1. Introduction: Problem Statement

- If global IPv4 address are shared between several clients, assignable port resources at each client will be limited.
  - Static port-assignment in CGN, A+P… , accelerate this problem

be limited.
- Static port-assignment in CGN, A+P… , accelerate this problem

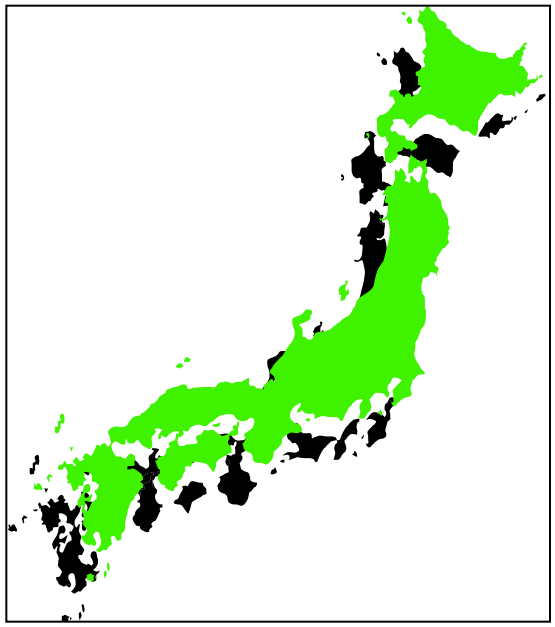
Whole address were available

Shared with some people

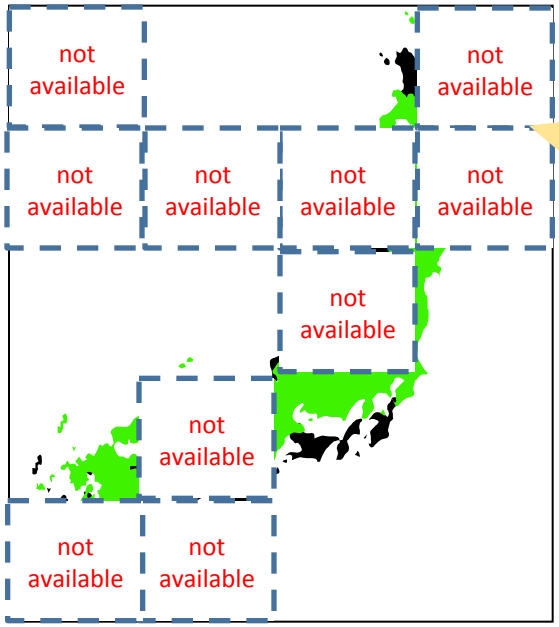
Shared with too many people

port restricted network

non-port-restricted network



network



A part of a website (e.g. map site) cannot be displayed.

What is the cause ?

- Analyses
  - Single session occupies a NAT external port exclusively. In nature, a port can be multiplexed by plural connections.
  - TIME_WAIT state of each TCP connection is kept for long time (2MSL) at NAT, which occupies the port for long time.

To solve this problem…

- TIME_WAIT to 0 sec.

- But, it spoils the aims of TIME_WAIT.

  A-1) It prevents duplicates from earlier incarnations.

  A-2) It makes sure the remote TCP received the ACK of its connection terminate request.

