

Monday

Week 5 Internet Programming

Week 6 Web Sockets

Week 7 Web RTC

Week 8

Exam

Thursday

Internet Programming

Web Sockets

Security(?)

Final



department of computer science
faculty of sciences

Internet Programming

Programming with Sockets
(SCTP)

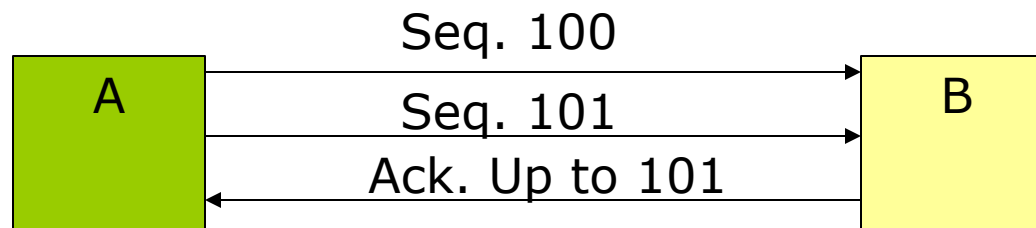
SCTP

Introduction

- ❑ Multi-homing
- ❑ Multi-streaming
- ❑ Initiation protection
- ❑ Message framing
- ❑ Configurable unordered delivery
- ❑ Graceful shutdown

