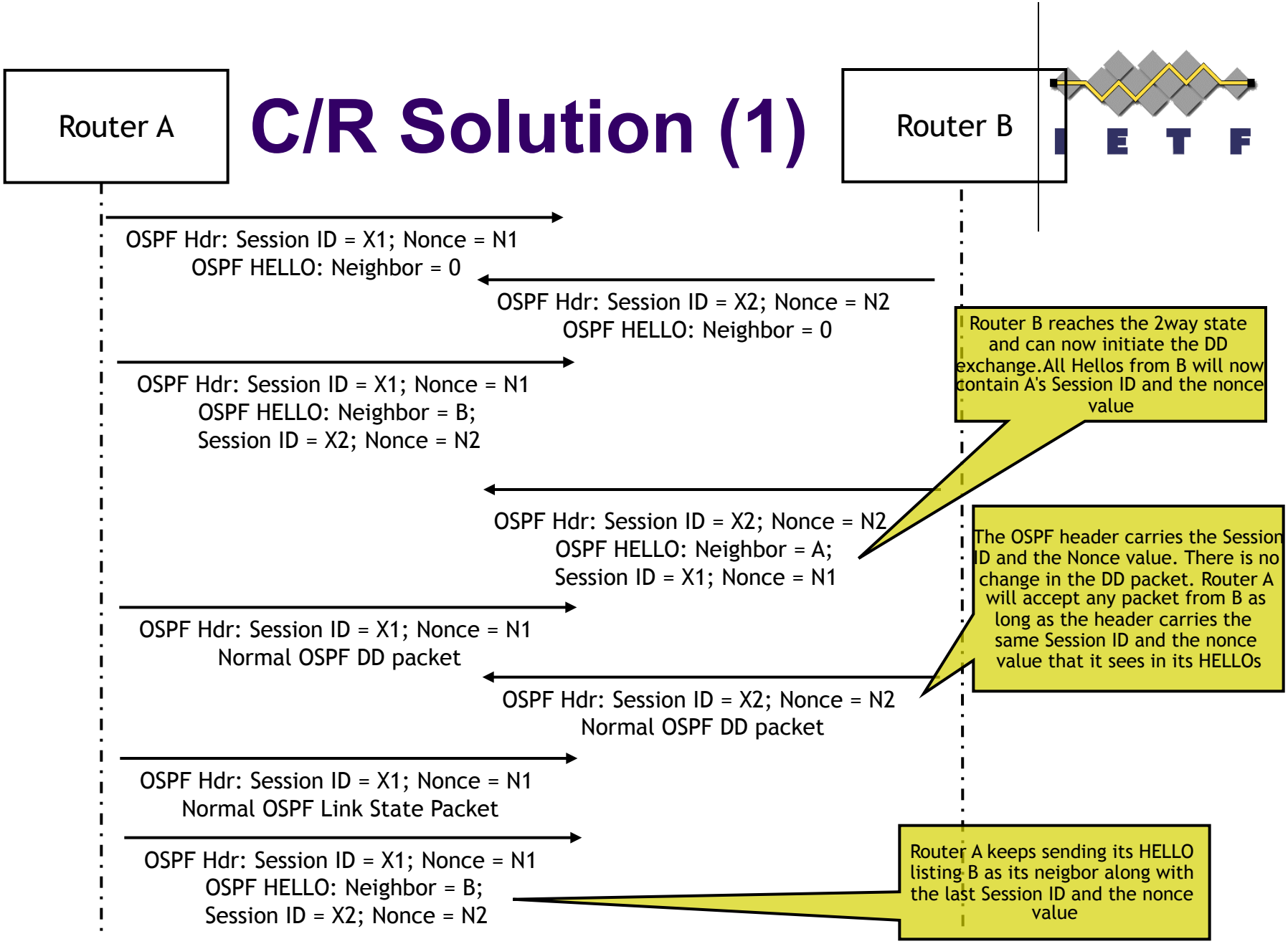
- We believe it solves the inter-session replay attacks with OSPF
- This solution does NOT guarantee packet freshness, i.e., you still don't know if you are speaking to a live router or if somebody is playing out the entire conversation
- If you want to fix this then the draft spells out the challenge/response mechanism using the Session IDs and Nonces

