

## Forwarding SCTP Traffic through a NAT

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### Outline

- SCTP Overview
- NAT and SCTP
- How to NAT SCTP Packets
- SONATA and alias\_sctp
- Conclusion



## SCTP – What is it?



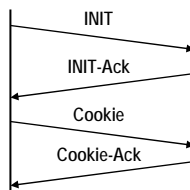
- SCTP is a Transport Layer Protocol that supports
  - A selection of guaranteed/best-effort/mixed-mode delivery
  - Multi-homed hosts
  - Multiple streams within an association
  - Message oriented service
  - Selective Acknowledgements
  - CRC32 Checksum for better error detection
- Originally developed for voice signalling traffic but potential uses are more widespread

## Setting up an Association



Host A

INIT  
Source/Dest IP  
Source/Dest Port  
Vtag: 0  
Inside INIT Chunk  
Initiation Tag  
Alternate IP add.



INIT-Ack  
IP addresses from INIT  
Original Ports  
Vtag: tag\_a  
Inside INIT-Ack Chunk  
Initiation Tag  
Alternate IP add.



Host B

### INIT

- Host B learns
  - Alternate addresses for A
  - SCTP Ports to use
  - vtag to include in all subsequent packets to A (Initiation Tag)
- Determine State Cookie

### INIT-Ack

- Check source/ports/vtag
- Host A learns
  - Alternate addresses for B
  - vtag to include in all subsequent packets to B (Initiation Tag)
- Echo State Cookie
- Association is UP for Host A

### Cookie

- Check source/ports/vtag
- Host B unpacks Cookie
  - Sets up kernel TCB for association
- Data may be appended to the Cookie chunk
- Association is UP for Host B

## What is the deal with...



- The State Cookie
  - Designed to protect against DoS attacks
  - Server association up second, no resources allocated until Client-side is up
- Vtags
  - An extra piece of information to help protect against spoofing
  - Allows multiple associations to one host to use the same port pair as long as the vtags are unique

## Association Maintenance



- Communications are not spread amongst all interfaces on a host
- Unused interfaces will periodically send a Heartbeat to alternate host and receive a Heartbeat-Ack
  - Tells remote host that alternate path is still available
  - Updates alternate path RTT
- Other interfaces can be added/removed using the SCTP ASCONF extensions
  - AddIP – Add a new interface to the association
  - RmIP – Remove an interface from the association

## NAT and SCTP



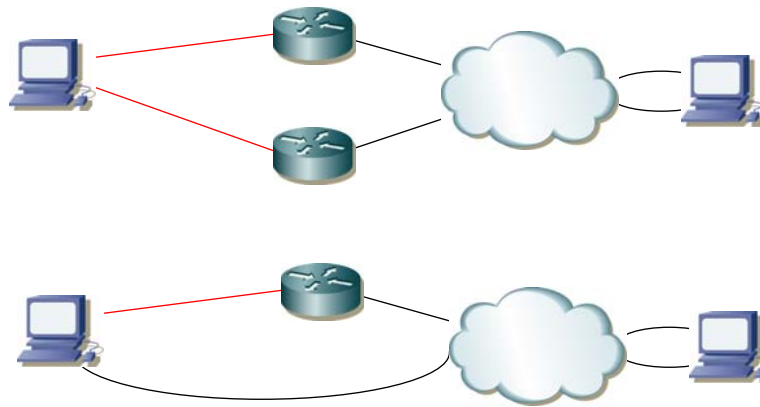
- NAT allows us to share a single public IP addressing by mapping a private address space to a public IP address
  - Typically used within home-user environments
- Important because
  - SCTP will never see widespread use until it is usable from behind a NAT
  - Eg. BT already runs ~1,000,000 concurrent SCTP SIP sessions over a private network

## Extend Existing Implementation for SCTP



- Not feasible
- SCTP Checksum – CRC32 is computationally intensive to recalculate
  - Difficult for consumer broadband equipment
  - Also difficult for corporate NATs dealing with high traffic volume
- SCTP Multi-homing
  - NAT has to manage packets for a single association from potentially multiple sources
  - Database management becomes more complex

## Multi-homing Problems



— Private Network  
— Public Network

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8 July 2008 Page 9

## How to NAT SCTP Packets



- We can't modify port numbers as per traditional NAT
  - CRC32 Checksum is computationally intensive
  
- Need to track
  - Vtags within tuples – this allows retaining the port numbers as-is
  - Allow for multi-homed hosts both within and without the NAT – there are two ways to manage this
  
- Basic approach is outlined in
  - Soon to be released Internet Draft
  - Paper submitted for publication
    - M. Tüxen, I. Rüngeler, R. Stewart, E. Rathgeb, "Network Address Translation (NAT) for the Stream Control Transmission Protocol (SCTP)", Submitted to IEEE Networks Special Issue on Implication and Control of Middleboxes in the Internet.

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8 July 2008 Page 10

## SCTP Modifications to assist NAT



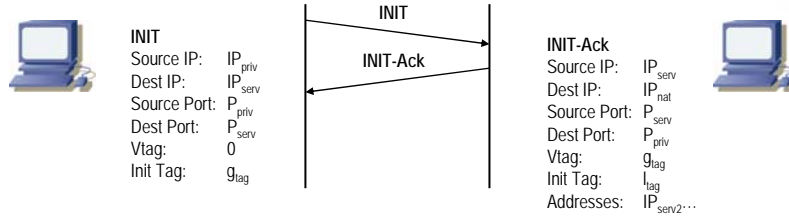
- Only Public IP addresses are allowed in an INIT, INIT-Ack or AddIP SCTP message
  - This ensures that remote hosts only learn about real IP addresses
  - Private addresses are learnt from the source IP address of the packet – modified by the NAT
  
