SATSiX Mobility Architecture and its performance evaluation

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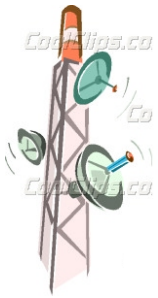


Mobility architecture in SatSix

- Three mobility scenarios defined
  - discrete/nomadic mobility
  - continuous mobility
  - seamless mobility
- Two mobility contexts according to network hierarchy
  - macro-mobility
  - micro-mobility
- Performance and mobility management using MIPv6 extensions
  - HMIPV6, FMIPv6 and the combination FHMIPv6
- Application mobility as a complement to network layer mobility
- Mobility impacts on other key networking functions like
  - Multicast
  - PEP
  - QoS

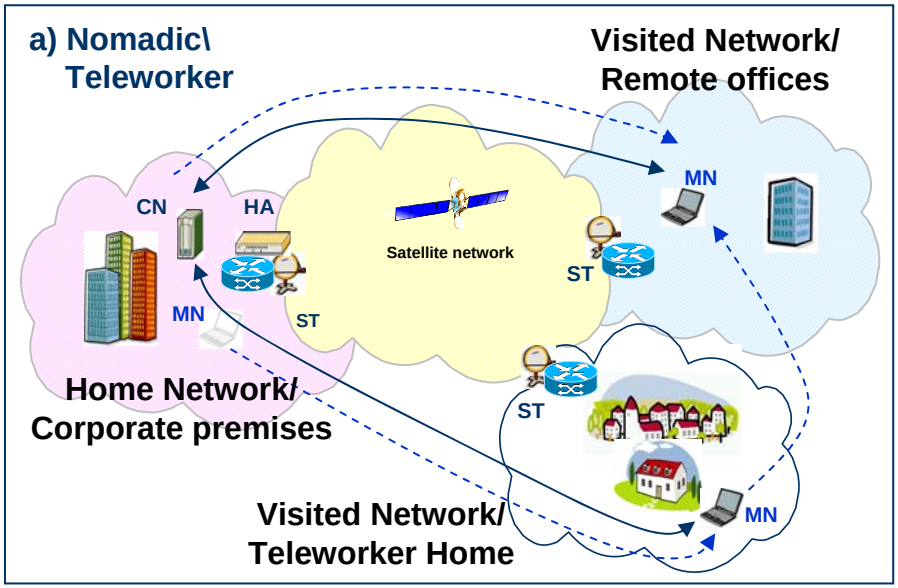
Functional requirements of mobility architecture

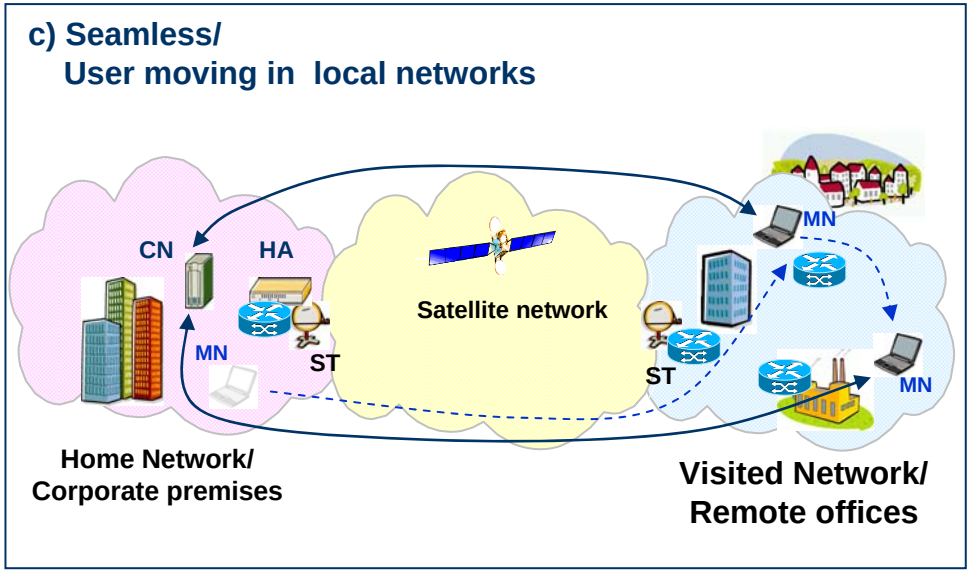
Mobility scenarios

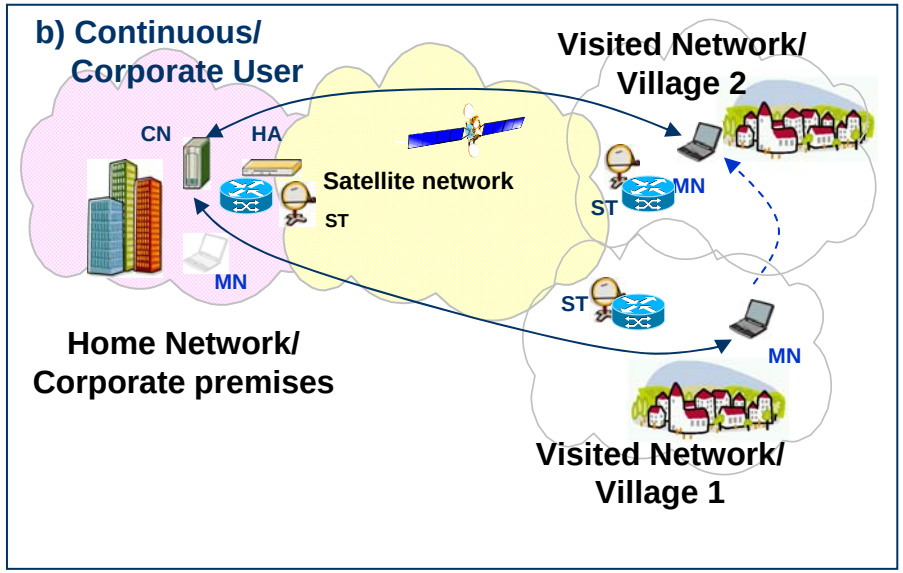
a) **Nomadic (or roaming)** mobility (macro) (e.g. Teleworker moving to his home)

b) **Continuous mobility (macro)** (e.g. Corporate User in rural domain)