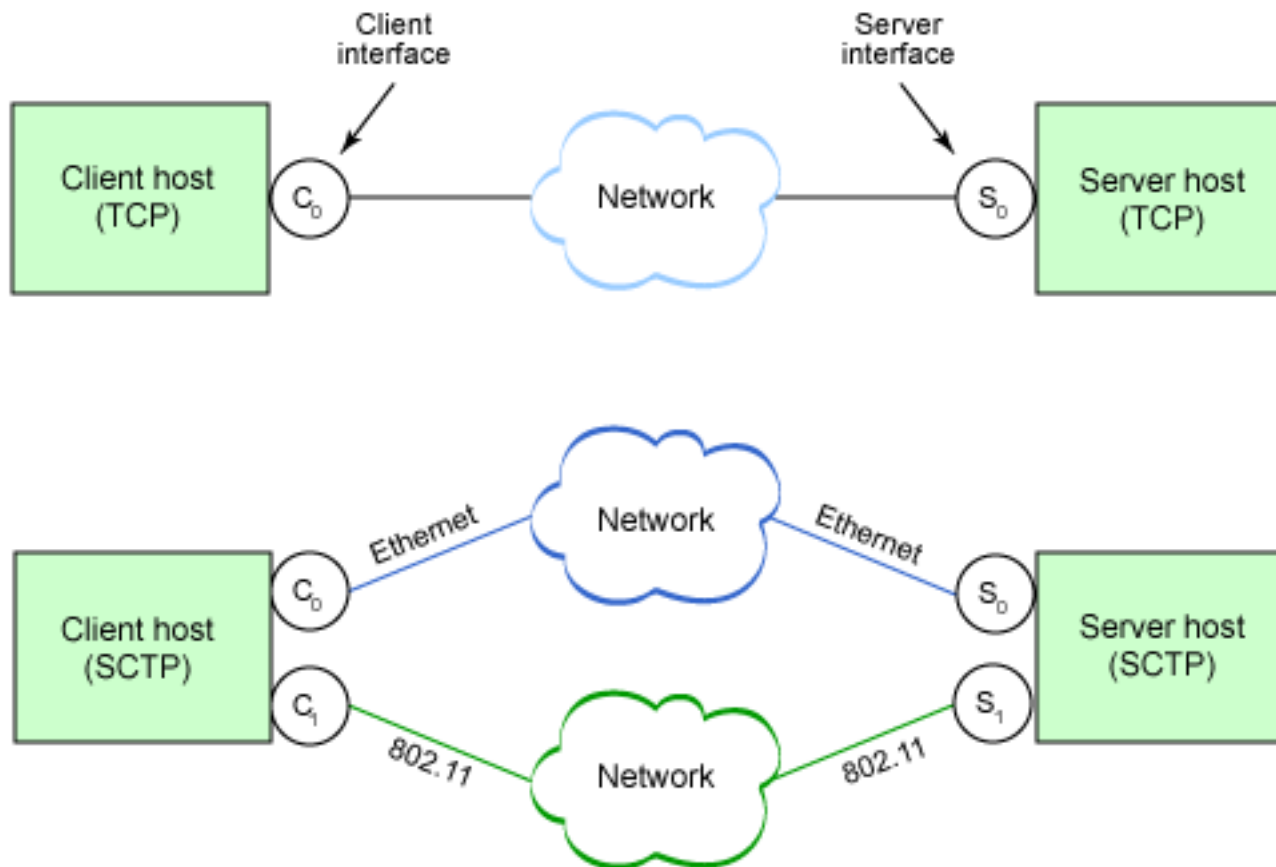
Stream Control Transport Protocol

- ❑ Based on TCP
- ❑ Defined in RFC 2960
- ❑ Connection-oriented transport protocol
- ❑ Designed to overcome problems with TCP
- ❑ Like TCP, it uses sequence numbers and acknowledgements to provide delivery guaranties
- ❑ Uses a window between peers to indicate the amount of data that can be in de receive buffer.