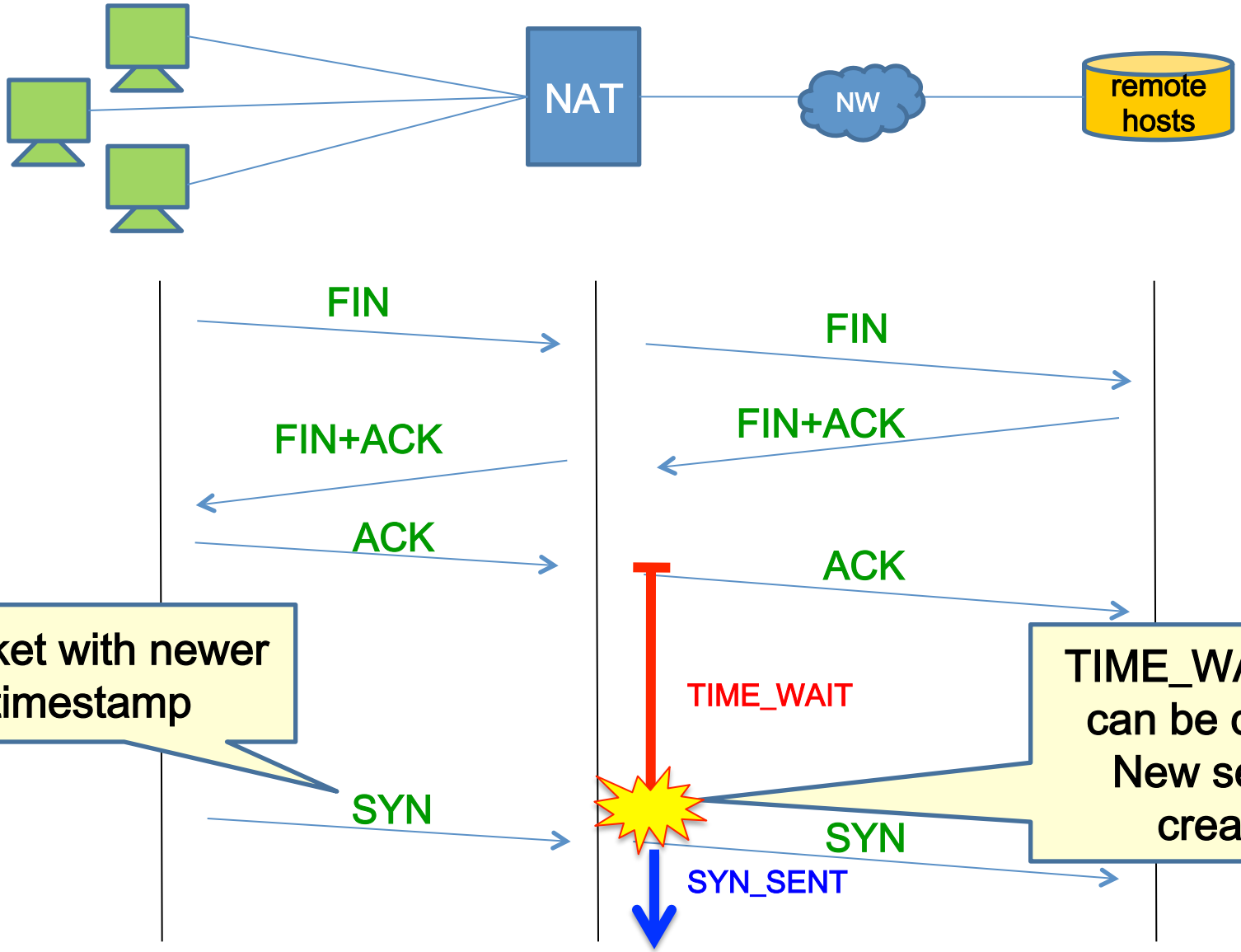
Apply RFC 6191/1323 at NAT

TCP Timestamps

- A TIME_WAIT state can be deleted, when a TCP-SYN packet carrying a larger timestamp value arrives.
- RFC1323: Protect Against Wrapped Sequence Numbers(PAWS) discard old duplicate packets
- A segment can be discarded if it has a timestamp less than the latest timestamp received.

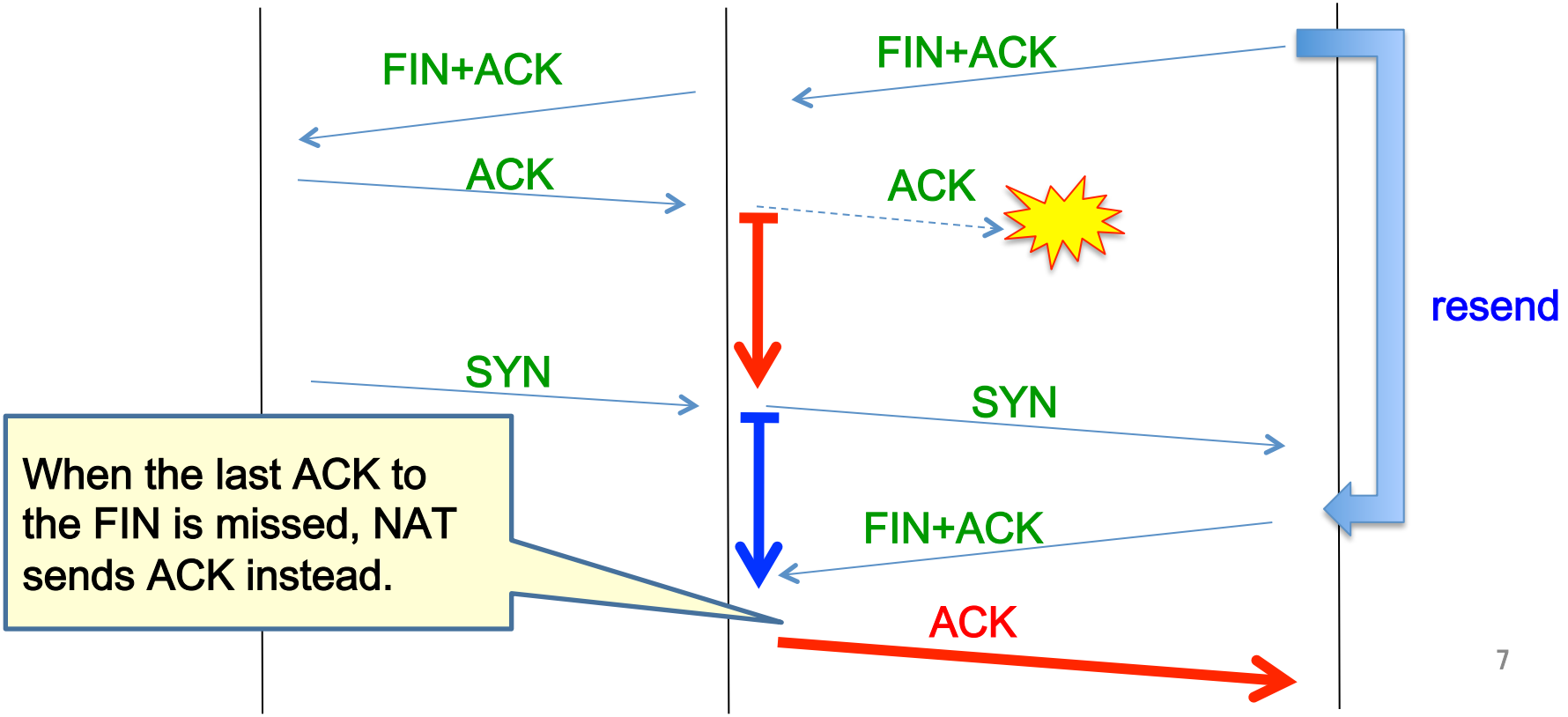
- A segment can be discarded if it has a timestamp less than the latest timestamp received.