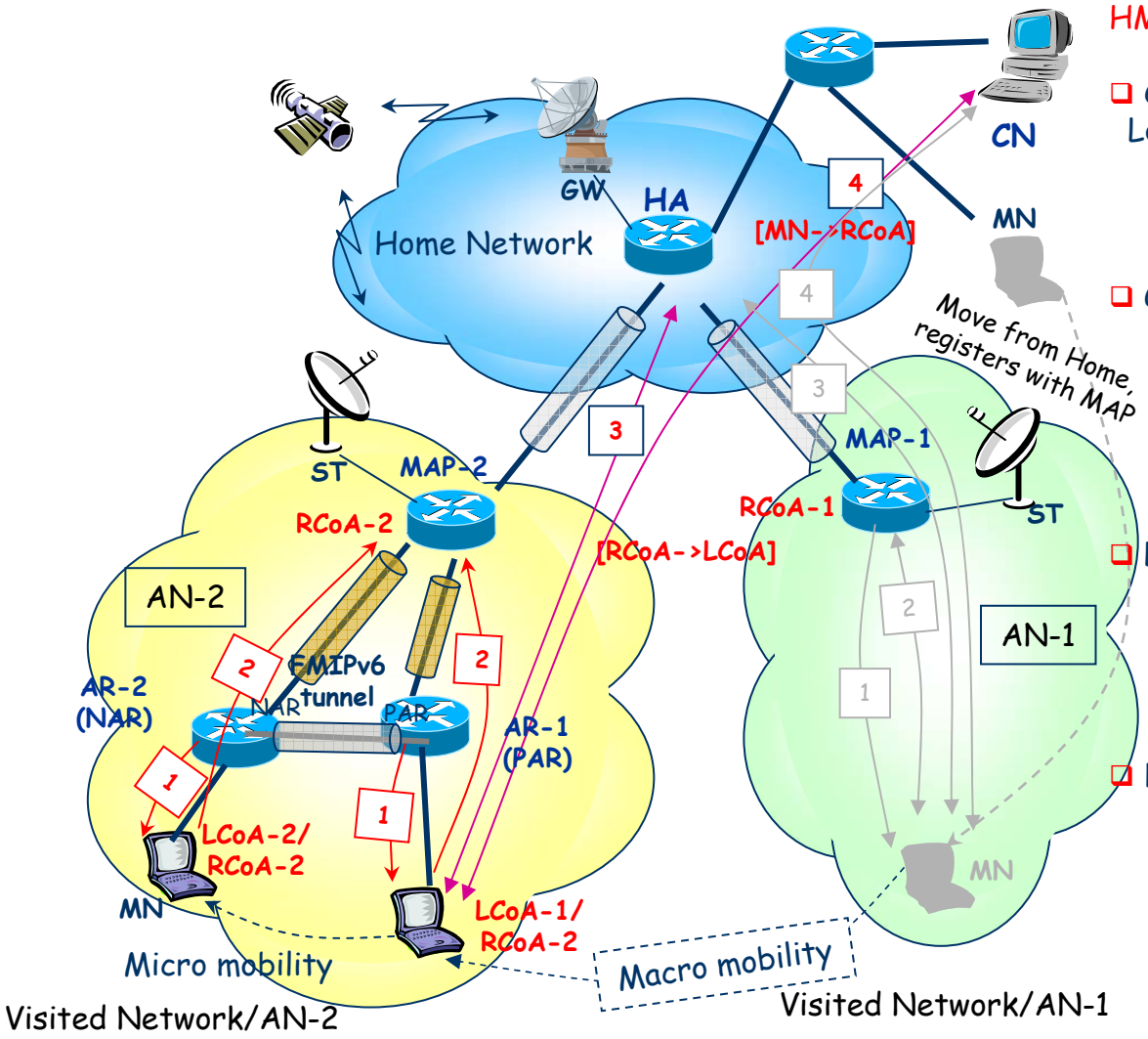
c) **Seamless mobility (micro)** (e.g. User moving to a visited network linked with one satellite terminal, but composed of several separate local networks







