The project

- Motivation for EPFL LRC:
  - Platform for ATM-related research
  - Prototypes freely distributable
  - Access to source of everything for education
- Project started 4Q94 at EPFL LRC
- Implementation started 1Q95
- Contributions:
  - University of Kansas: ILMI address registration
  - Tampere University of Technology: LANE client
  - TU Chemnitz: TI TNETA1570 driver

What is ATM ?

- Asynchronous Transfer Mode
- 25 Mbps, 155 Mbps, 622 Mbps, ...
- Information is sent in small cells (53 bytes each)
- Supports real-time traffic (e.g. video, audio, ...)
- Connection-oriented

Why ATM ?

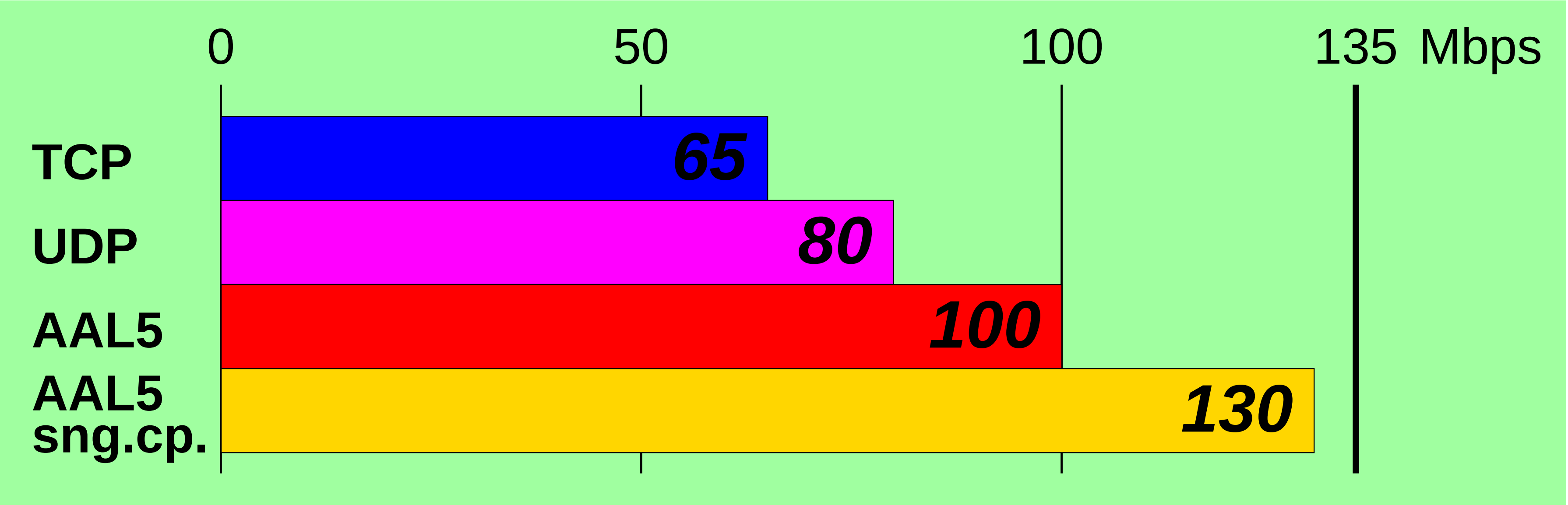
- General:
  Bandwidth can be scaled
- Multimedia:
  Quality of service (QOS) considered during whole design phase
- Data:
  Overcomes MTU problems

Drawbacks:

- More expensive than 100 Mbps Ethernet
- Protocols are complex and not yet stable

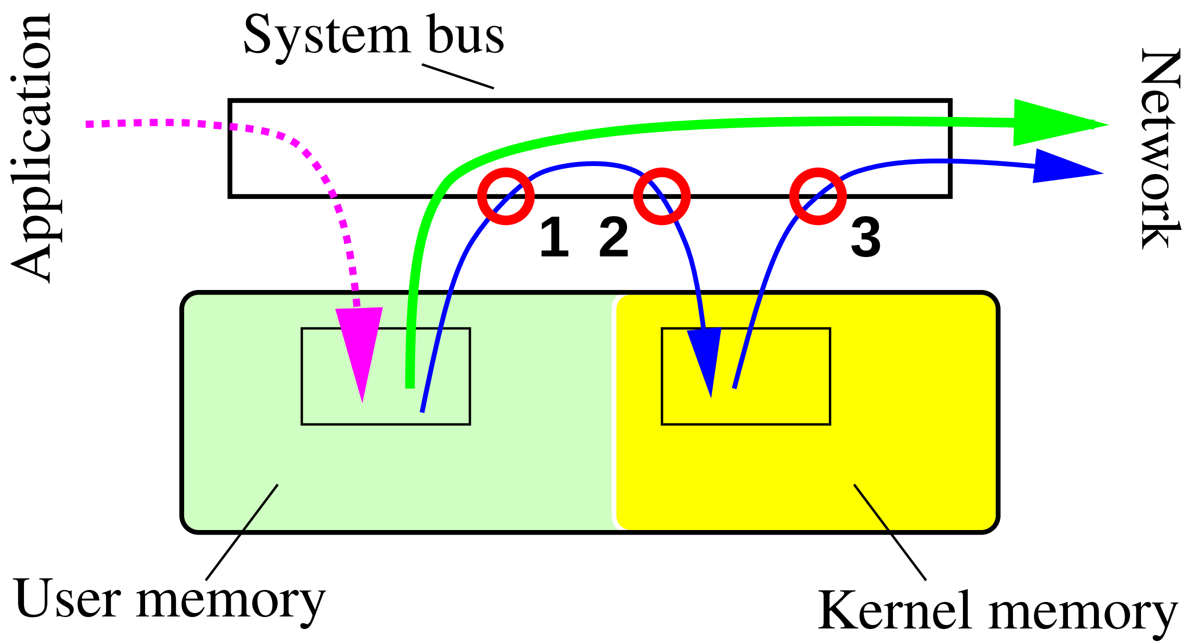
Throughput

- Pentium 90 MHz, Neptune
- Efficient Networks ENI-155p-MF-C ATM adapter
- Unidirectional, memory to memory
- 2048 SDUs of 8192 bytes



Bus throughput

- Data crosses bus at least three times
- To/from IO: 51–53 MB/sec; Memory copy: 19-39 MB/sec
- Combined: 14–23 MB/sec



Single-copy

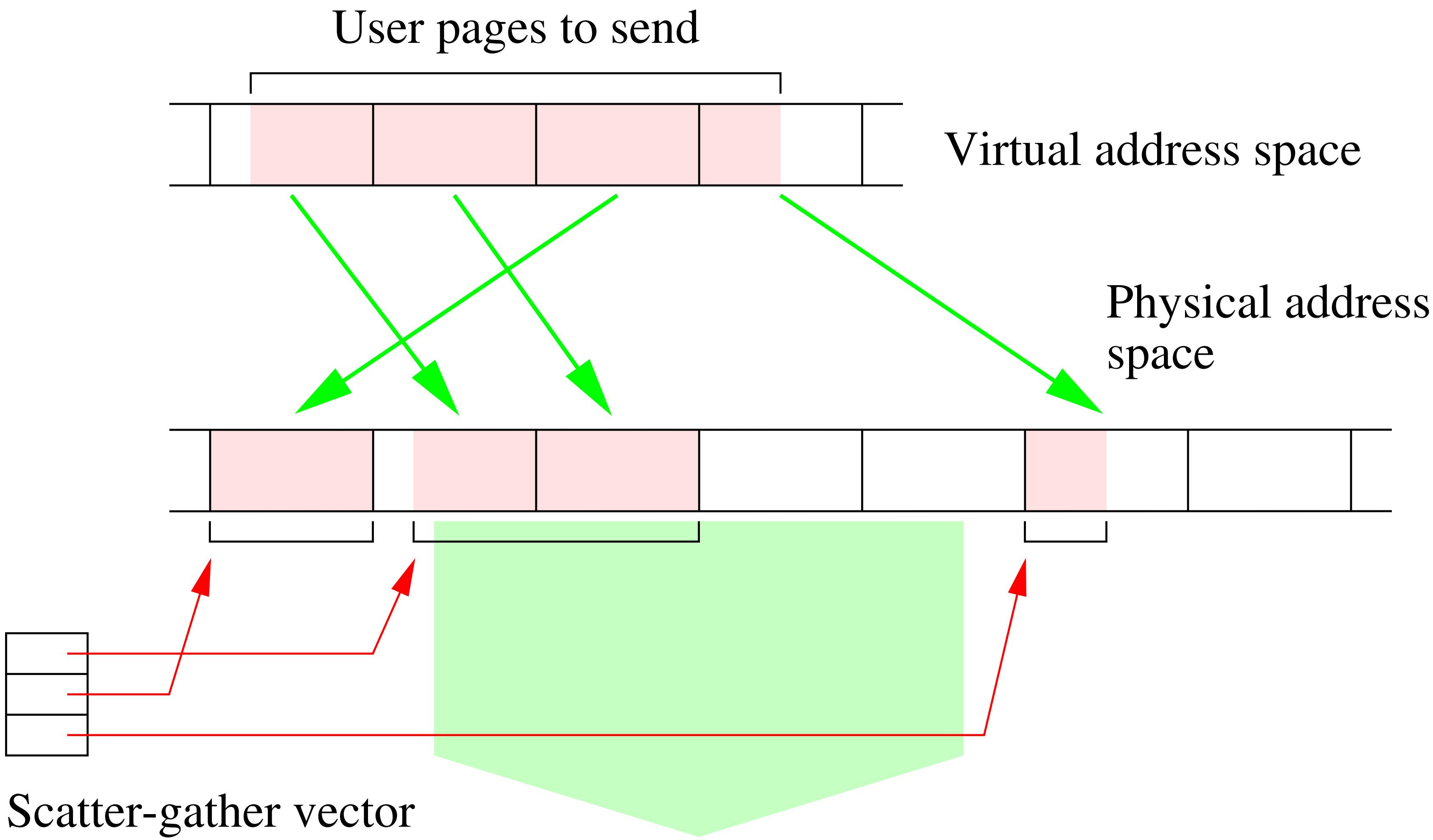
MMU:

- Memory is organized in pages of 4 kB
- Physical pages can be mapped at any virtual address

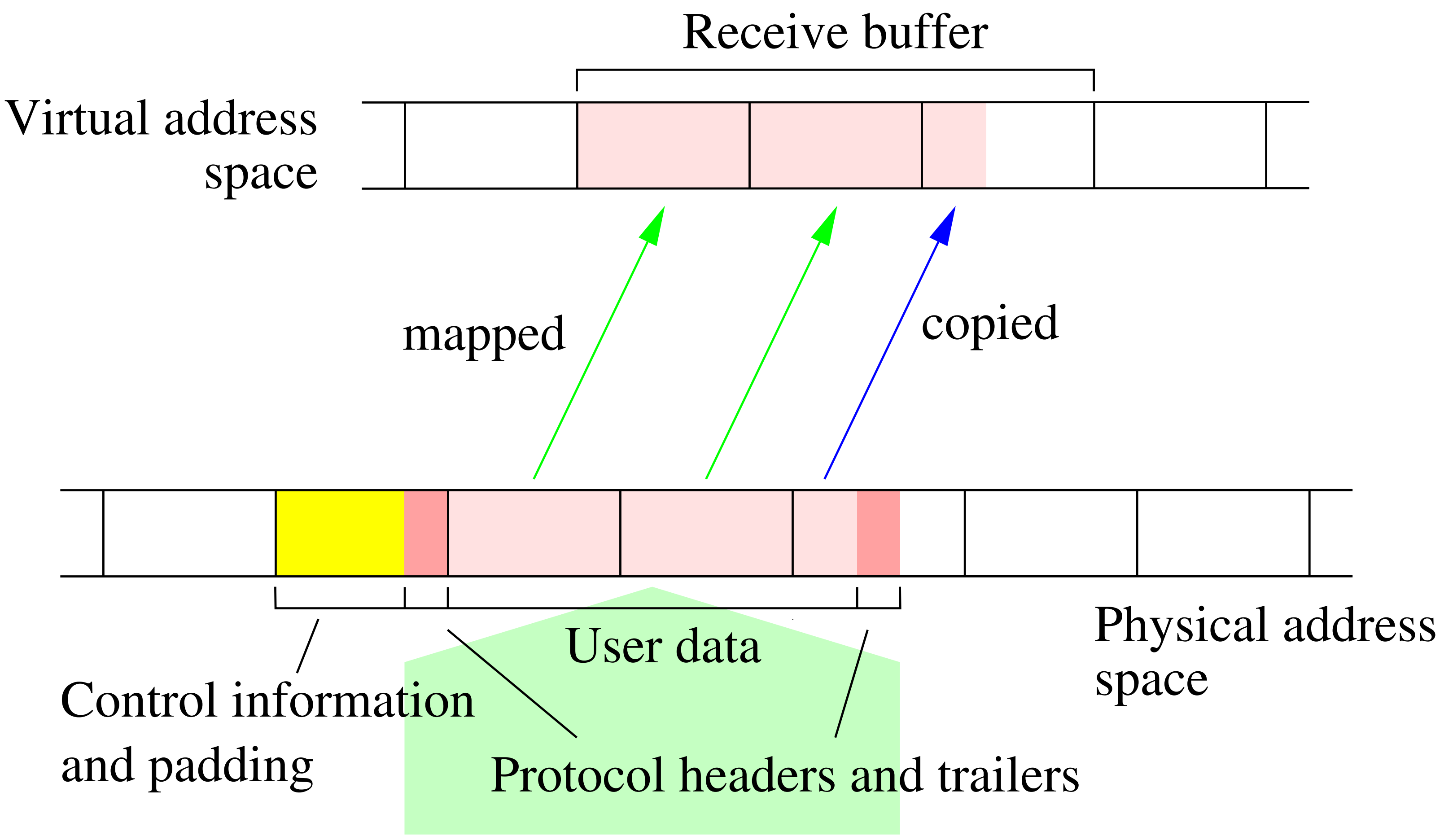
TX: Keep data in user space until sent
→ memory pages must be locked

RX: Could use the same idea, but `read` may not have started before data arrives (e.g. if using `select`)
→ must buffer received data (in the kernel)
→ move page descriptors (only four bytes) instead of page contents