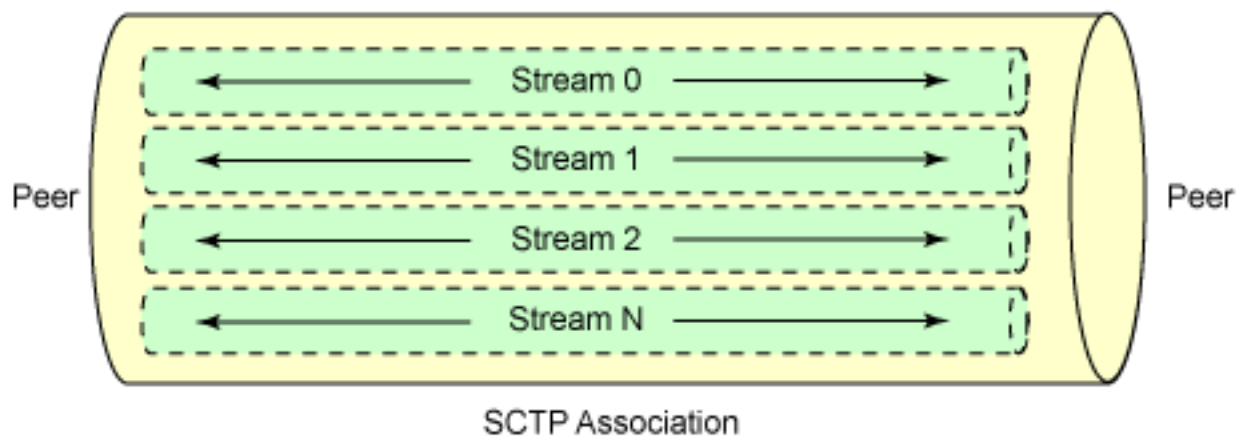


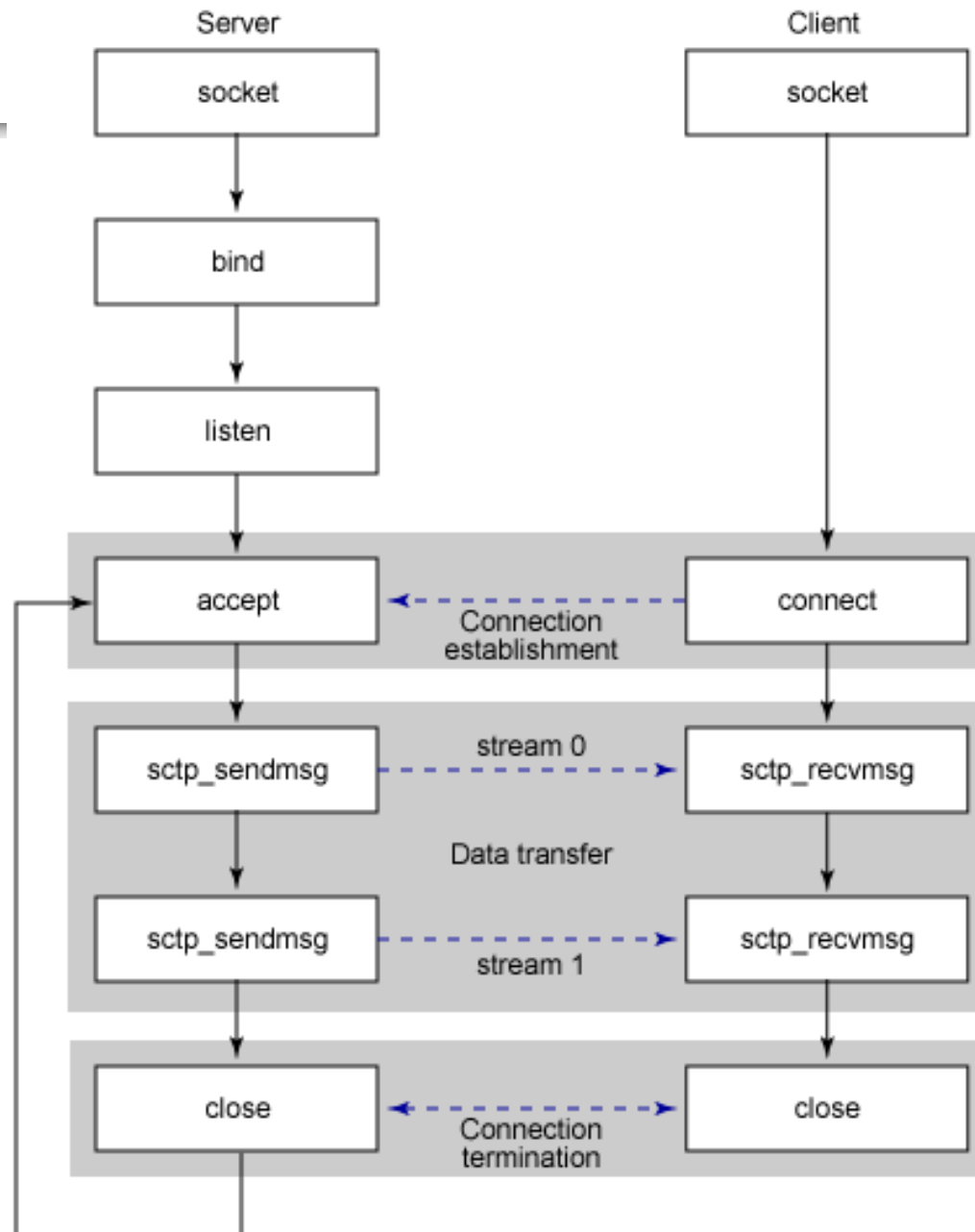
Multihoming

- Association formed between two endpoints
- **Paths** are established between those two endpoints



- ❑ Multiple streams within an association.
- ❑ Avoids *head-of-line* blocking
- ❑ Provides better responsiveness than TCP for example HTTP protocol