Network layer mobility - optimising MIPv6 with HMIPv6



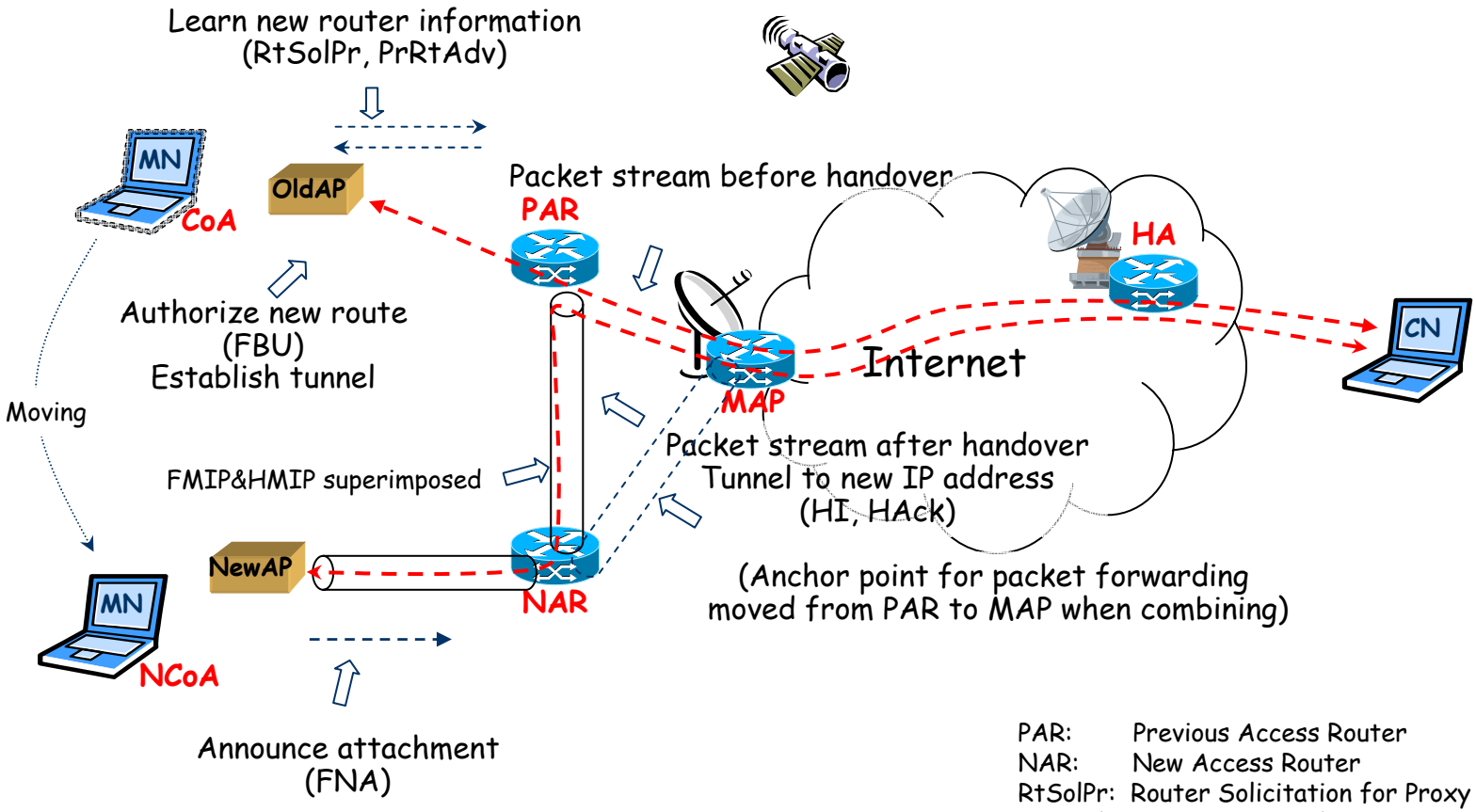
HMIPv6 Signalling with MAP

- CoA splits into Regional-CoA (RCoA) and Local-CoA (LCoA)
  - RCoA identifies region (AN)
  - LCoA identifies access point (AR)
- Global/macro movement from AN-1 to AN-2
  - MN learns discovery of new MAP(1)
  - MN registers LCoA with MAP (2)
  - MN registers (BU/BUAck) RCoA with HA and CNs (3), (4)
- Local movement requires single registration
  - MN learns the availability of the same MAP (1)
  - MN registers new LCoA with same MAP (2)
  - For HA and CNs the RCoA has not changed
- FMIPv6
  - Tunneling between PAR and NAR until new LCoA has been registered

Home Agent at Sat-GW

AR: Access Router
MAP: Mobility Anchor Point
MN: Mobile node
AN: Access Network
LCoA: Local Care-of Address
PAR: Previous Access Router
RCoA: Regional Care of Address
MS: Mobile Station
SS: Subscriber Station
BU: Binding Update
BUAck: Binding Update Acknowledgement
NAR: Next Access Router