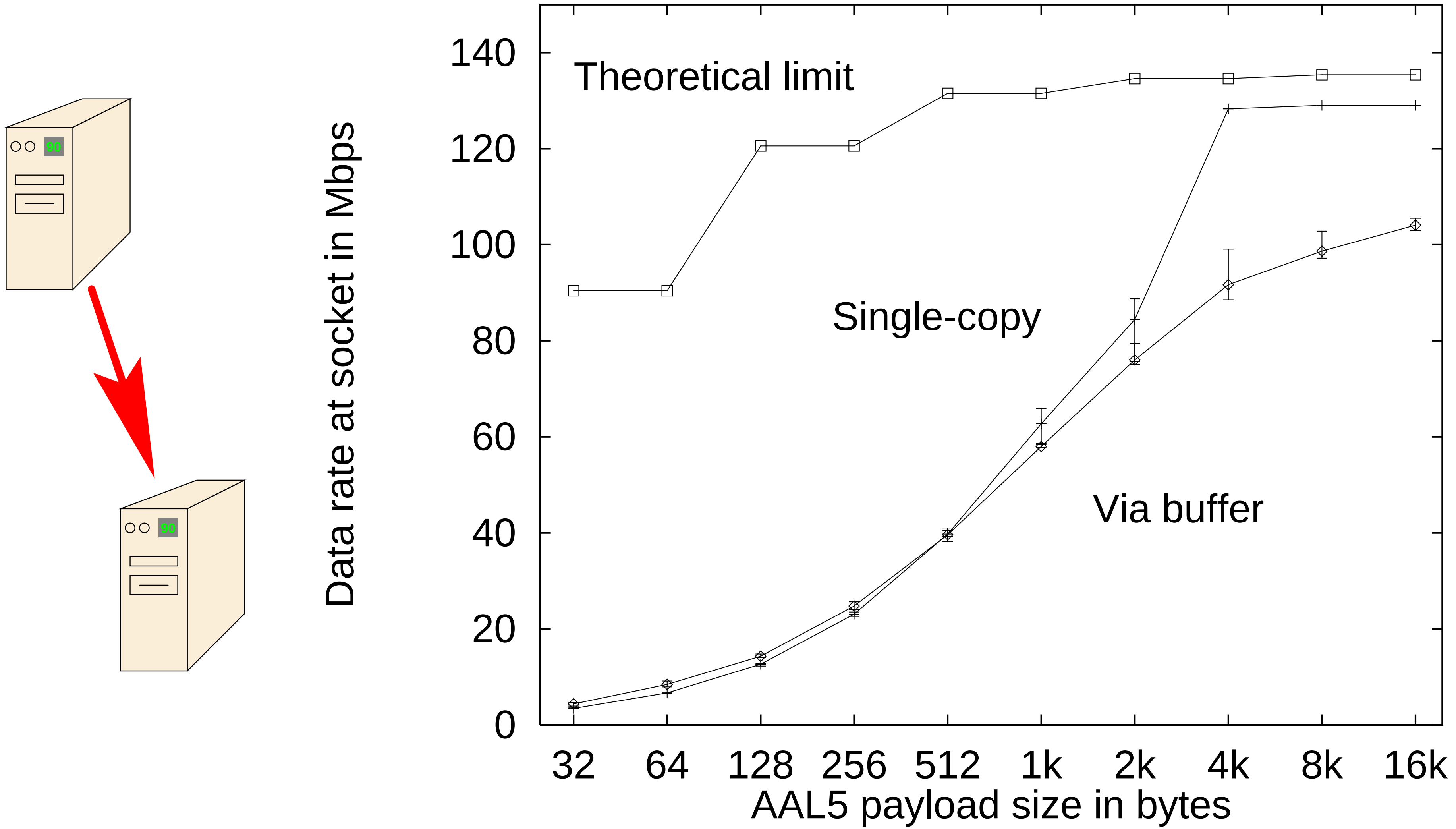
Single-copy TX



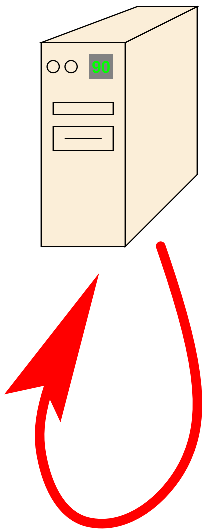
Single-copy RX

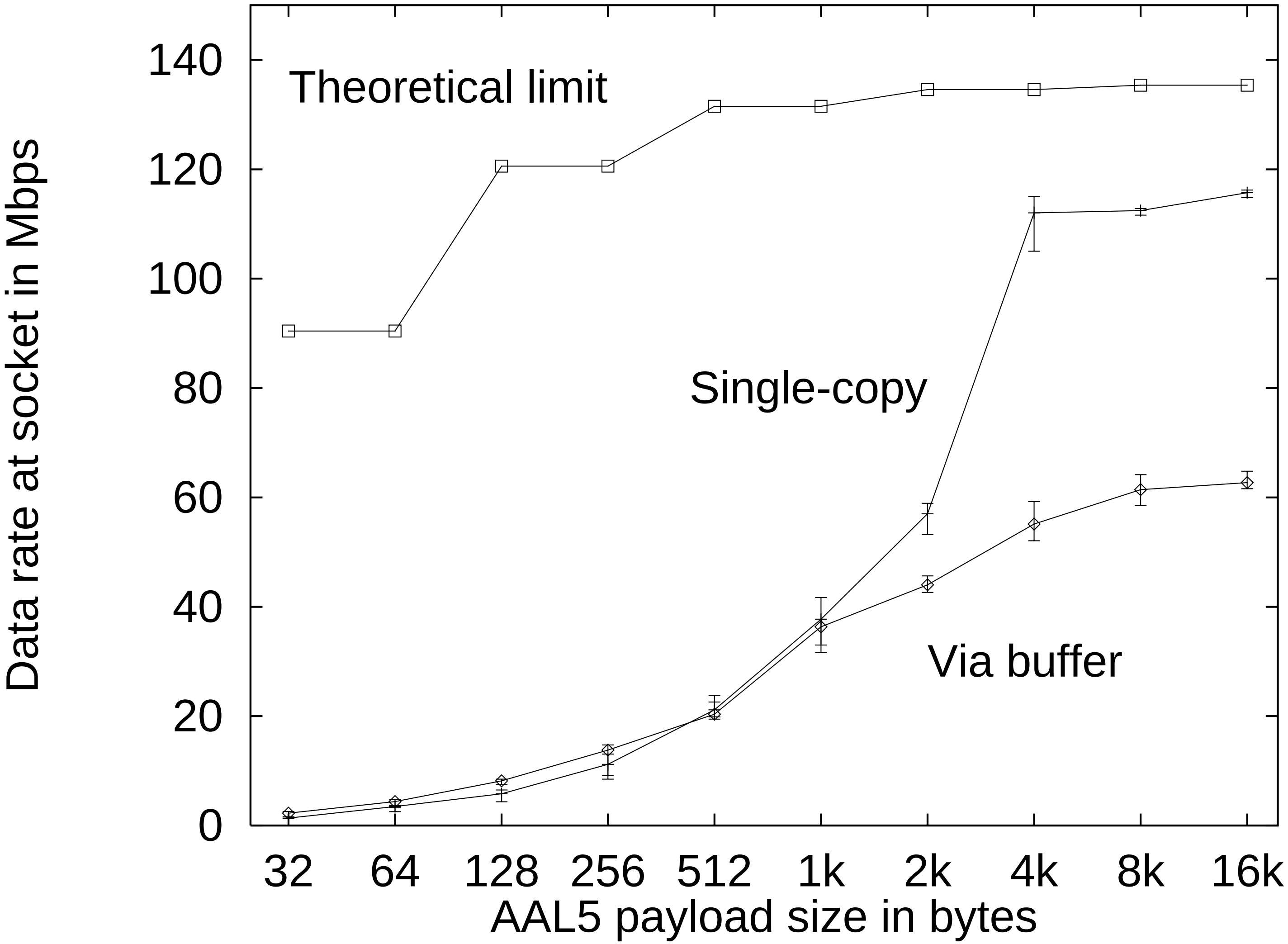