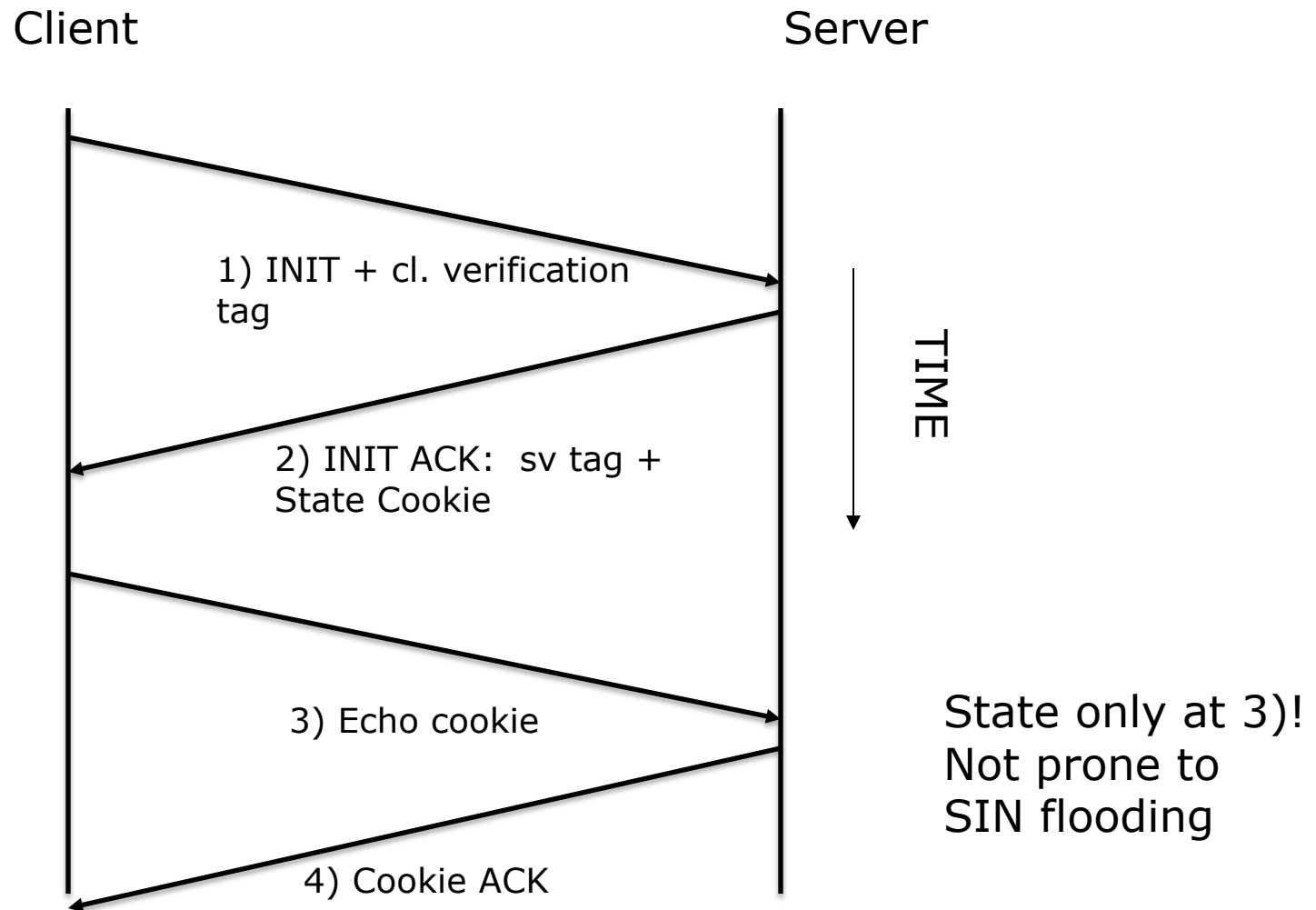
Header

| Bits | 0–7 | 8–15 | 16–23 | 24–31 |
|------|------------------|---------------|------------------|-------|
| +0 | Source port | | Destination port | |
| 32 | Verification tag | | | |
| 64 | Checksum | | | |
| 96 | Chunk 1 type | Chunk 1 flags | Chunk 1 length | |
| 128 | Chunk 1 data | | | |
| ... | ... | | | |
| ... | Chunk N type | Chunk N flags | Chunk N length | |
| ... | Chunk N data | | | |