Network layer mobility - optimising HMIPv6 with FMIPv6 / FHMIPv6



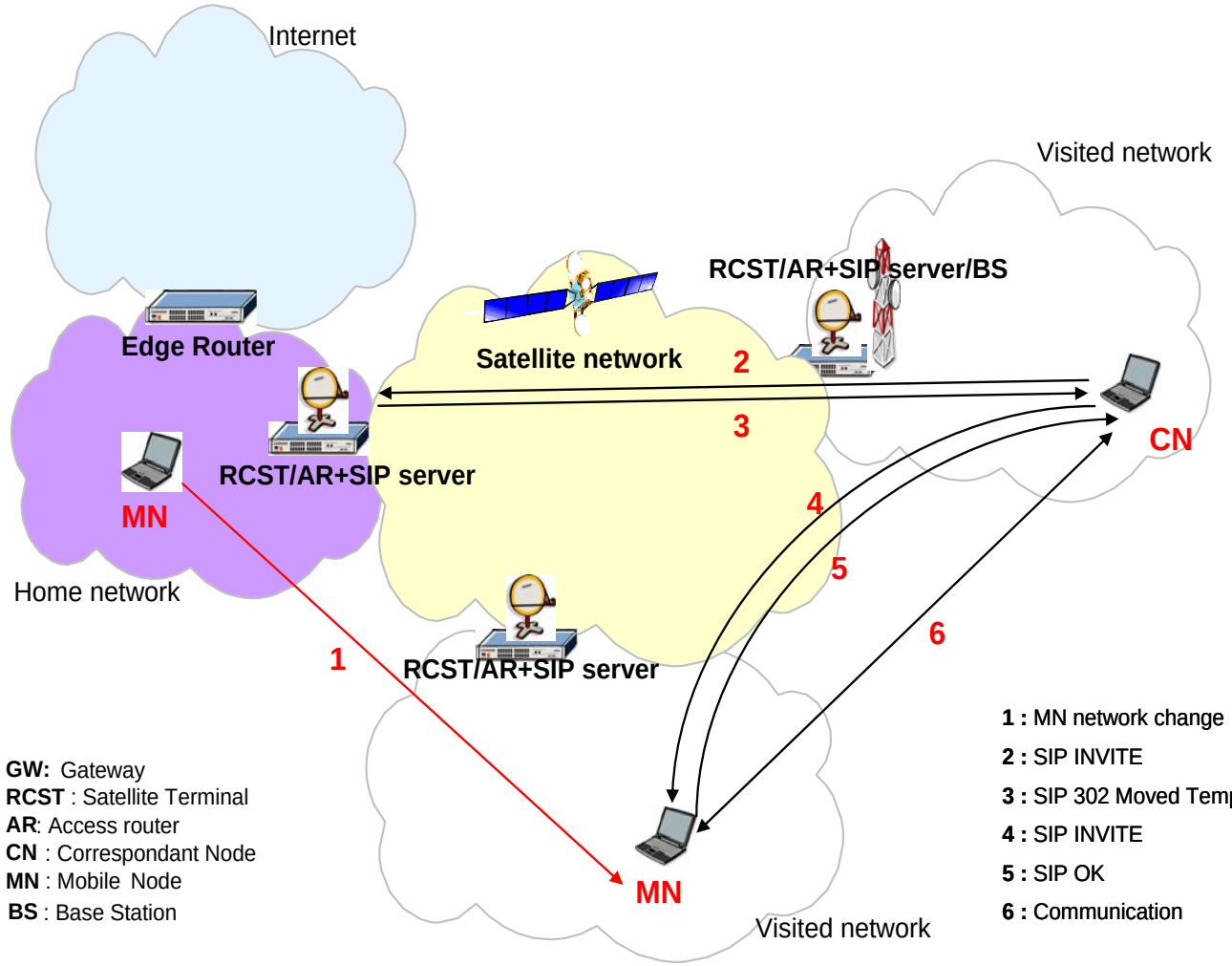
- Prefix discovery and tunneling
- Prefix discovery requires that nearby APs are detected before handover is conducted

PAR: Previous Access Router
NAR: New Access Router
RtSolPr: Router Solicitation for Proxy Advertisement
PrRtAdv: Proxy Router Advertisement
FBU: Fast Binding Update
FNA: Fast Neighbour Advertisement
HI: Handover Initiate
Hack: Handover Acknowledge
NCoA: New Care of Address
AP: Access Point

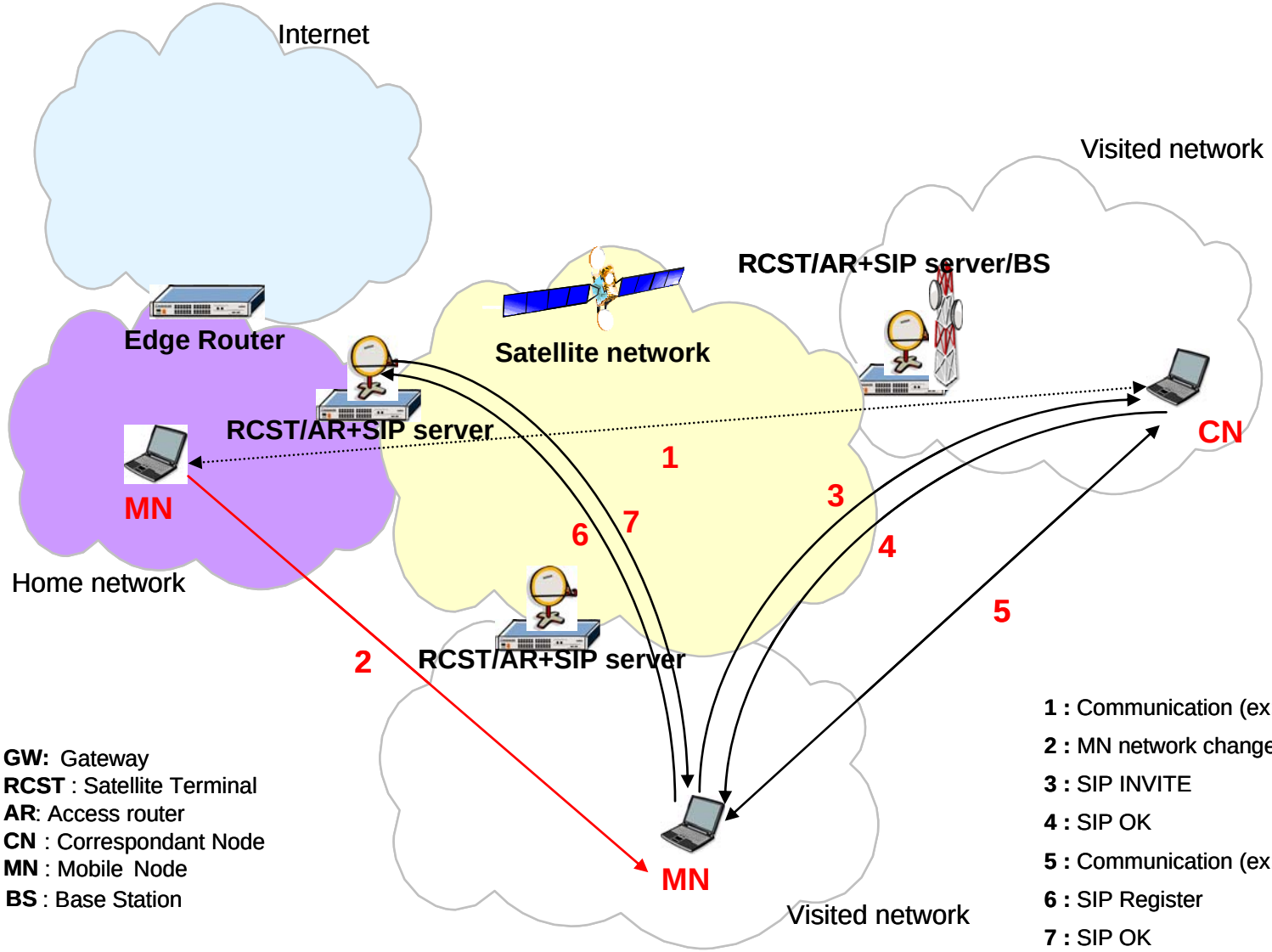
SIP Application layer mobility (1)