Unidirectional transfer

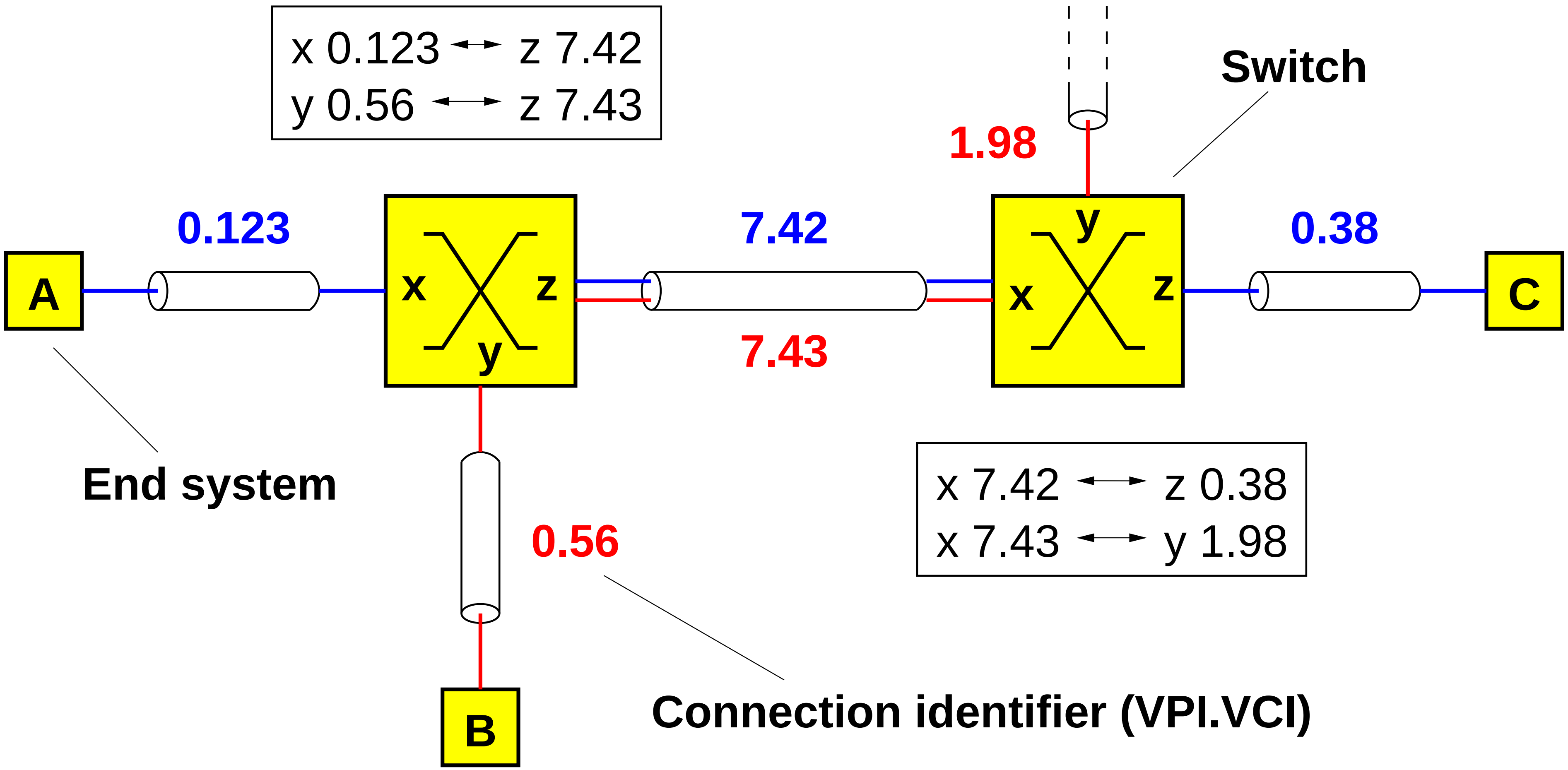


Bidirectional transfer

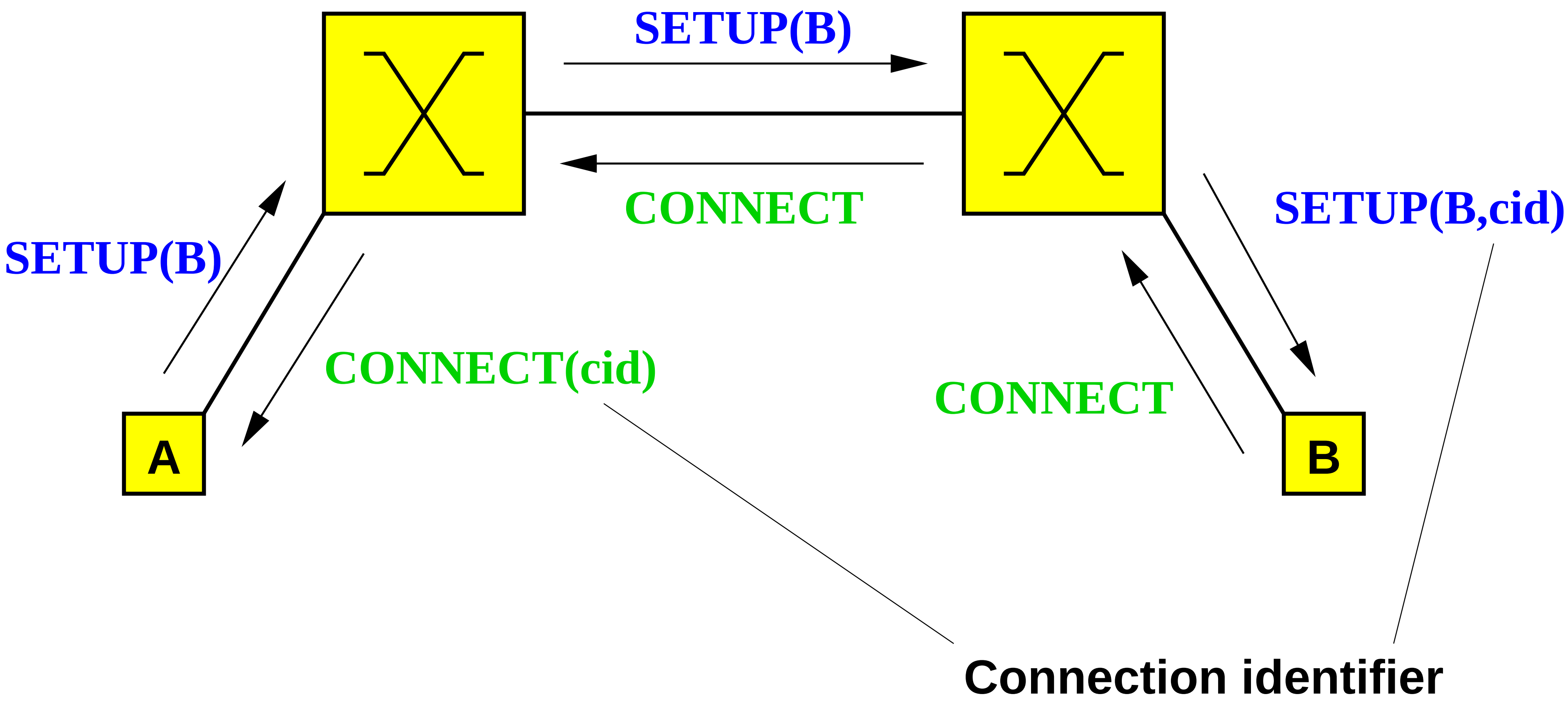




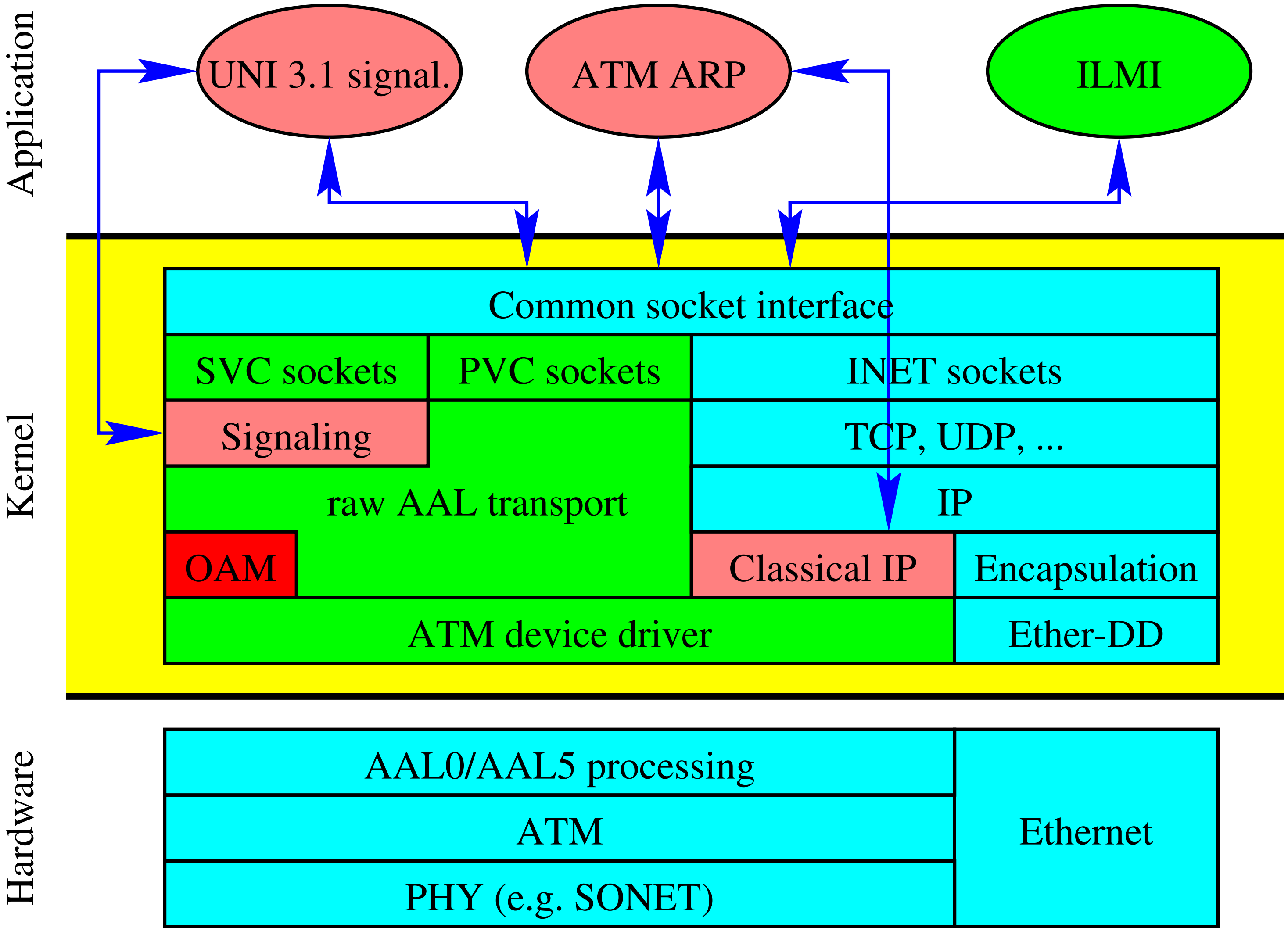