SCTP Protocol Terminology

- ❑ “Data Chunk”: Individual SCTP messages sent with a packet
- ❑ “Path”: Connection between two endpoints
- ❑ “Association”: The connection between to computers.
- ❑ TSN: *Transmission Sequence Number*. An increment of data chunks, not bytes.
- ❑ Heartbeat: Like a TCP keepalive. Sent on a per-path basis
- ❑ Shutdown: Fin flag
- ❑ Abort: same as reset(RST) flag in TCP

Session setup: Four-way handshake

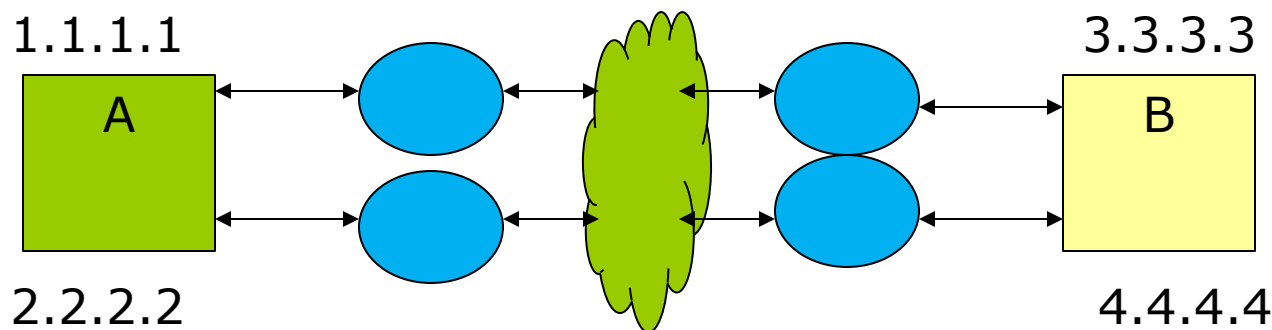


Retransmissions

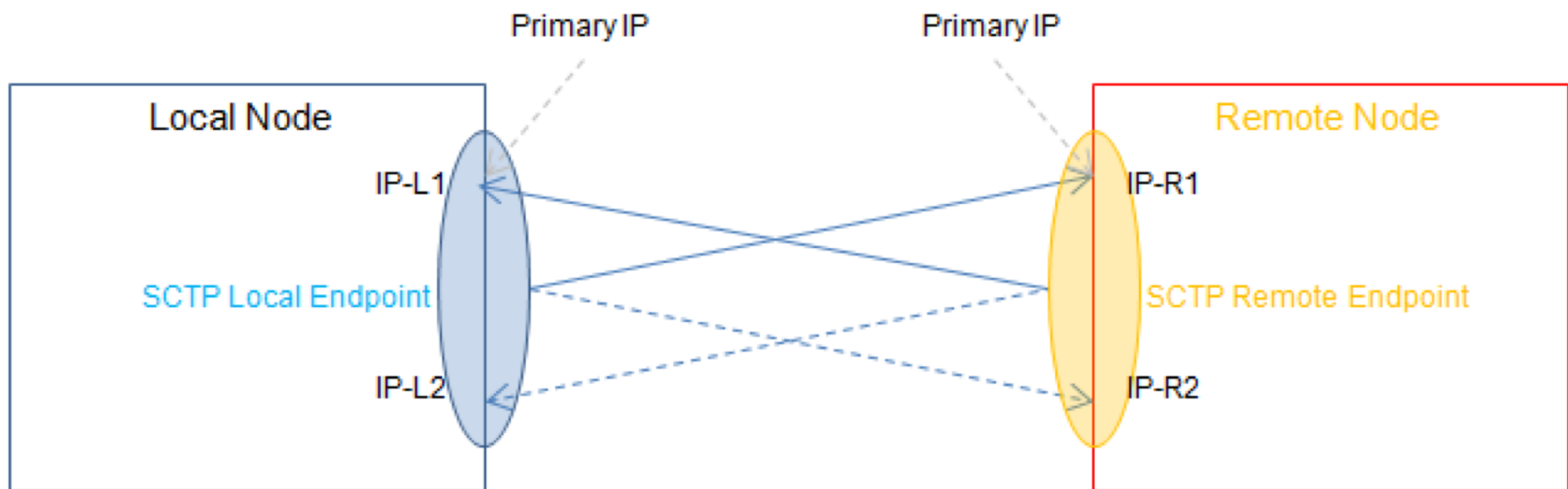
- ❑ When a receiver notices packet loss, it send a selective ACK for the missing TSN. Explicitly asking for packets. This is called “fast retransmission”.
- ❑ If RTO (Retransmission Time OUT) expires without acknowledgements, retransmission is triggered. **RTO is per destination IP address.**

