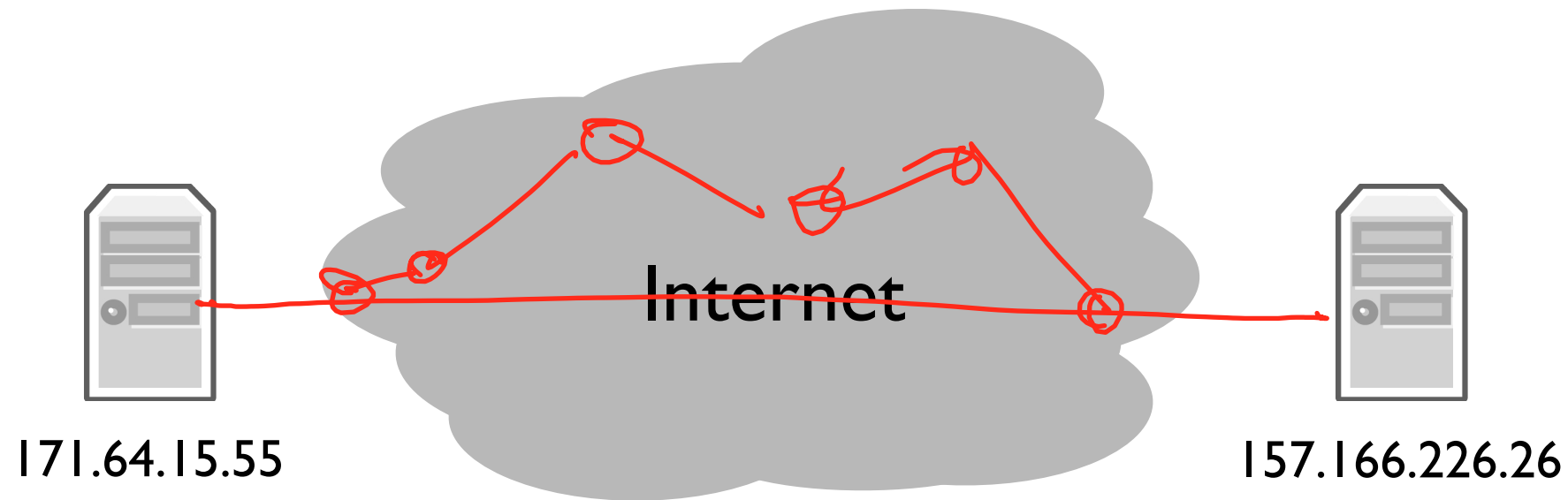


Network Address Translation

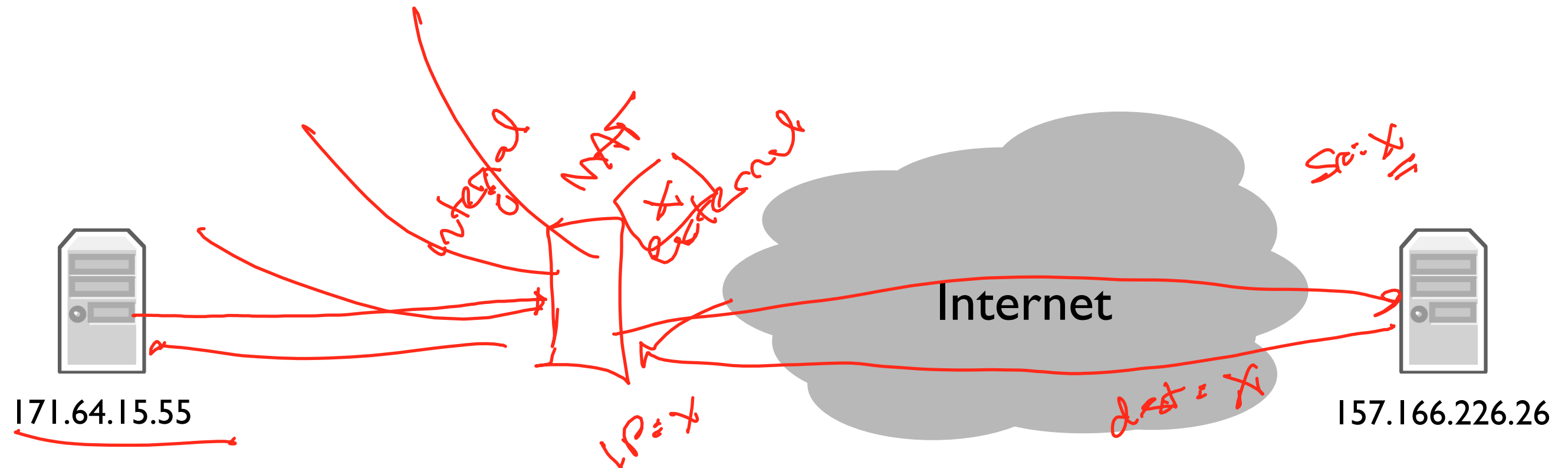
Strong End-to-End

- “The network's job is to transmit datagrams as efficiently and flexibly as possible. Everything else should be done at the fringes.”