Permanent connections



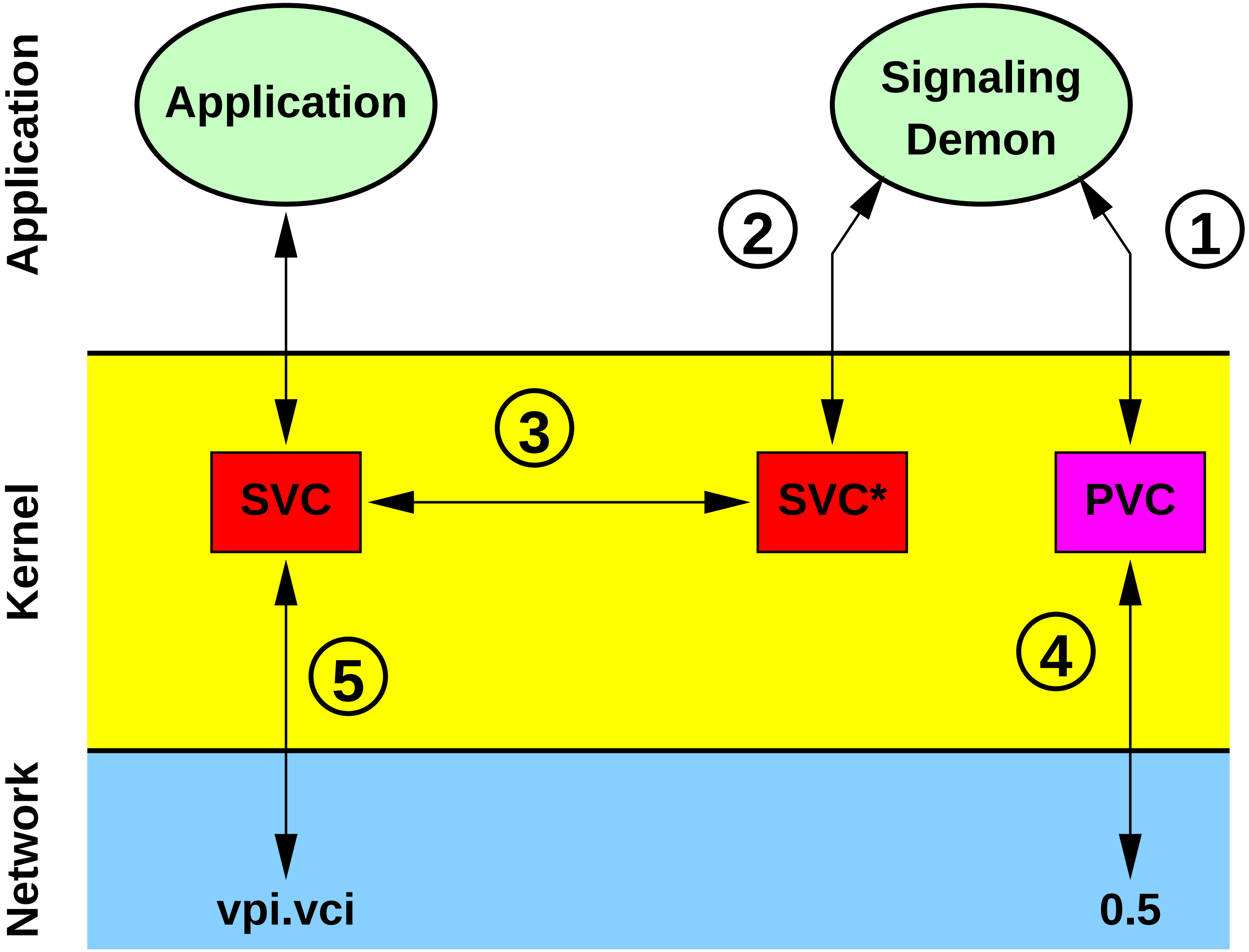
Signaling


SETUP(B)
CONNECT
SETUP(B)
SETUP(B,cid)
CONNECT(cid)
CONNECT
A
B
Connection identifier