- The Session Initiation Protocol (SIP) is an application-layer signalling protocol
  - creating, modifying and terminating sessions
- SIP is based on a client-server architecture
- User Agents (UA) originate and terminate sessions
- Localization Servers (LS) locate the user agents
- Registrar Servers (RS) provide databases in which the location of the users is stored and modified
- Proxy Servers (PS) relay requests to another server

SIP Application layer mobility - Nomadic



SIP Application layer mobility - Mid Call



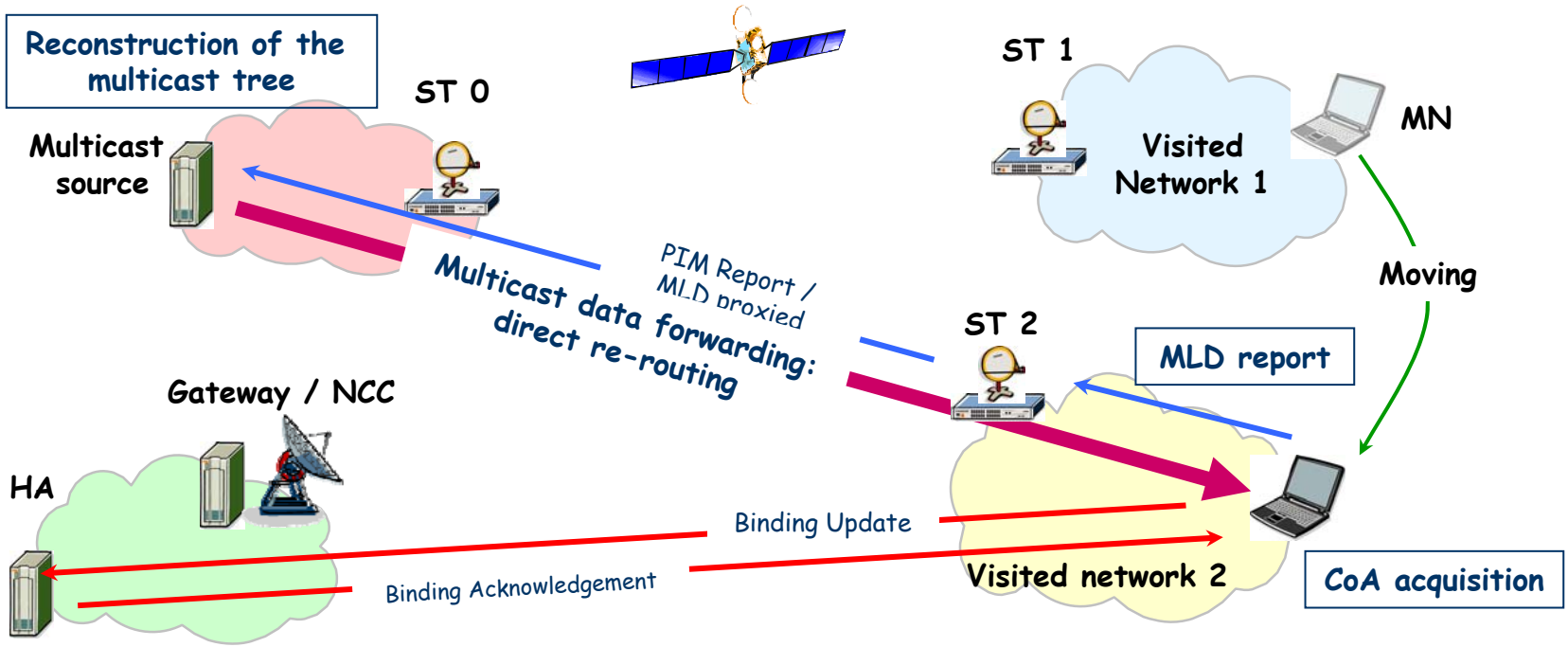
GW: Gateway
RCST : Satellite Terminal
AR: Access router
CN : Correspondant Node
MN : Mobile Node
BS : Base Station

1 : Communication (ex: VoIP)
2 : MN network change
3 : SIP INVITE
4 : SIP OK
5 : Communication (ex:VoIP)
6 : SIP Register
7 : SIP OK