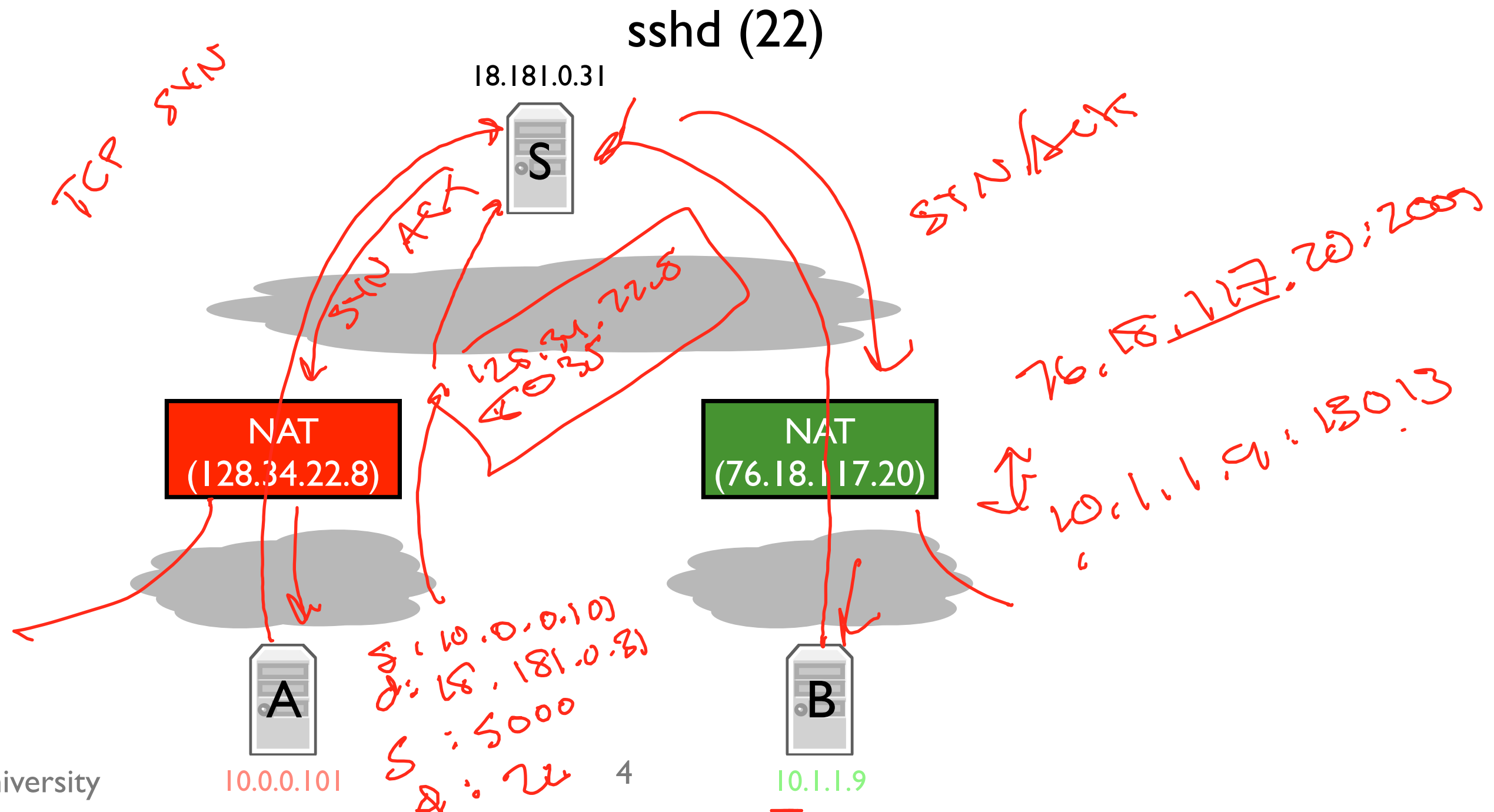


Network Address Translator (NAT)