Protocol stack

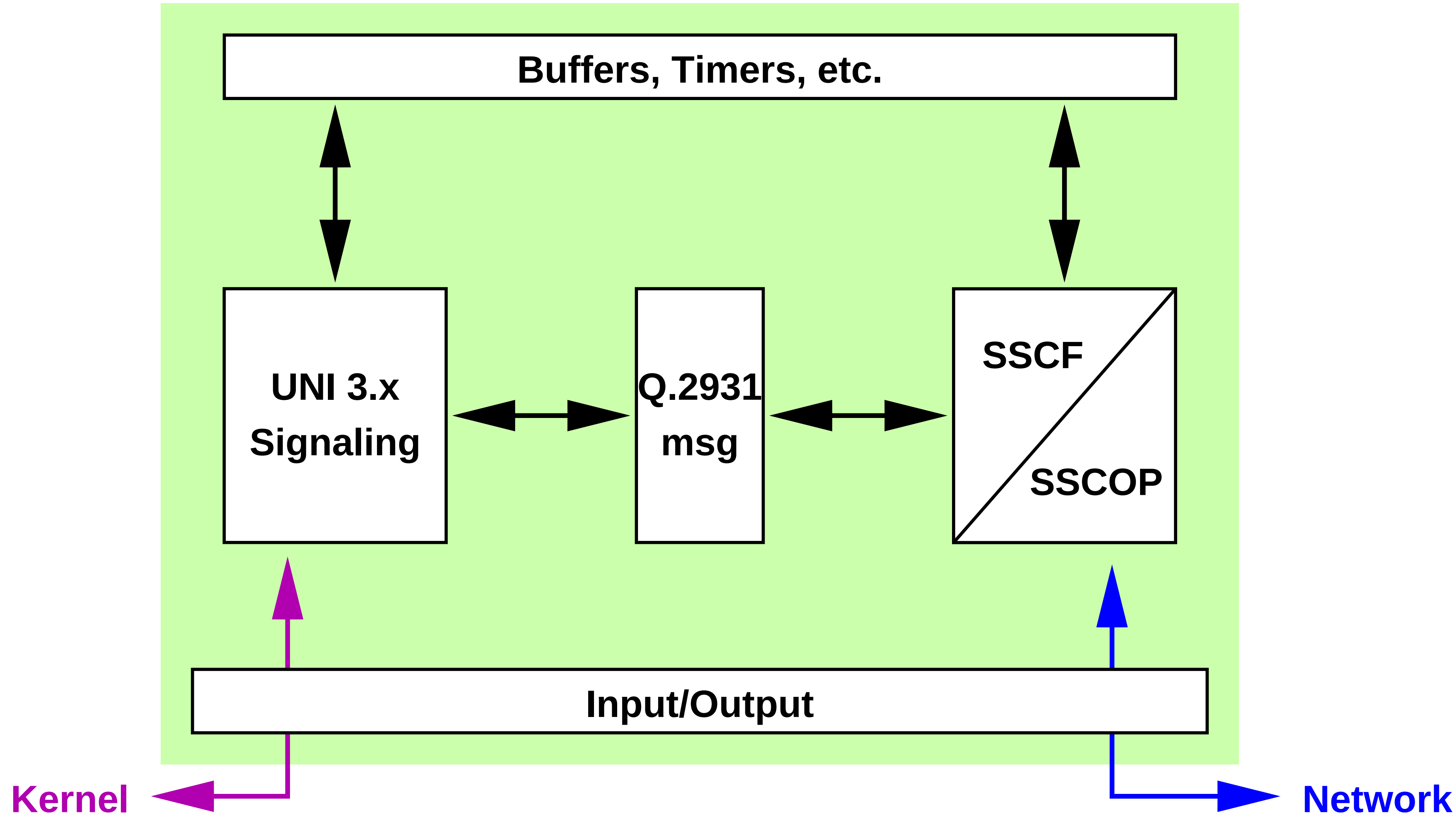


SVC sockets

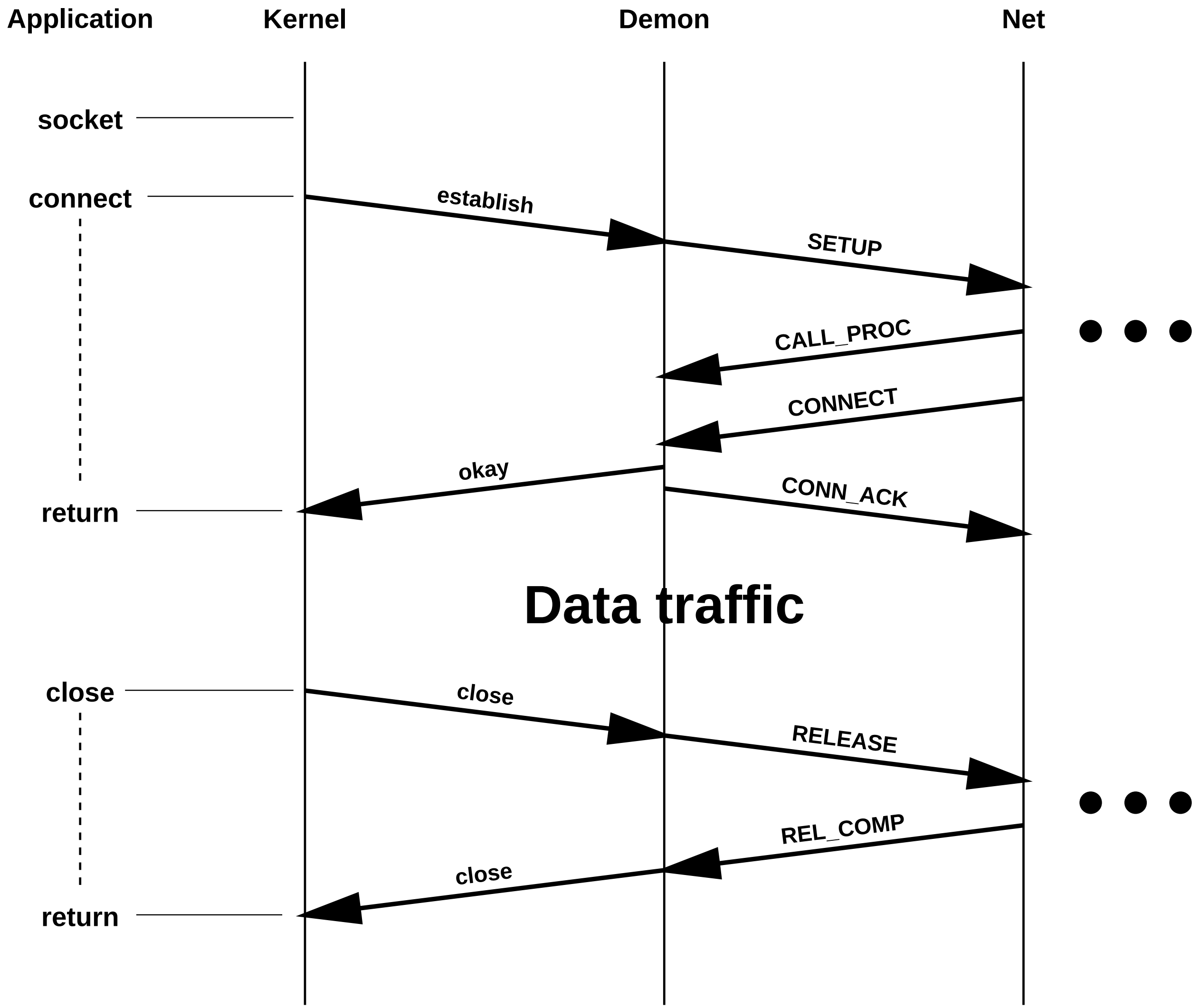


Application
Kernel
Network
Application
Signaling Demon
2
1
3
SVC
SVC*
PVC
5
4
vpi.vci
0.5

Signaling demon



Internal signaling



Q.2931 IEs

Bits

8	7	6	5	4	3	2	1
Broadband bearer capability							
0	1	0	1	1	1	1	0
Information element identifier							
1 ext	Coding Standard		IE Instruction Field				
Length of B-BC contents							
Length of B-BC contents (continued)							
0/1 ext	0	0	Bearer Class				
	Spare						
1 ext	0	0	Traffic Type			Timing Requirements	
	Spare						
1 ext	Susceptibility to clipping		0	0	0	User plane connection configuration	
			Spare				

```
def ie_bbcap = {
  ITU_STD_HDR {
    bearer_class <5@1,more>
    _ext <1@8> = case {
      0 {
        _ext <1@8,more> = 1
        traf_type <3@3,more> = 0
        tim_req <2@1> = 0
      }
      default 1 {}
    }
    _ext <1@8,more> = 1
    susc_clip <2@6,more> = 0
    upcc <2@1> = 0
  }
}
```

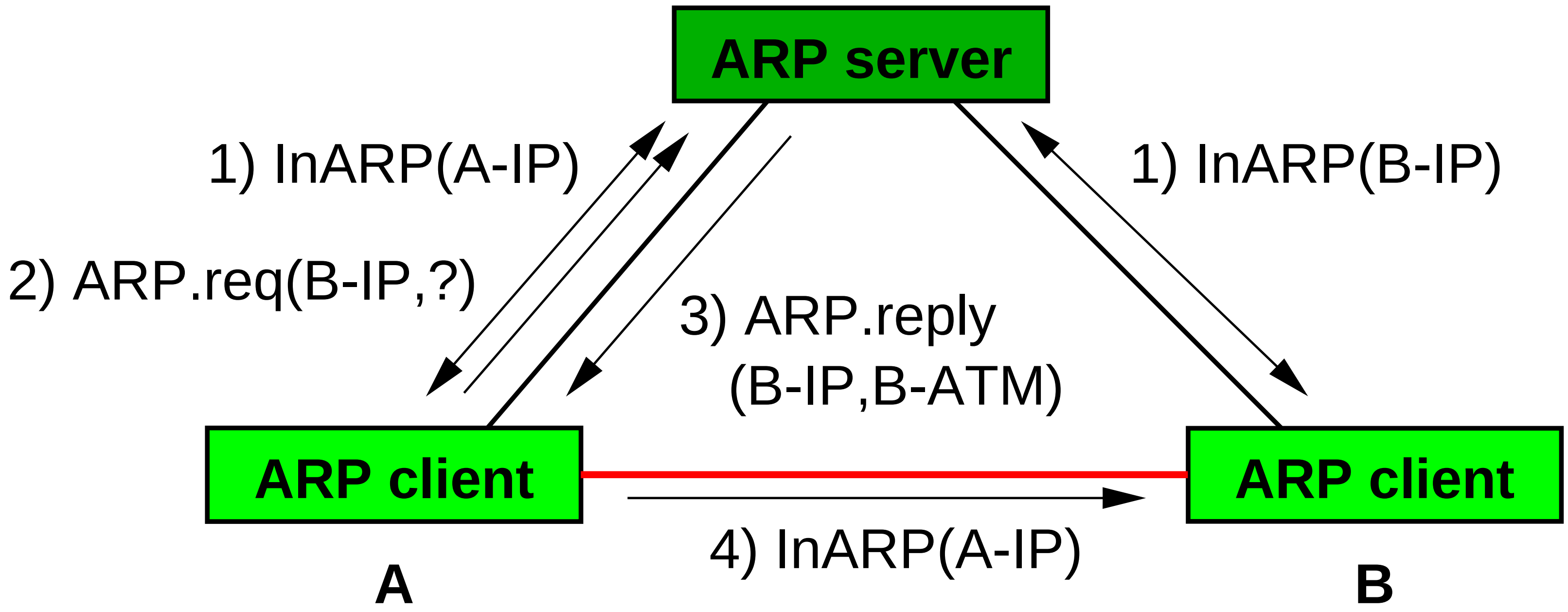
Native ATM socket API

- Based on 4.3 BSD UNIX socket API
- Supports PVCs and uni-cast SVCs
- Supports CBR and UBR VCs