- New AddIP format for private addresses
  - Includes both vtags within message so NAT can learn information

## SCTP Modifications to assist NAT



- A new Abort message (AbortM) can be sent to the sender of an INIT or INIT-Ack
  - Will cause recipient to select a new vtag and re-transmit the packet
  - Allows notification of a collision in the NAT table and shortcut the timeout at the end-host
  
- A new Error message (ErrorM) can be sent to the sender of an SCTP packet
  - Indicates that the NAT is not aware of this association – causes recipient to initiate an AddIP message to update the NAT database
  - Allows for multi-homed hosts behind multiple NATs to learn about new associations and extra end-hosts within that association

# Basic Approach



- INIT
  - Half populate NAT table entry
    - $local\_ip = IP_{priv}, local\_port = P_{priv}, local\_tag = 0, global\_ip = IP_{serv}, global\_port = P_{serv}, global\_tag = g_{lag}$
  - NAT IP<sub>priv</sub> => IP<sub>nat</sub>
- INIT-Ack
  - Check source IP, ports, vtag for matching entry
  - Complete NAT entry
    - $local\_tag = l_{lag}$ , extract all IP addresses in INIT-Ack and store in NAT table (IP<sub>serv2</sub>...)
  - NAT IP<sub>nat</sub> => IP<sub>priv</sub>



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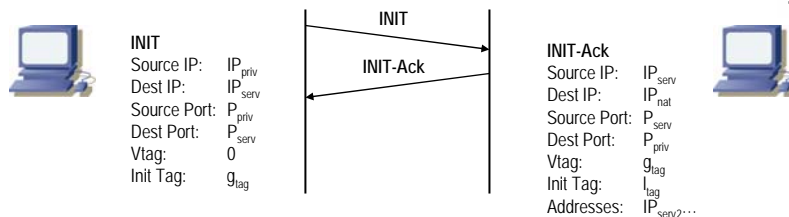
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8 July 2008 Page 13

# Basic Approach



- NAT Table
  - $local\_ip = IP_{priv}, local\_port = P_{priv}, local\_tag = l_{lag}, global\_ip = (IP_{serv}, IP_{serv2}), global\_port = P_{serv}, global\_tag = g_{lag}$
- All other packets
  - Outgoing
    - local\_ip/Ports/local\_tag match, global\_ip in list. NAT local\_ip and forward
    - No match, send ErrorM to private host
  - Incoming
    - Ports/global\_tag match, global\_ip in list. NAT to local\_ip and forward
    - No match, drop silently



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8 July 2008 Page 14

## Multi-homed Private Hosts



- INIT goes out one private address to server
  - NAT<sub>1</sub> gets entry
- INIT-Ack comes back via same connection
  - NAT<sub>1</sub> brings up entry
- Private host sends AddIP(0.0.0.0) out alternate address
  - NAT<sub>2</sub> populates entry
- AddIP-Ack comes back via alternate address
  - NAT<sub>2</sub> confirms entry
- Both NATs are now aware of the association, ports and vtags
- Subsequent NATs may not know all IP addresses of global host

## Do We Need to Track Global Addresses



- Proposed Internet Draft says yes
- Optional to assume that any global IP address where the port numbers and vtags match is part of the existing association
  - Don't store any global IP addresses in the NAT DB
  - Will result in more potential collisions in the NAT
  - Resolved via use of AbortM messages
- More efficient

## Tracking Global Addresses – Advantages



- Less database collisions – more associations will get up without an AbortM being sent
  - Better for older SCTP stacks that do not recognise an AbortM
- Can drop forged packets *before* they enter the private network

## Tracking Global Addresses - Disadvantages



- Resource Requirements
  - Parsing INIT, INIT-Ack, AddIP messages to extract public IP addresses
  - Store a more complex database entry (and lookup)
- More edge cases
  - NAT not knowing all addresses, increased ErrorM messages
  - More complex handling when different hosts contact a multi-homed host outside the NAT

## Tracking Global Addresses – State



- Extended debate between myself and ID author about need to track Global IP Addresses
  - Hung up on potential number of collisions
  - Hung up on issue of older stacks
- Managed to extract an entry in new ID to state that tracking Global Addresses may not be required or optimal on low end devices
  - We believe this is true on high end devices as well

## SONATA and alias\_sctp



- Cisco funded project to implement a NAT for SCTP
  - <http://caia.swin.edu.au/urp/sonata>
  - Kernel patches for ipfw2 and libalias
  - Initial June 18 release – FreeBSD 8
  - Upcoming release – FreeBSD 7+8

## alias\_sctp – Version 0.1



- Single homed private hosts to multi-homed public hosts
- IP Address forwarding
- Configurable logging levels – Kernel compile time
- Tested with approx. 10,000 concurrent flows for periods of up to 72 hours
- Logging of AbortM/ErrorM generating situations

## alias\_sctp – Next Release



- Sending of AbortM/ErrorM packets
- Per port IP Address forwarding
- Dynamically configurable
  - Log levels
  - Hash Table size
  - Timeouts
- ASCONF AddIP – Support for multi-homed private hosts
- This will be a fully functional SCTP NAT implementation

## alias\_sctp – Future Releases



- Dynamically configurable support for tracking Global IP Addresses
- Code Optimisation
- Fully tested with testing documentation
  - Functionality Testing
  - Performance Testing

## Conclusions



- SCTP is a new Transport Layer Protocol with no SCTP support
- An Internet Draft is being developed to outline how to NAT SCTP packets using addresses, port numbers **and** vtags in the flow identification tuple
- The SONATA project is aiming for a public release of code to implement the draft
  - BSD Licensed
  - Fully tested – functionality and performance
  - Optional Global IP Address Tracking
- Initial prototype verifies that NAT for SCTP is possible