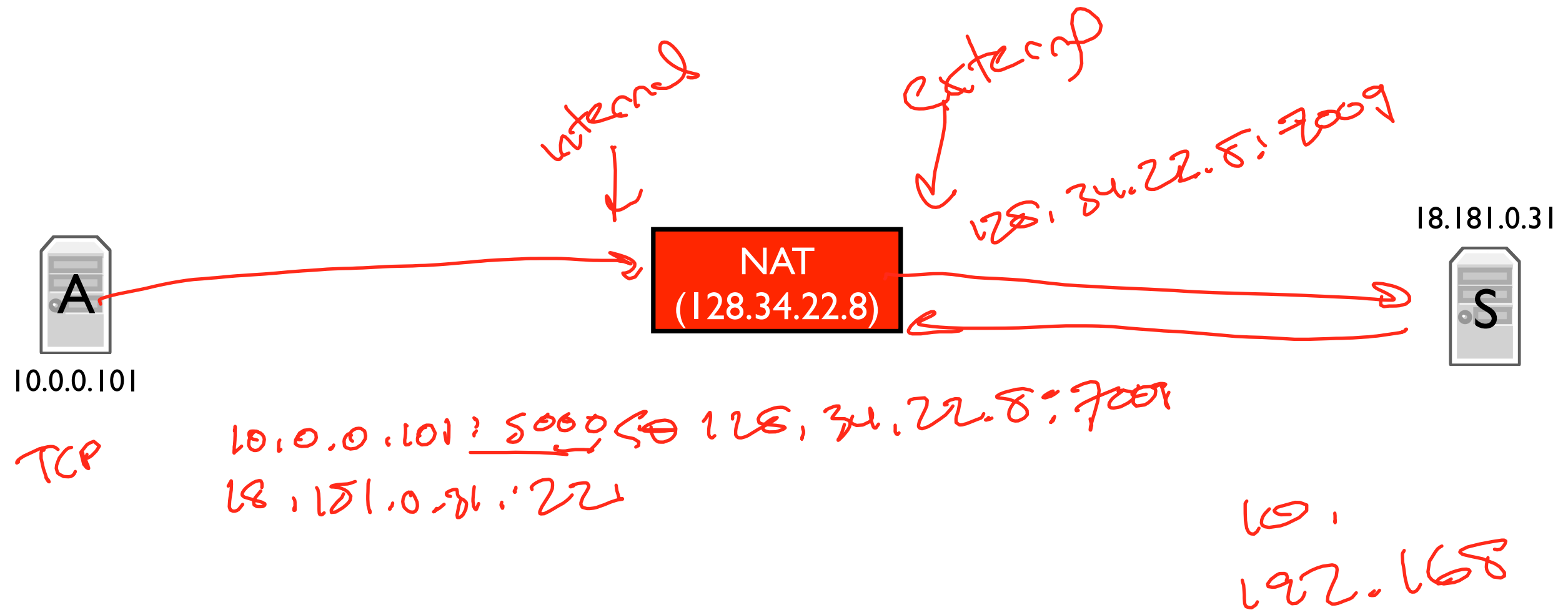
RFC 1631



NAT Example

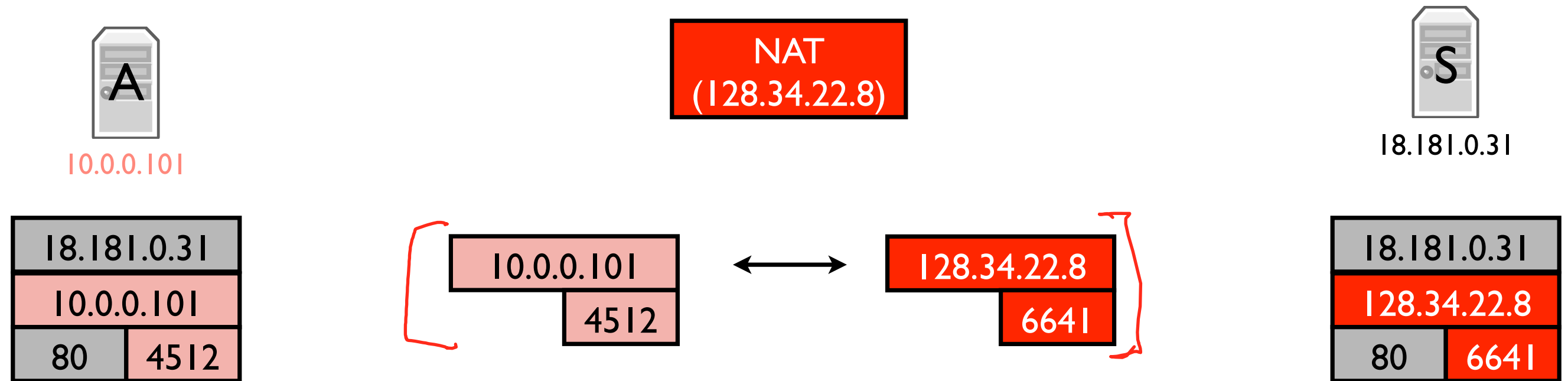


How a NAT Works



Types of NATs

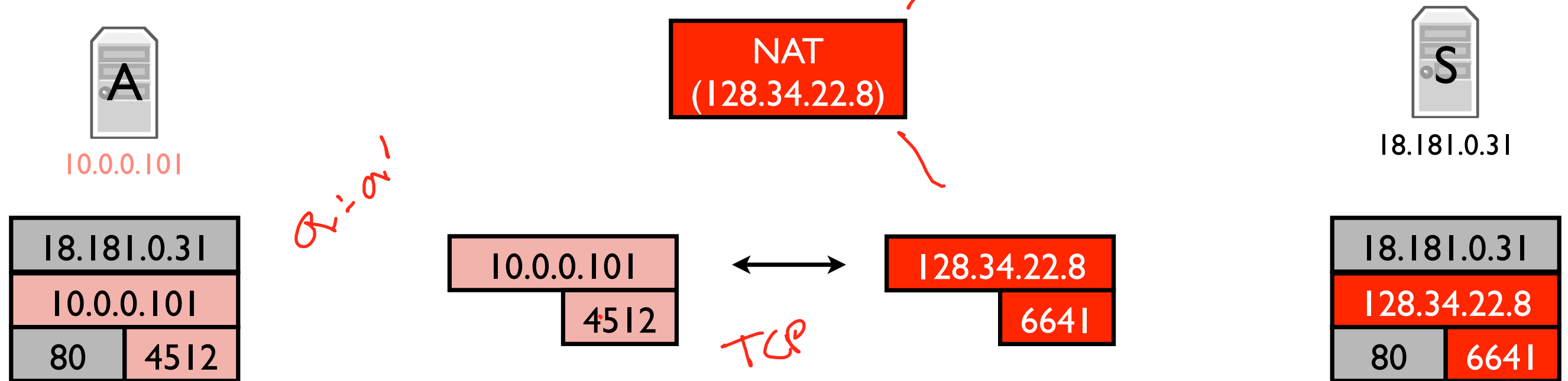
NAT Internal Mapping



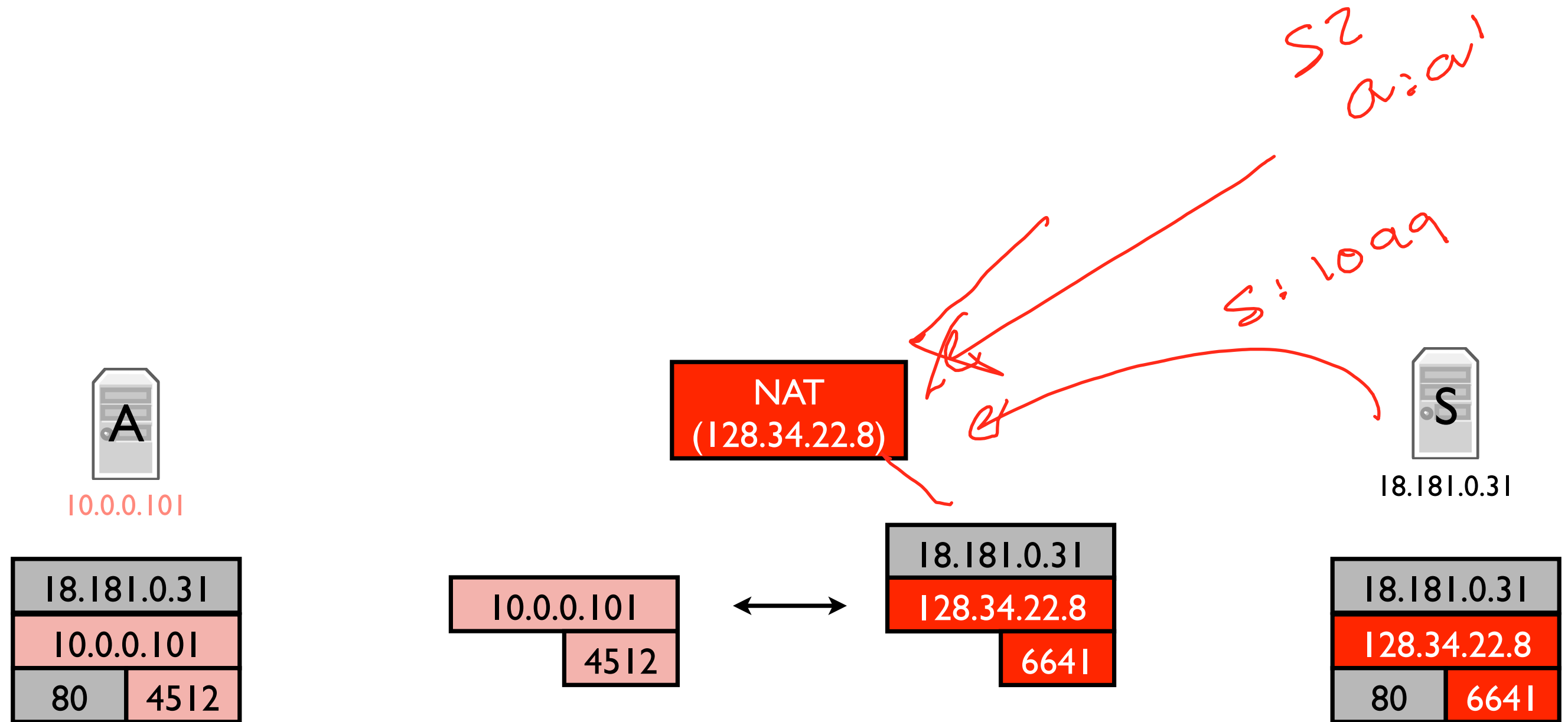
Two Questions

- What packets does a NAT allow to traverse mappings?
- How and when does a NAT assign mappings?
- NAT terminology/classification in RFC3489]