Multicasting – different approaches

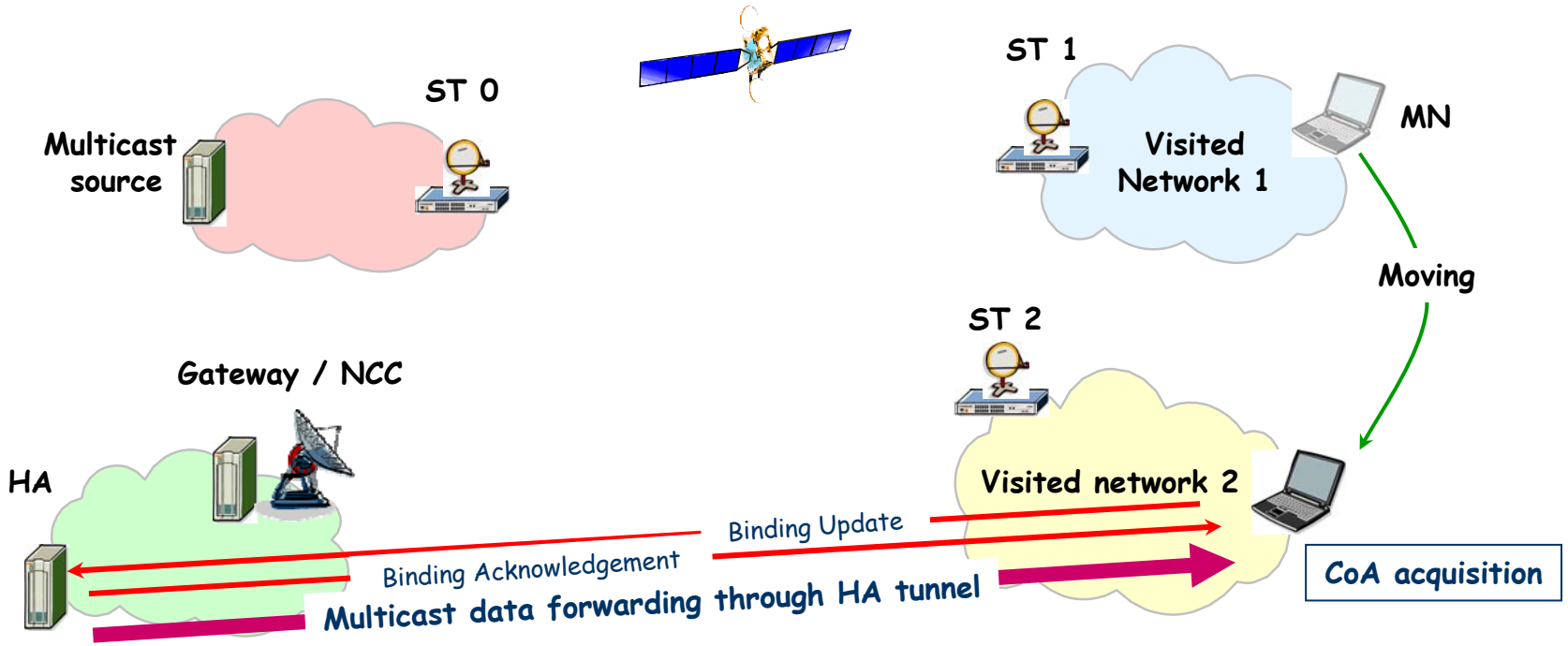
- Remote subscription: The mobile node joins a multicast group via a local multicast router on the foreign link by using its Care-of-Address instead of its Home Address.
- Home subscription: The mobile node joins the group, send and receive packets from its Home Agent through bidirectional tunnelling.
- MLD (Multicast Listener Discovery) proxying is a mix of the previous ones where a Multicast Agent near the Home Agent network
  - joins the multicast session on behalf of mobile node in the visiting network
  - then forwards traffics to attached mobile nodes (as in unicast addressing).