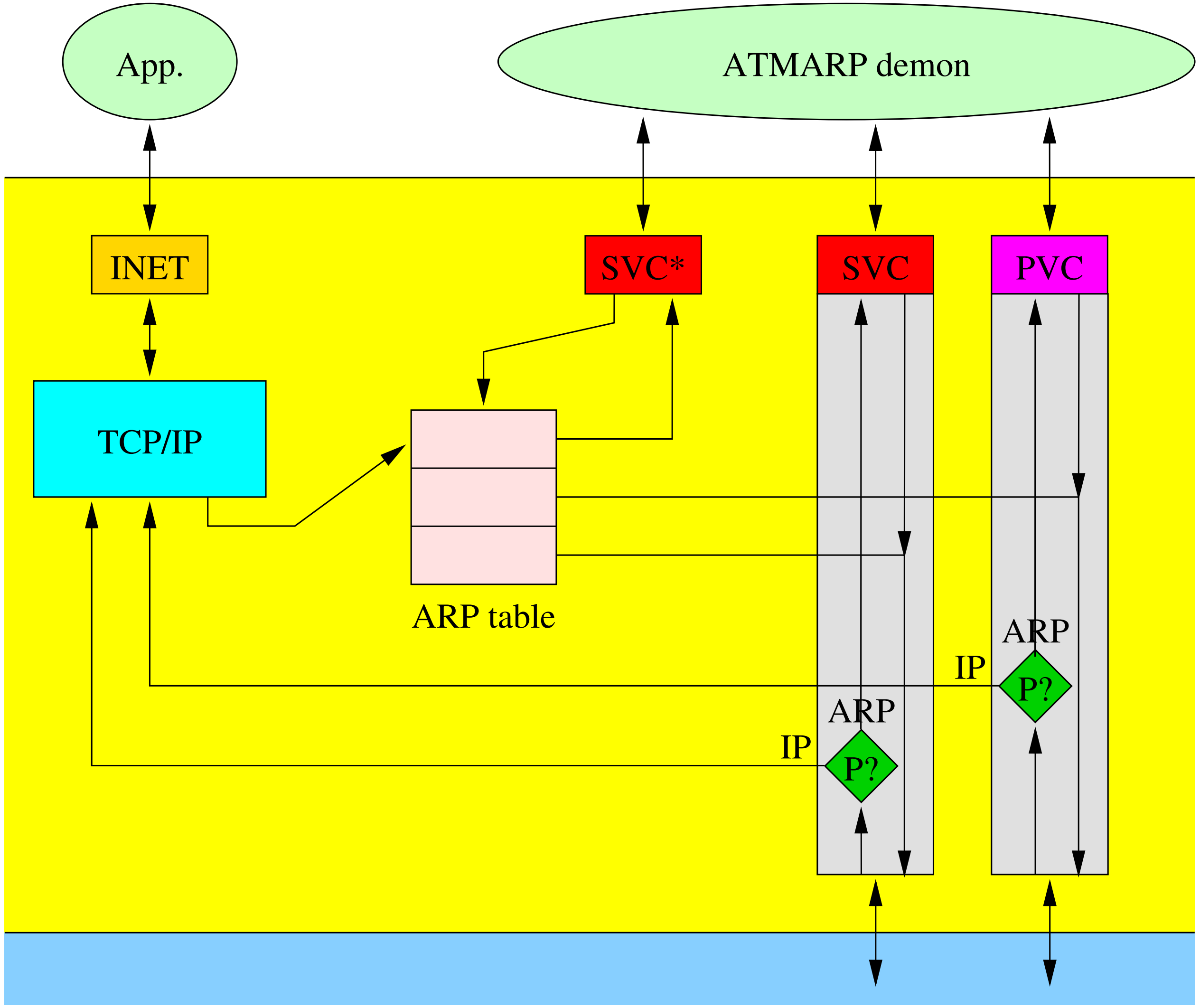
```
struct sockaddr_atmpvc addr;
int s;

s = socket(PF_ATMPVC,SOCK_DGRAM,ATM_AAL5);
memset(&addr,0,sizeof(addr));
addr.sap_family = AF_ATMPVC;
addr.sap_addr.itf = 0;
addr.sap_addr.vpi = 0;
addr.sap_addr.vci = 42;
addr.sap_txtp.class = ATM_CBR;
addr.sap_txtp.min_pcr = 10000;
addr.sap_txtp.max_sdu = sizeof(MESSAGE);
connect(s,(struct sockaddr *) &addr,sizeof(addr));
write(s,MESSAGE,sizeof(MESSAGE));
```

Classical IP over ATM

- General concept: Logical IP subnets
- Problem: Address resolution without broadcast
- All clients of a LIS register with its ARP server, which responds to resolution queries

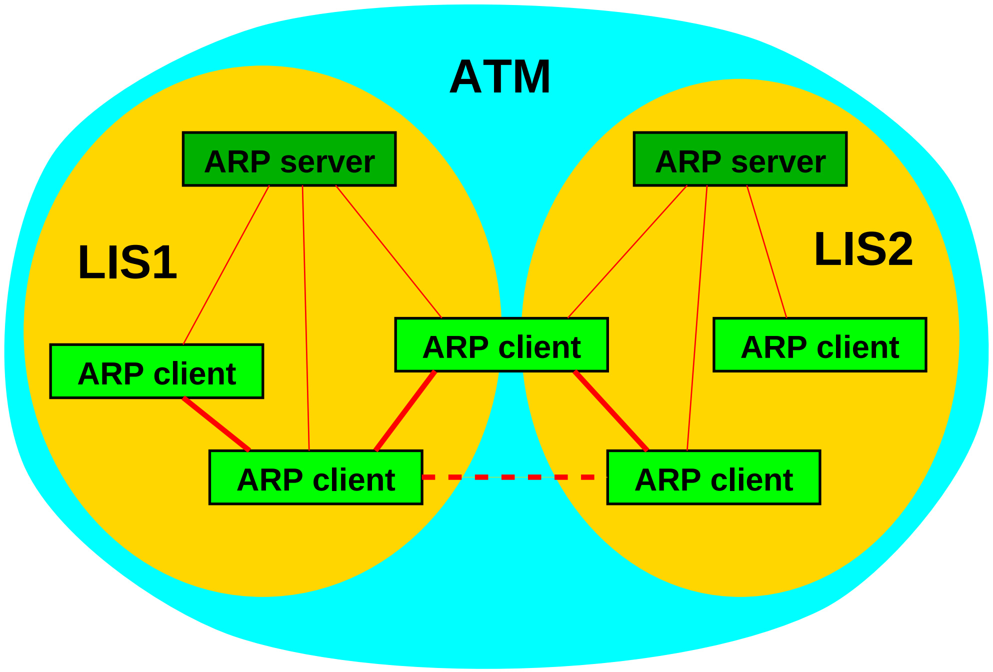


ATMARP implementation



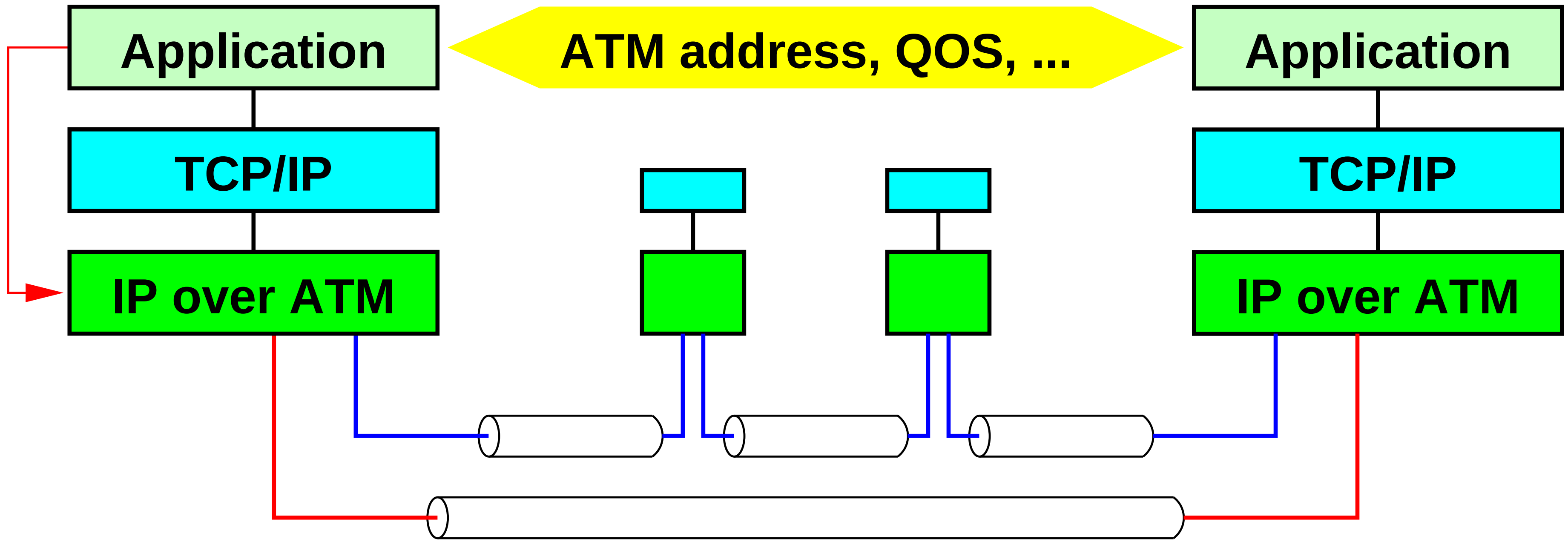
AREQUIPA

- QOS for IP needs RSVP, but ATM already supports this
- NHRP needed for direct IP over ATM connections
- Application requested IP over ATM is an "easy" solution