Advantages over TCP

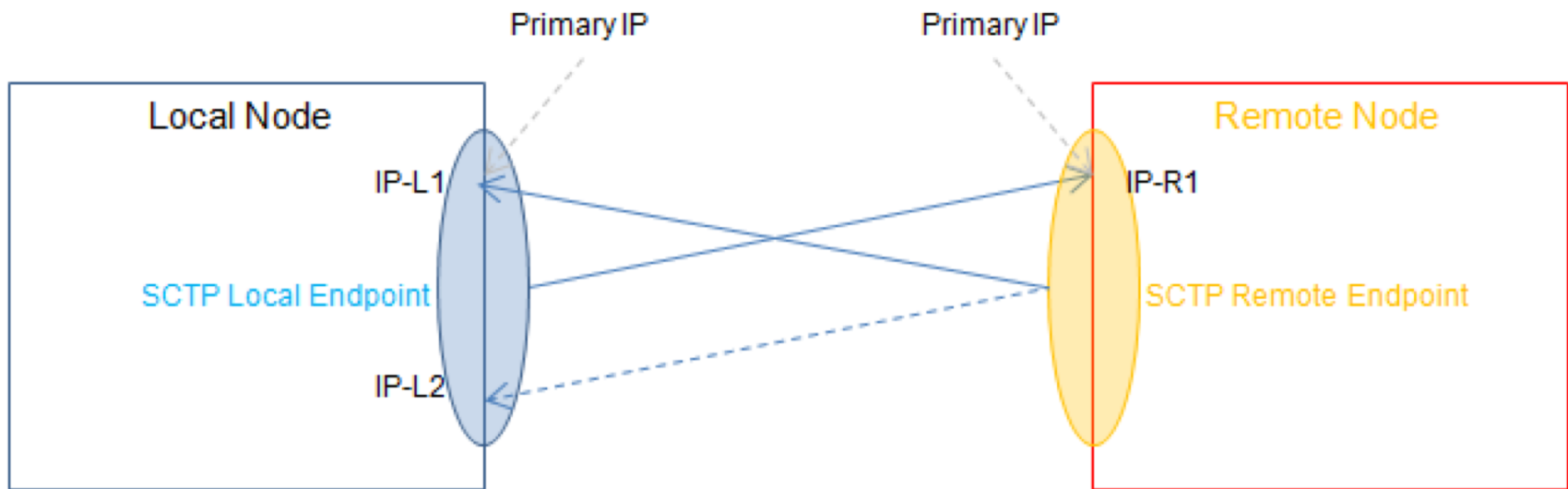
- ❑ Four-way handshake protects from SYN floods
- ❑ Support multihomed devices.
- ❑ Supports explicit error codes and message types
- ❑ Selective ACKs are supported in all SCTP connections.
- ❑ Window size is 32-bit value with no scaling window.
- ❑ Supports “Partially Reliable” delivery options
- ❑ Resilience