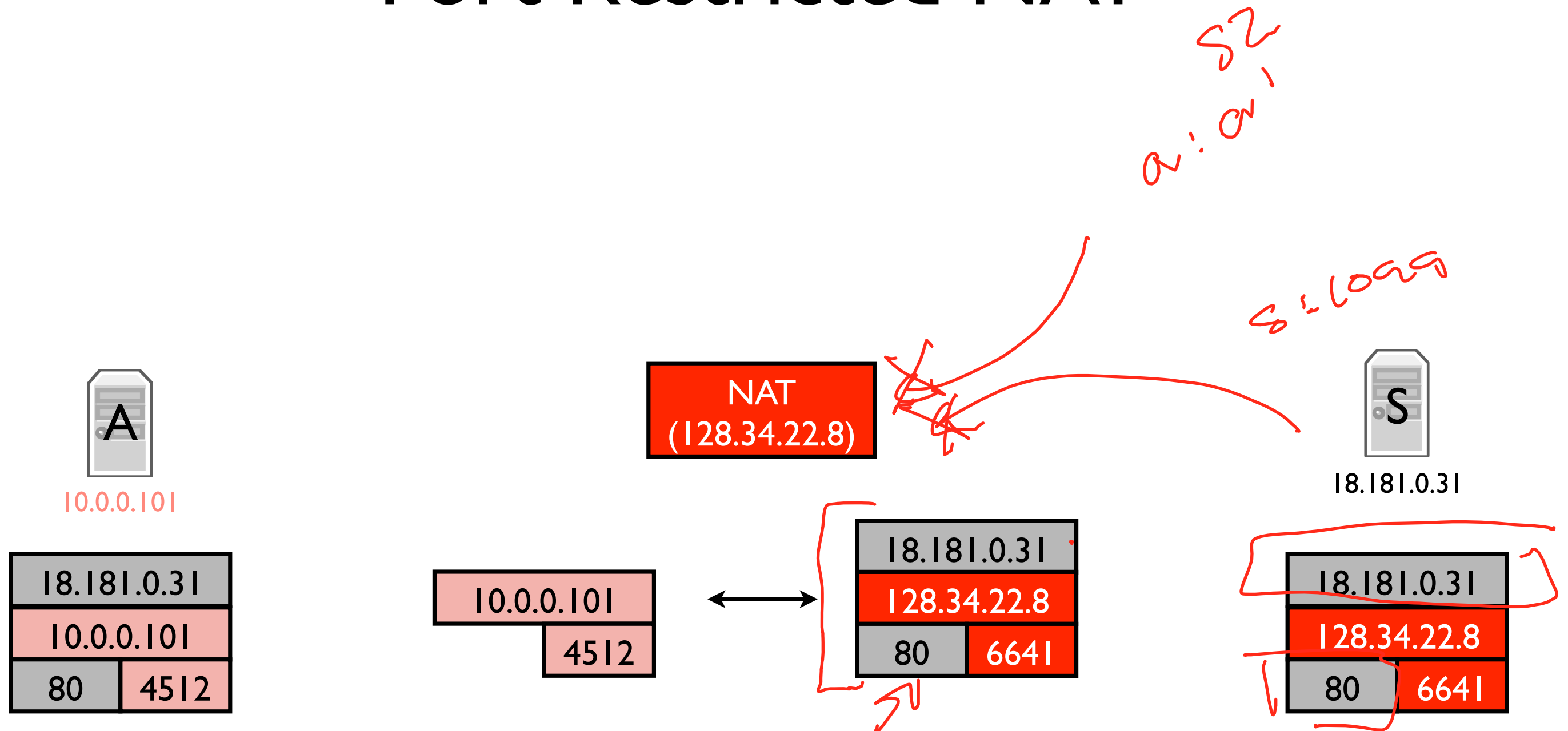
Full Cone NAT



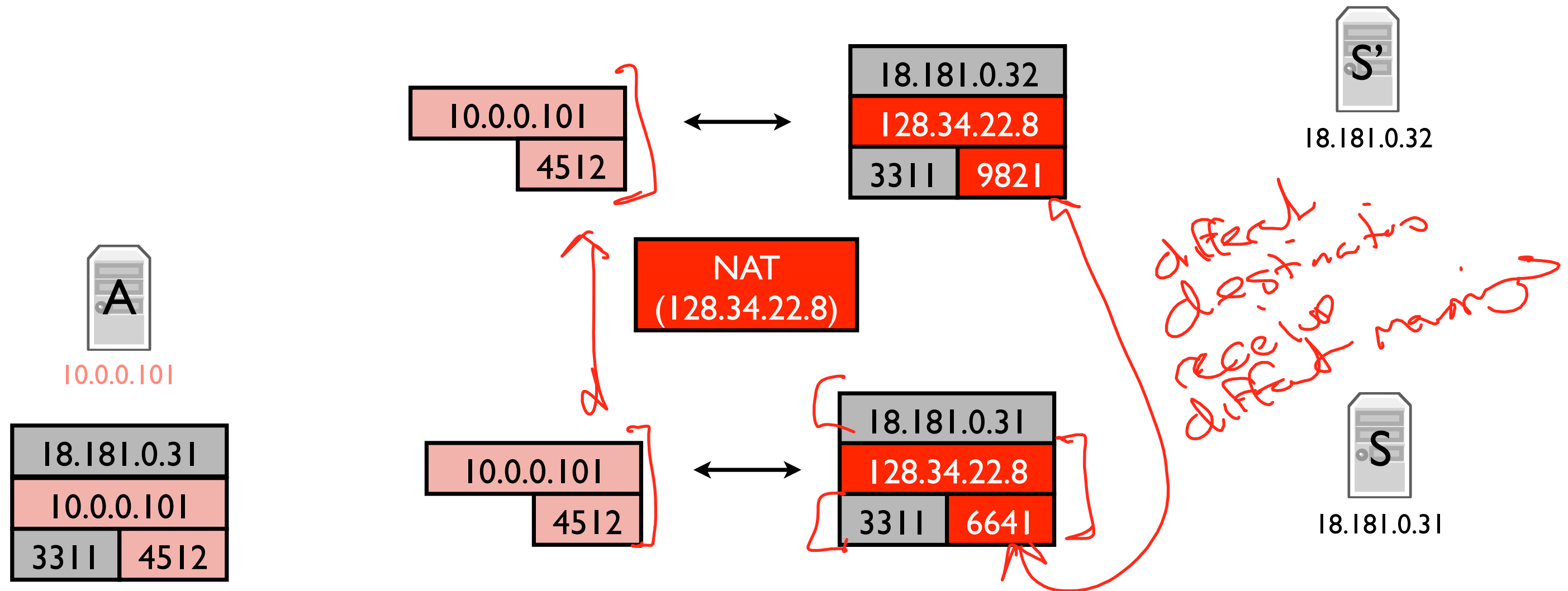
Restricted Cone NAT



Port Restricted NAT



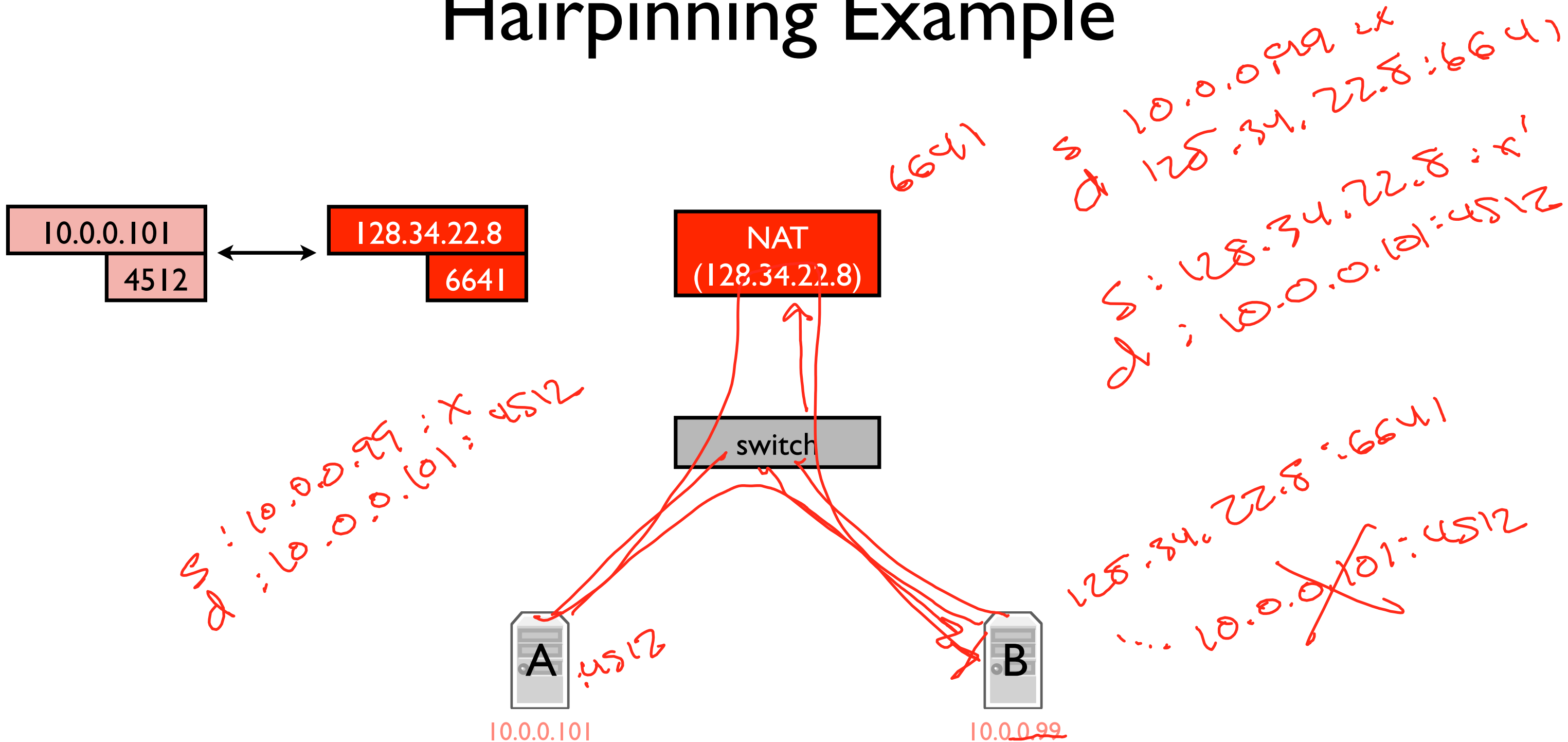
Symmetric NAT



NAT Behavioral Recommendations

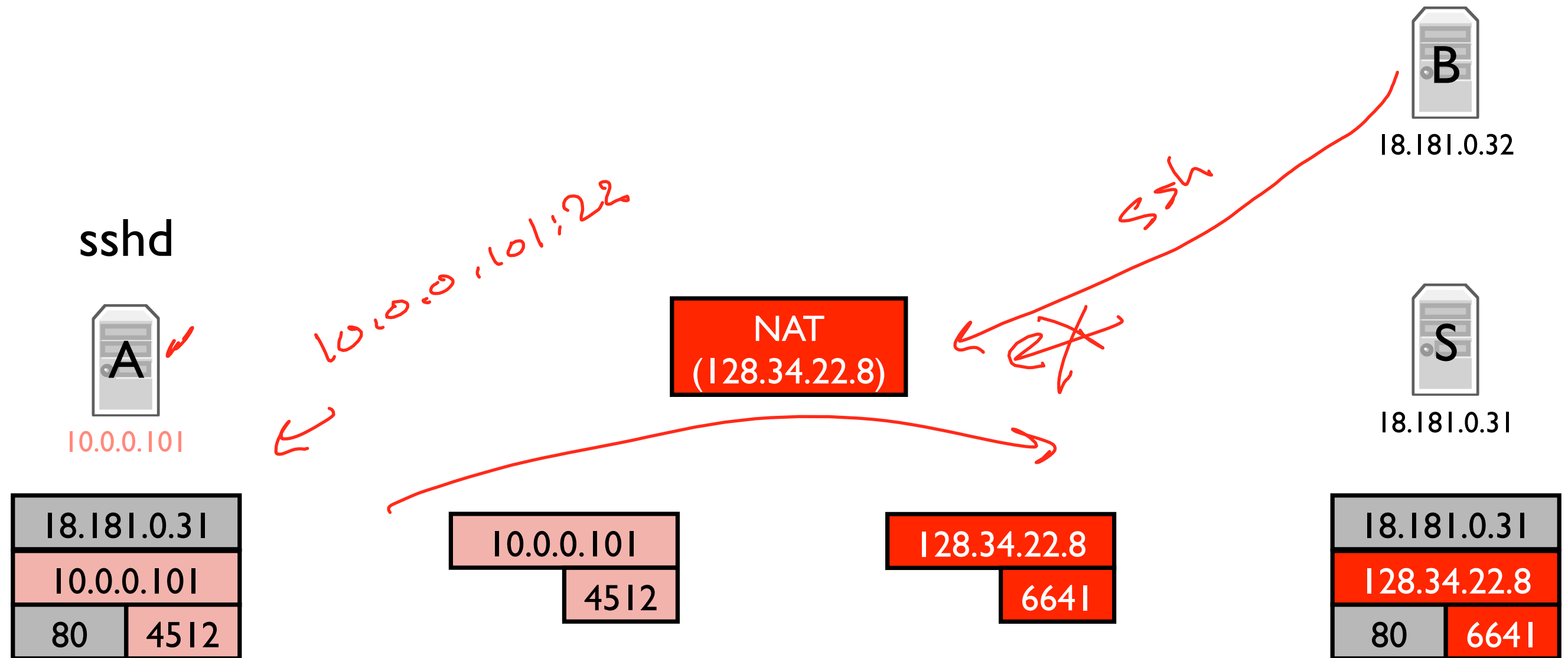
- More complications: static mappings, triggers, more complex behaviors
- TCP recommendations: RFC5382
- UDP recommendations: RFC4787
- Hairpinning: packet from internal address to external address translated properly (internal mapped to external)