Benefits



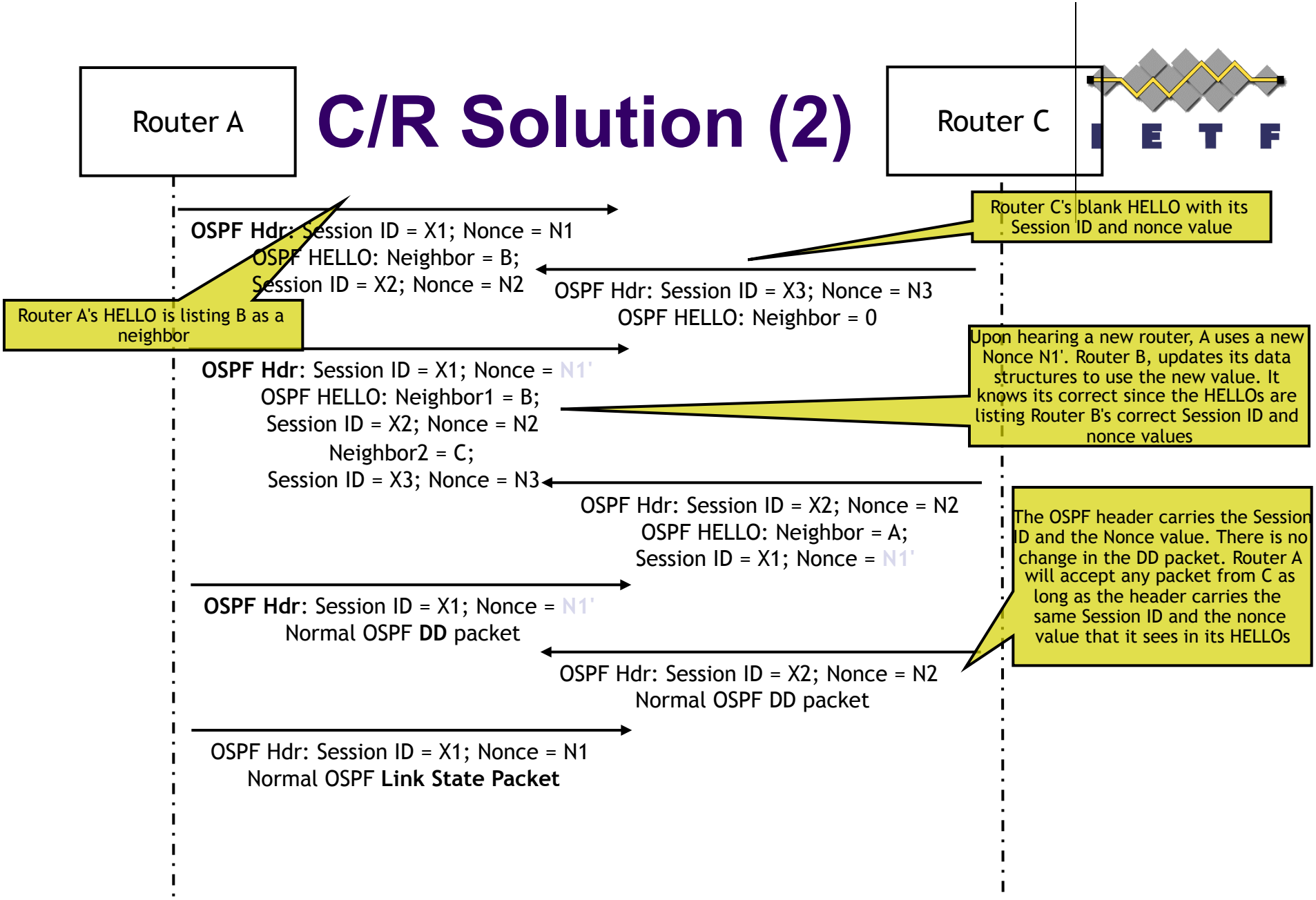
- Easy to implement - very minimal changes to the OSPF running code
- Consider this as part of the KARP infrastructure that even other routing protocols can use
- Minimal changes required in the OSPF packet encoding

C/R Solution (1)