Multicasting - Remote subscription

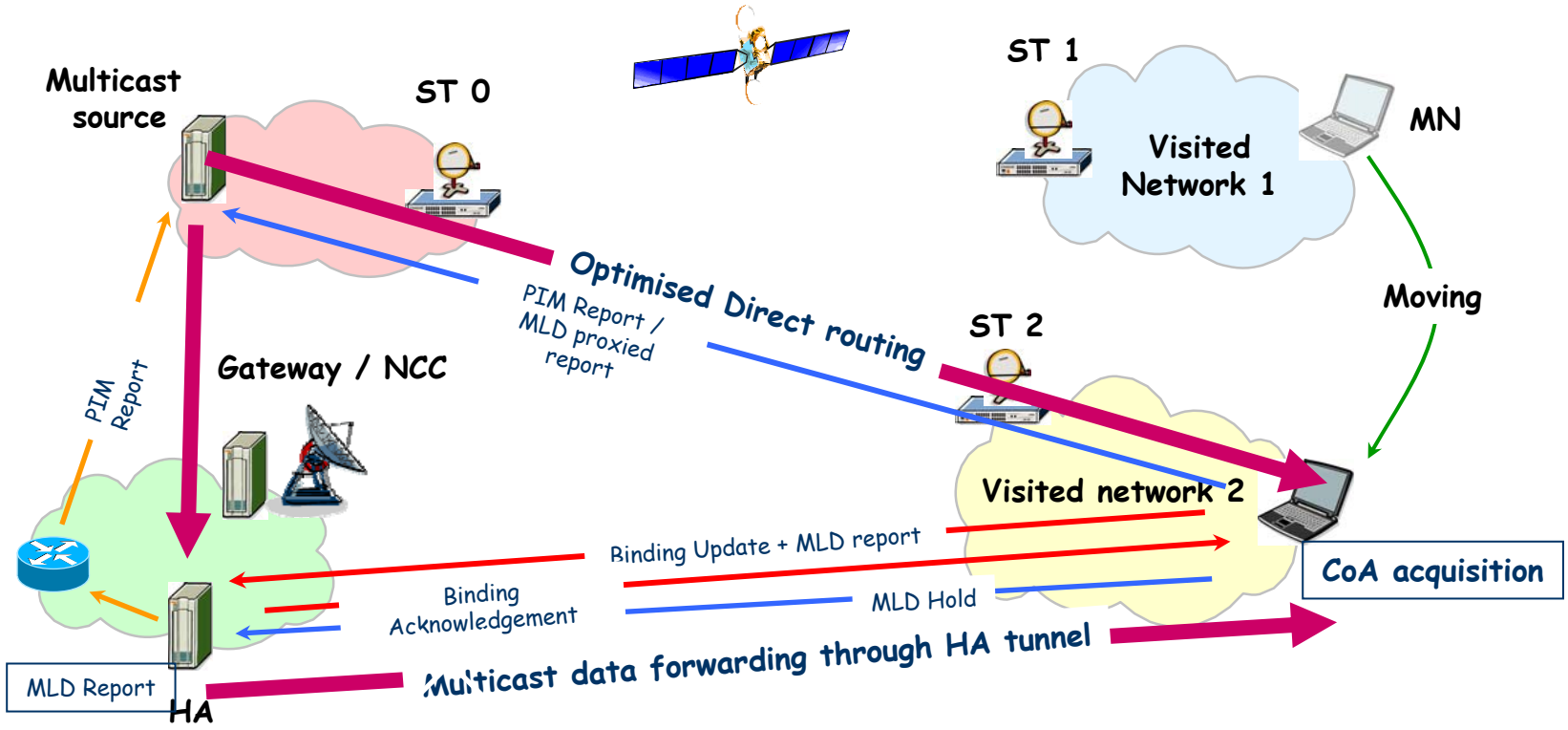


PIM: Protocol Independent Multicast
MLD: Multicast Listener Discovery

Multicasting - Bidirectional tunnelling via HA



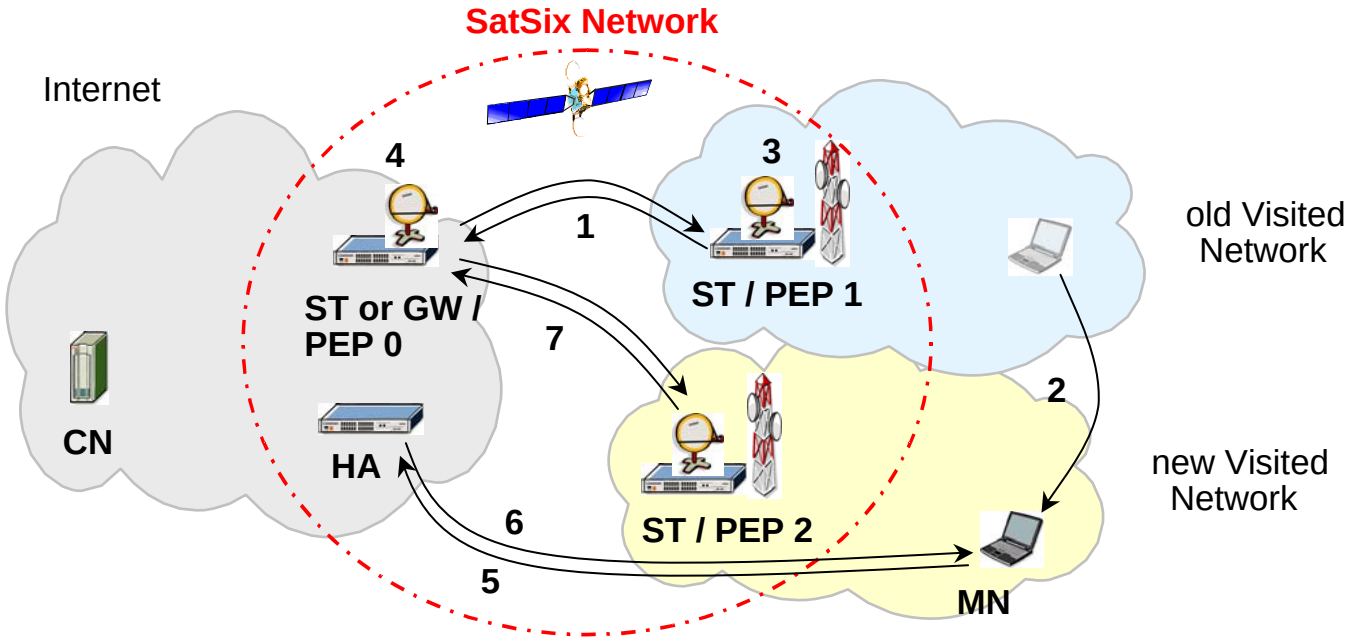
Multicasting - MLD proxying at HA



PEP and mobility (1)

- TCP Performance Enhancements Proxies (TCP-PEPs) are the general solution to overcome TCP limitations in GEO satellite networking.
- Unfortunately, during active connections, they introduce new issues in the context of MIPv6 mobility
  - Context loss, after a MN has changed from the PEP1 to the PEP2 "attachment", PEP2 will suddenly receive segments or ACKs for which no connection context is normally known.
  - Addressing, the change of CoA must now be considered at the PEP level. Only the Home Address (and not the CoA) plus the port numbers should be used as TCP flow identifiers.
  - Misrouting, due to the latency to complete the binding update process some data segment could be routed to the old PEP1) whereas the MN is only reachable from PEP2.
  - Security, end-to-end security (e.g. based on IPSec) is a main issue with PEP because IP payload data like TCP headers they have to inspect are encrypted.