Hairpinning Example

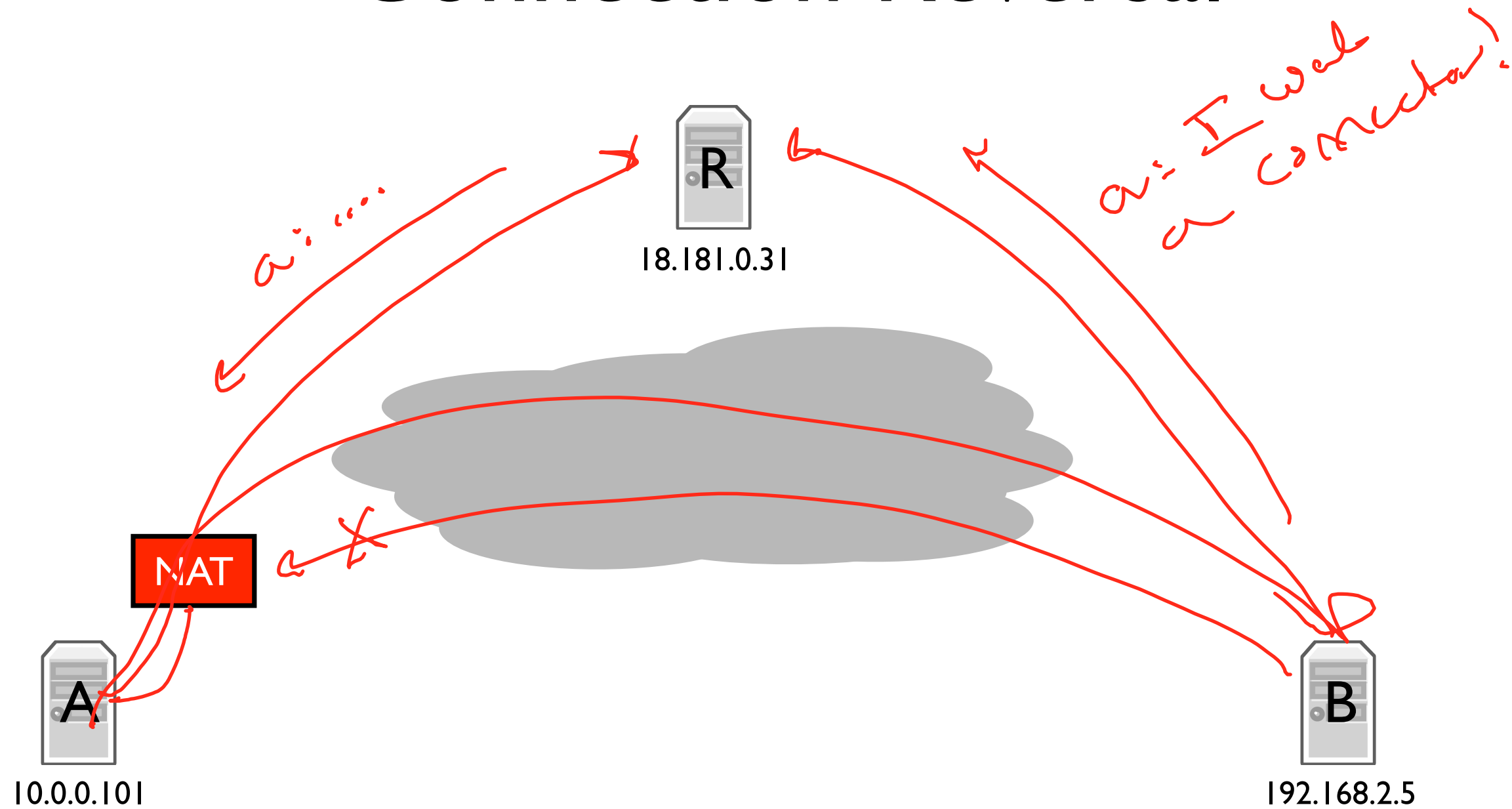


NAT Implications

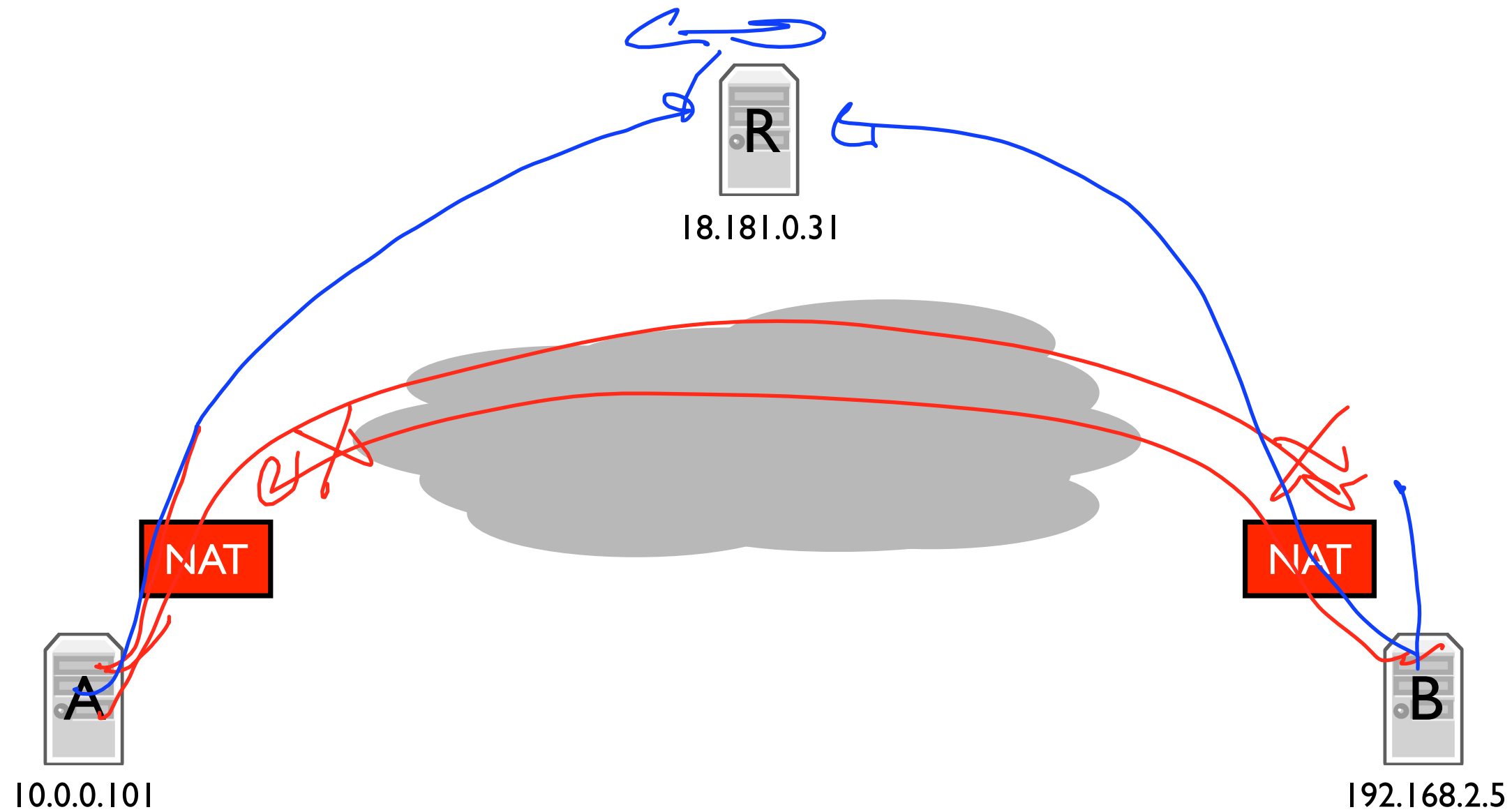
Applications: Incoming Connections



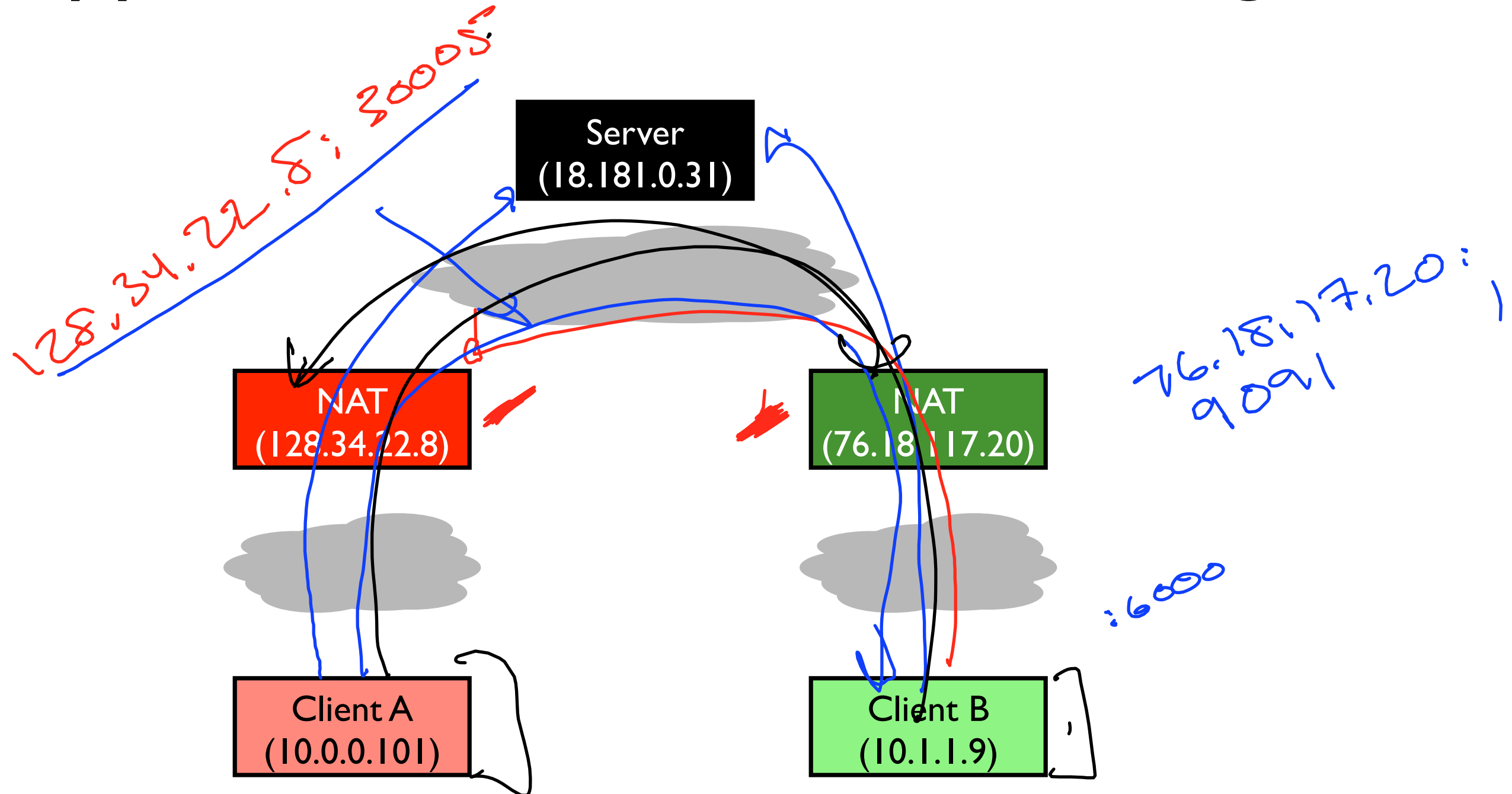
Connection Reversal



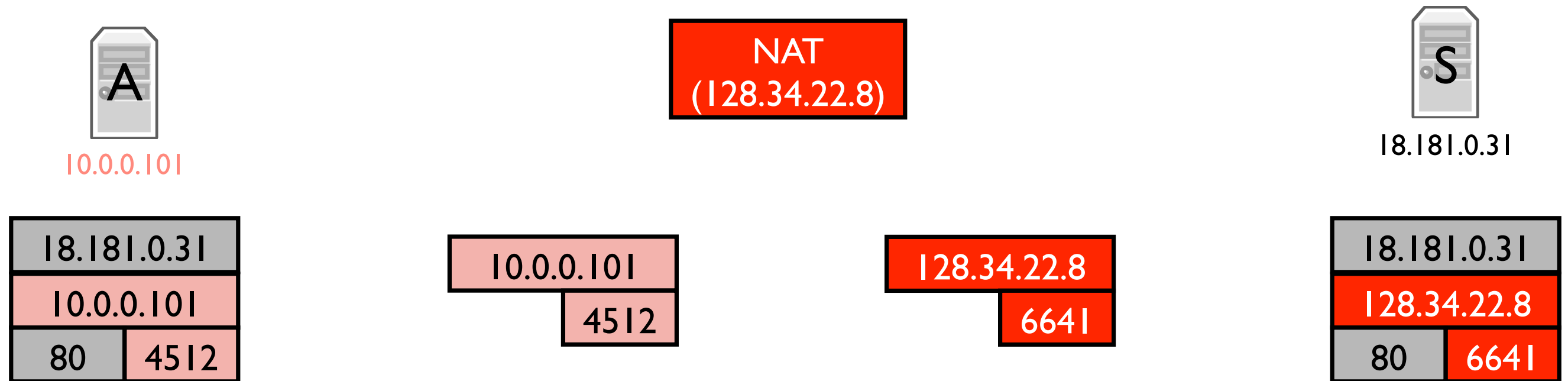