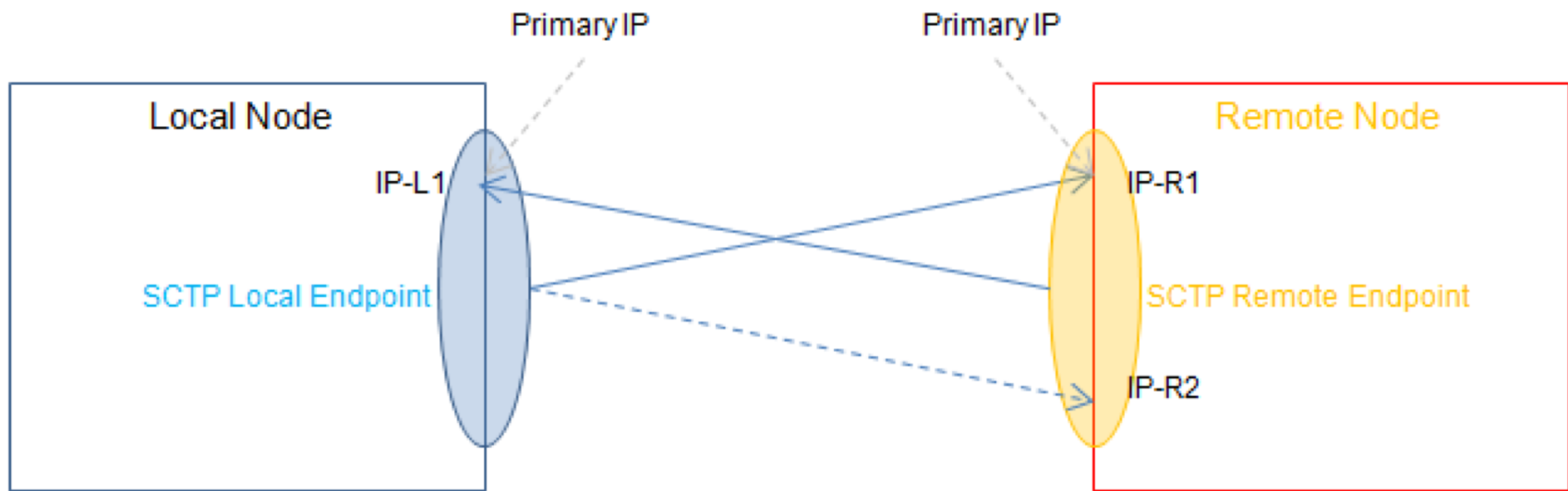
SCTP - Multihoming



SCTP - Asymmetric Multihoming



SCTP - Asymmetric Multihoming



-
- Common: Multiple data chunks in a single IP packet
 - TSN numbers and acknowledgement can be **harder** to follow per packet then TCP Stream.

Example

```
#include <netinet/sctp.h>
#include <sys/types.h>
#include <sys/socket.h>
#include <netinet/sctp.h>

int main(int argc, char *argv[]) {
    int sockfd, connSock, n;
    struct sockaddr_in addr, *addresses;
    int addr_size = sizeof(struct sockaddr_in);
    int port;

    sockfd = socket(AF_INET, SOCK_STREAM, IPPROTO_SCTP);
    if(sockfd < 0) {}

    ...
    addr.sin_family = AF_INET
    addr.sin_addr.s_addr = init_addr(argv[1])
    addr.sin_port = 0
    if (bind(sockfd, (struct sockaddr *) &addr, addr_size) == -1) {}

    listen( sockfd, 5 );
```

Example

```
listen( sockfd, 5 );

while( 1 ) {
    connSock = accept(sockfd, (struct sockaddr *)NULL, (int *)NULL);

    /* client has connected */
    ret = sctp_sendmsg(connSock, (void *)buffer, (size_t)
strlen(buffer), NULL, 0, 0, 0, LOCALTIME_STREAM, 0, 0);

    in = sctp_rcvmsg( connSock, (void *)buffer, sizeof(buffer),
                      (struct sockaddr *)NULL, 0, &sndrcvinfo, &flags
);

    close(connSock);
}

}
```