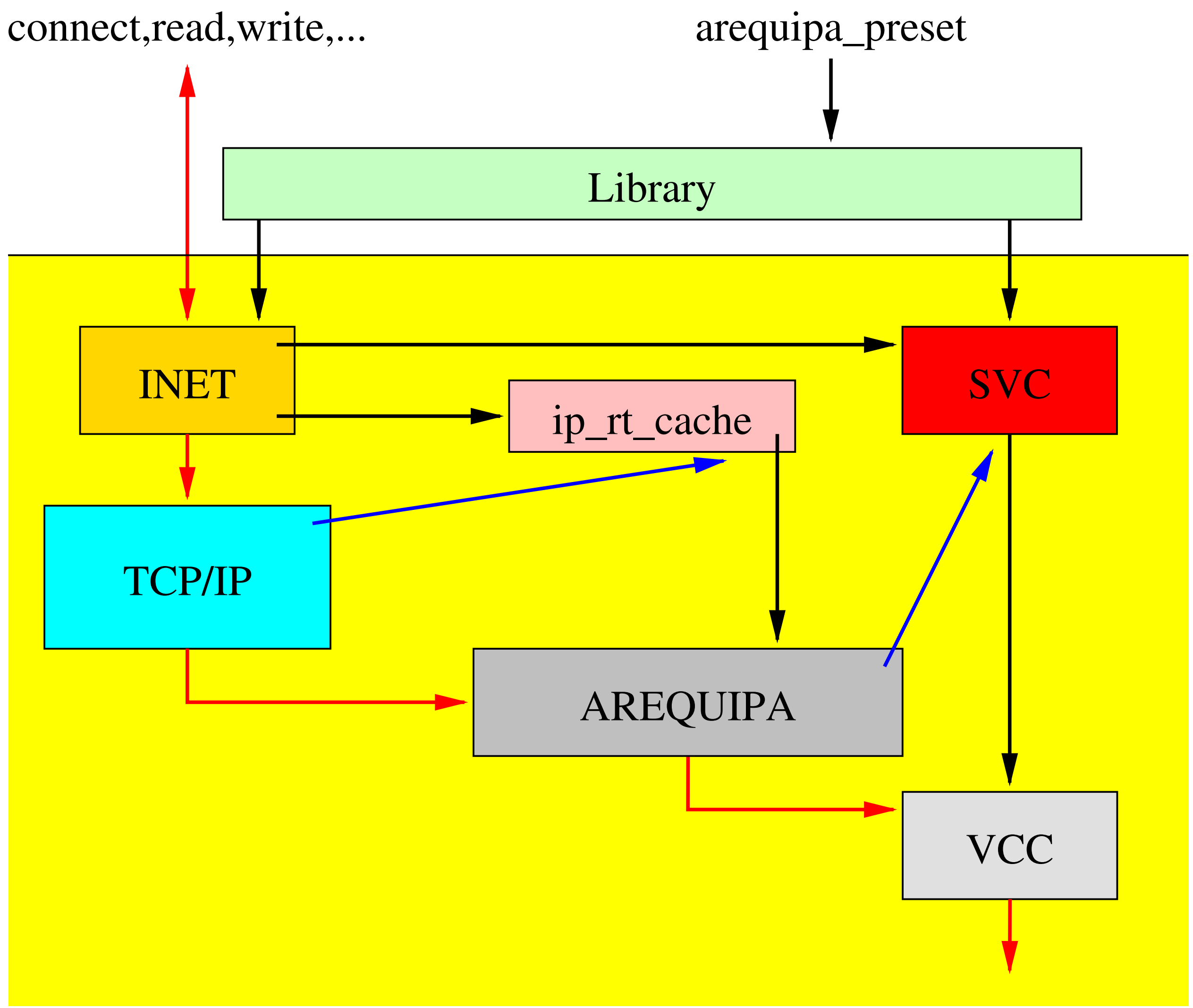


AREQUIPA concept

- Applications negotiate to request AREQUIPA
- SVC with appropriate QOS parameters is set up
- Exclusively traffic between those applications uses that SVC



AREQ. implementation



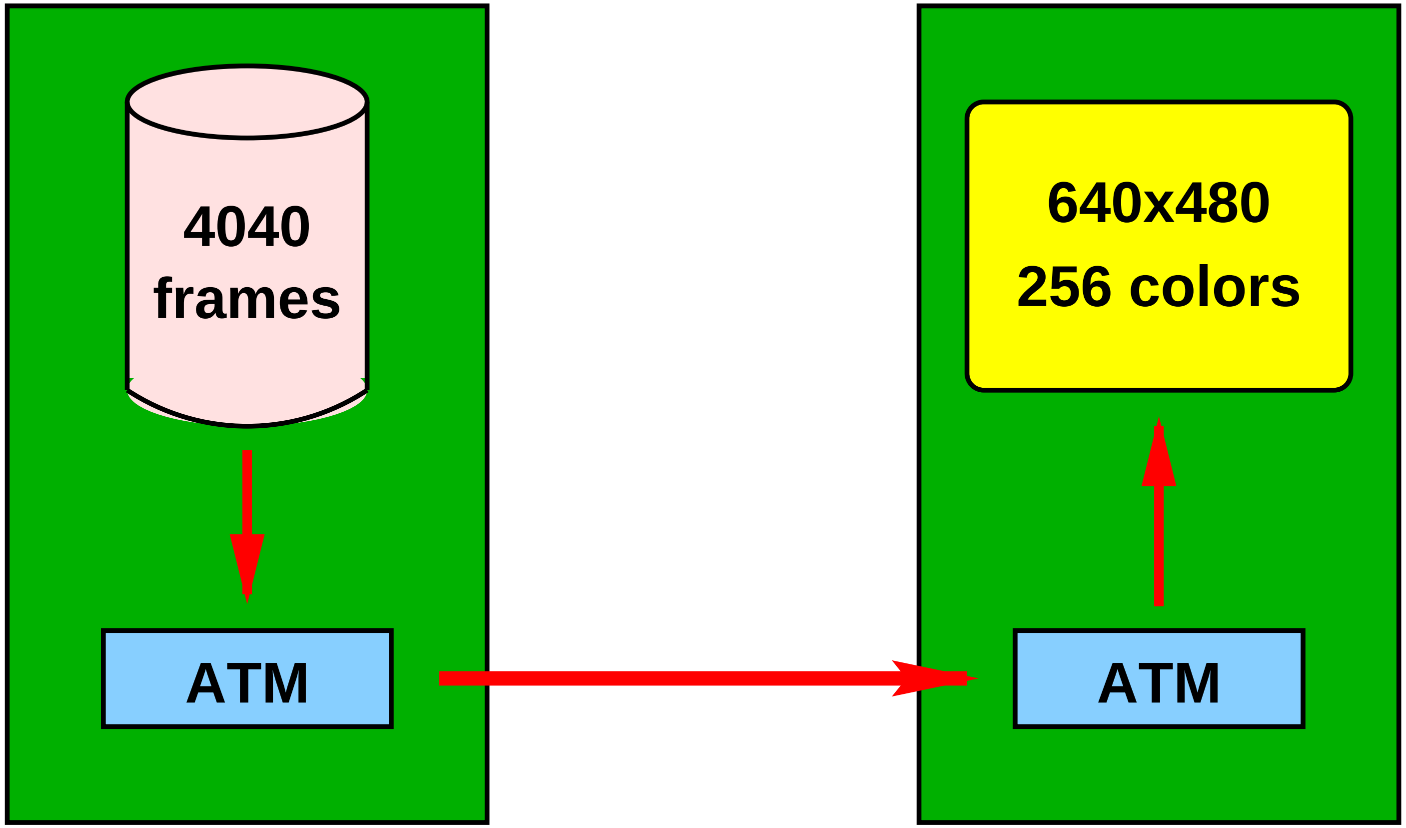
Current status

- ATM device drivers (ENI155p, ZN1221, TI TNETA1570)
- Native ATM socket API for PVCs and SVCs
- Single-copy for native ATM
- UNI 3.x signaling, including SSCOP and ILMI
- Classical IP over ATM for PVCs and SVCs (ATMARP)

The future

2Q96	• LAN Emulation • Arequipa • First high-end demo (Berlin)
3Q96-4Q96	• UNI 4.0 signaling • Multicast
1Q97	• Integration into mainstream Linux kernel

Demonstration setup



Filler

Filler