Relays



Applications: NAT Hole-Punching



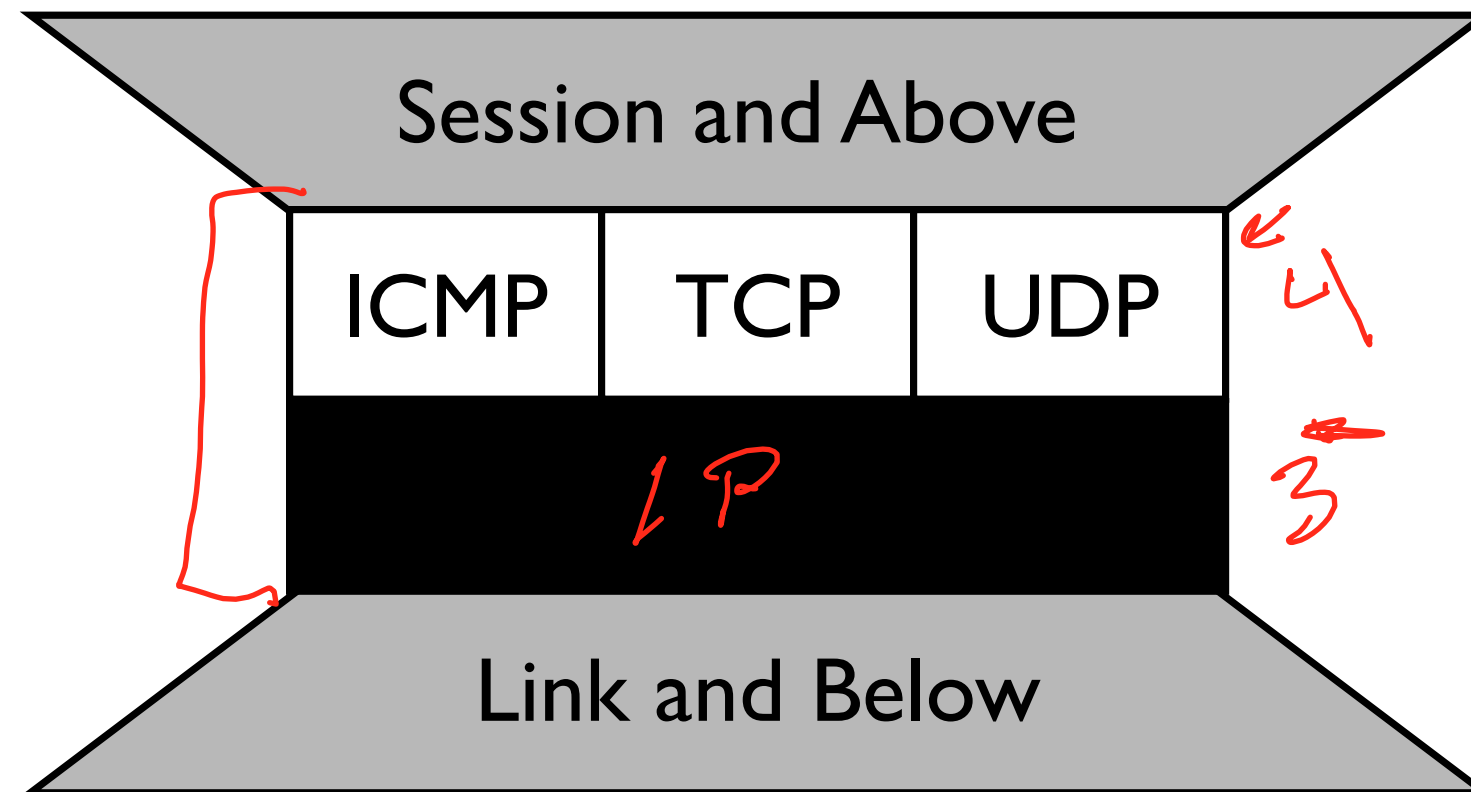
Transport: No New Transport!



NAT Debate

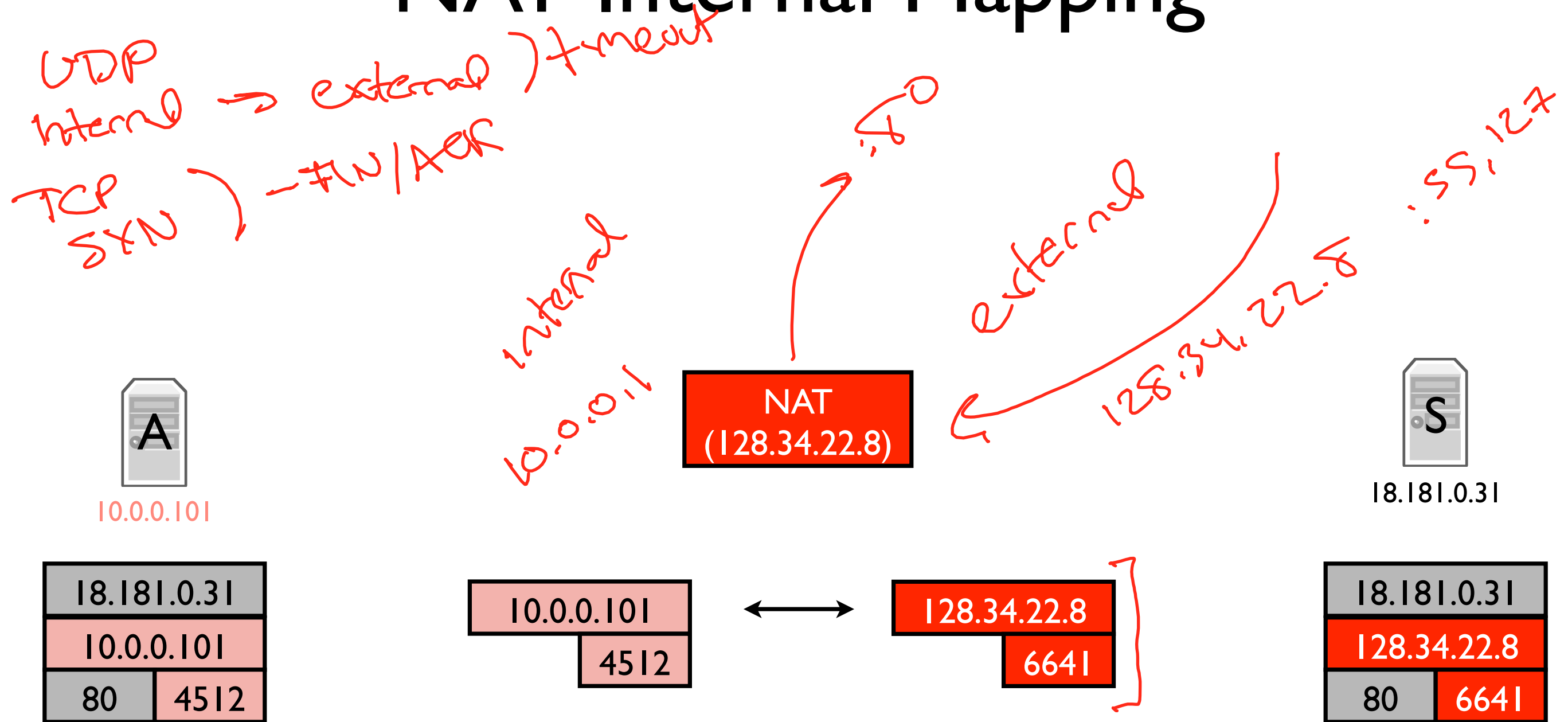
- Tremendously useful
 - ▶ Reuse addresses
 - ▶ Security (not opening connections can be good!)
- Tremendously painful
 - ▶ Large complication to application development
 - ↳ ▶ Speak Freely (pre-Skype VoIP!)
- Debate interesting but pointless: NATs are here to stay

The New Hourglass



NAT Operation Details

NAT Internal Mapping



UDP

- RFC4787

TCP

- RFC5382