Sequence


NAT
NW
remote hosts
FIN
FIN
FIN+ACK
FIN+ACK
ACK
ACK
Packet with newer timestamp
TIME_WAIT
TIME_WAIT state can be deleted. New session created.
SYN
SYN
SYN_SENT

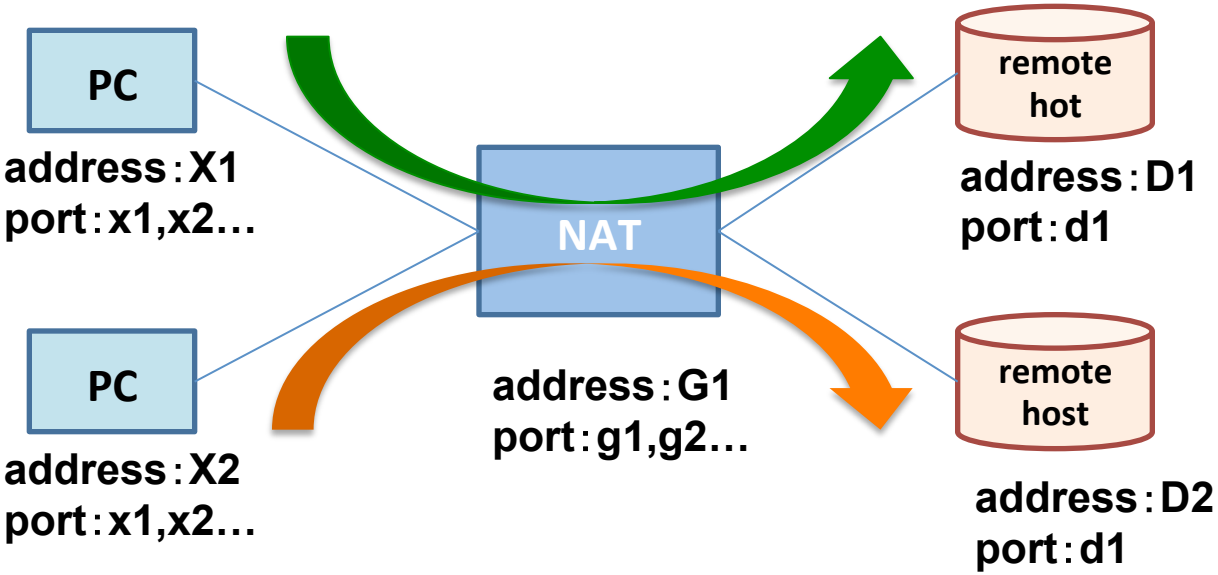
Can this preserve the aims of TIME_WAIT?

- A-1) Duplicates from earlier incarnations
  →Can be discarded by the proposed mechanism.
- A-2) Reliable delivery of the last ACK to the remote TCP
  →Needs the following mechanism.



Proposal2:
Apply Port overlapping to NAT

- Port overlapping behavior
  - If destinations are different, NAT MAY assign the same external port.



X1,x1 →(translated:G1,g1)→ D1,d1
X2,x1 →(translated:G1,g1)→ D2,d1

Questions and Comments?

- Two address saving mechanisms are proposed.
  - Proposal1: Enables safe reduction of TIME_WAIT states.
  - Proposal2: Boosts the number of concurrent connections.
  - These proposals are independent.

- This proposal may effect TCP behavior between clients and remote hosts, so comments are needed.
  - We have already introduced this proposal at behave interim, and been advised to do so.