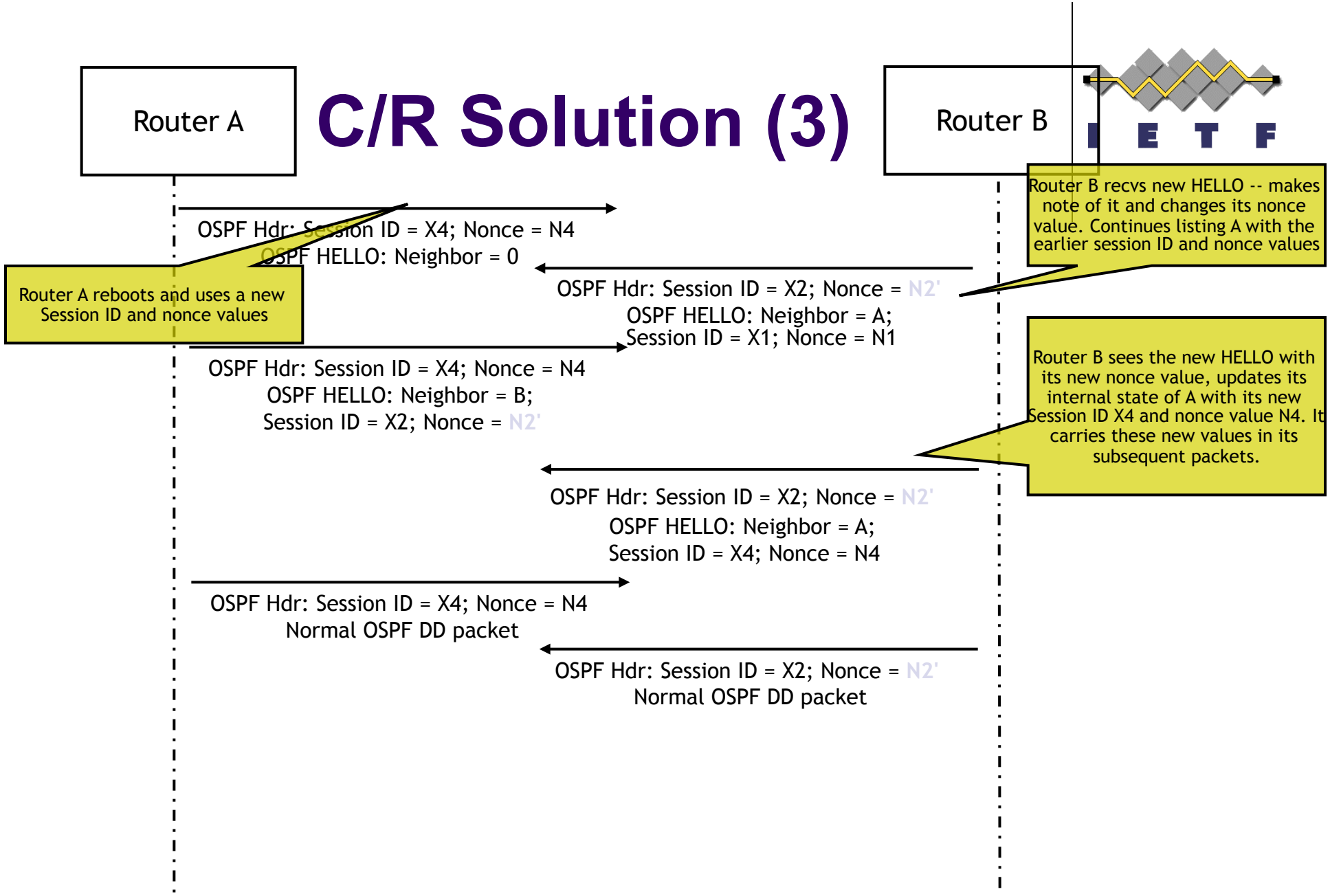
Scenario 1: Two Routers coming up ..

C/R Solution (2)



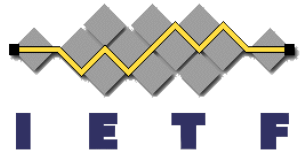
Scenario 2: Another Router C comes up on that LAN

C/R Solution (3)



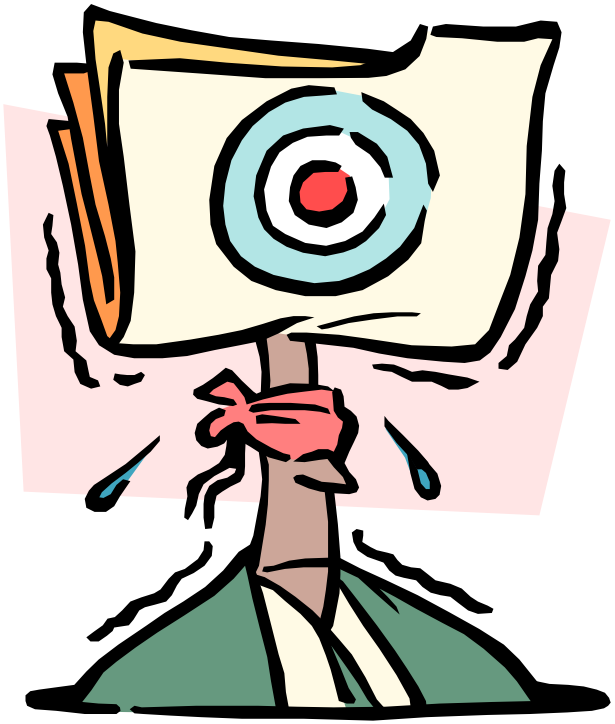
Scenario 3: Router A reboots

Next Steps



- We need people who understand OSPF to look at this mechanism and see if they find some holes in it.
- If they think this is fool-proof then we can remove the Session ID and the Nonce stuff that currently exists in the draft
- Accept this as a WG document since there has been a lot of discussion on the mailing list and people have taken it positively there!

Feedback!



Protecting the source IP address