PEP and mobility (2)



1. MN is first accessed through TCP-PEP connections between ST/PEP 0 and ST/PEP 1
2. MN leaves the ST/PEP 1 network to ST/PEP 2 network
3. Segments received from ST/PEP 1 with the oldCoA are still acknowledged by ST/PEP1 and forwarded to the oldCoA
4. These ACKs are received at ST/PEP 0 and corresponding data are removed from its buffer

   But ST/PEP 1 can not reach MN anymore on its oldCoA

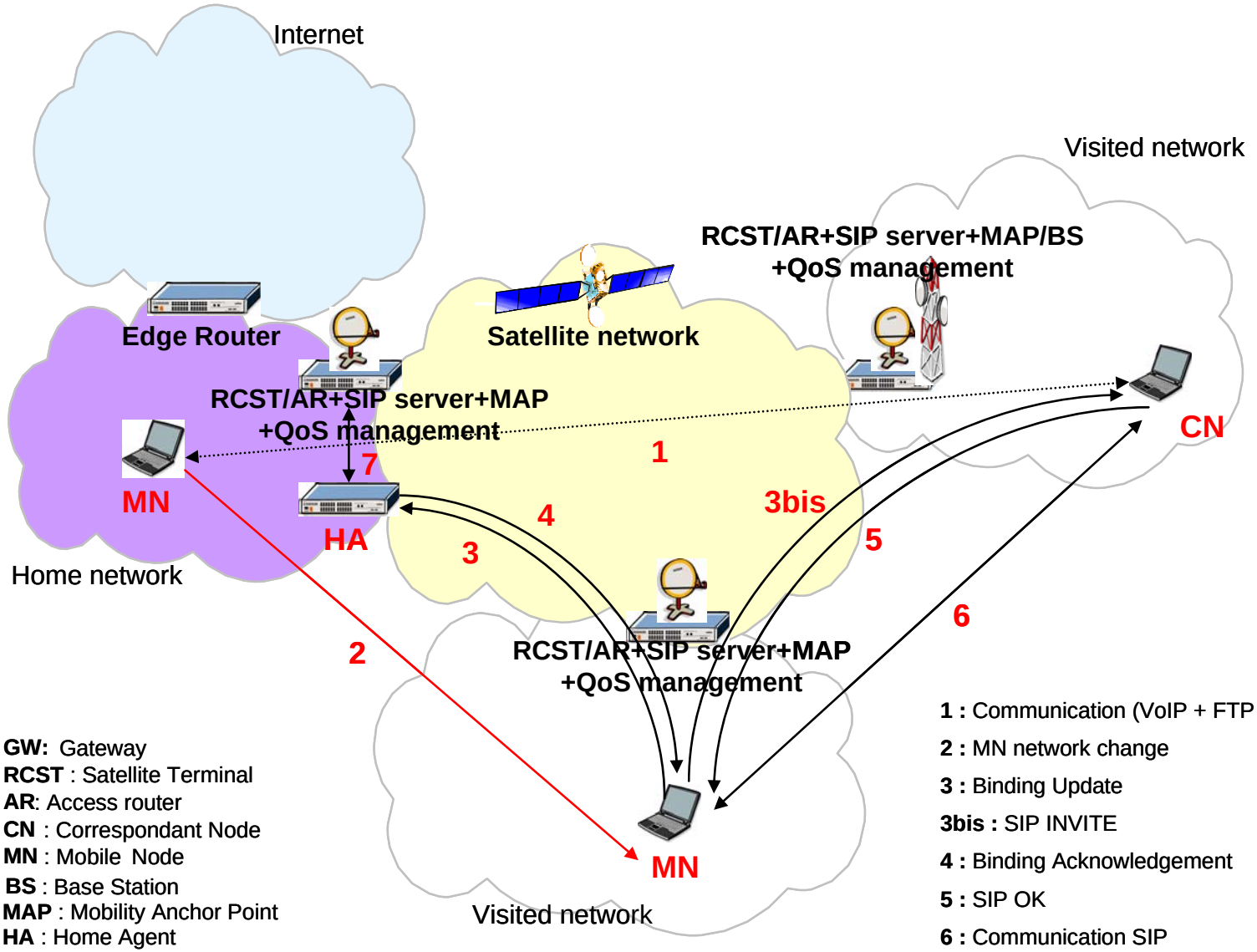
5. The BU is sent to HA (or CN)
6. The Binding Acknowledgement is received at the MN
7. ST/PEP 0 may now forward new incoming segments to the nextCoA of MN via ST/PEP 2

   Data stored at ST/PEP 1 can not be retrieved by MN

QoS and mobility architecture (1)

- Proper Quality of Service (QoS) is necessary for the forwarding of the mobile node's packet stream at the intermediate nodes
- Currently, the mobile IP routing decision algorithms do not combine any information regarding the availability of the resources such as network bandwidth....
- For active application sessions on the mobile, the network should negotiate QoS along the new route as part of the handover procedure
- The QoS part of the mobility architecture could be based on a QoS server, a QoS agent for non QoS-aware applications and the enhanced SIP Proxy for QoS-aware applications (using SIP).

QoS and mobility architecture (2)



GW: Gateway
RCST : Satellite Terminal
AR: Access router
CN : Correspondant Node
MN : Mobile Node
BS : Base Station
MAP : Mobility Anchor Point
HA : Home Agent

1 : Communication (VoIP + FTP + Web Browsing)
2 : MN network change
3 : Binding Update
3bis : SIP INVITE
4 : Binding Acknowledgement
5 : SIP OK
6 : Communication SIP
7 : Communication between the HA and the SIP server

Conclusion

- Network layer mobility with MIPv6 and its optimisation protocols, the hierarchical (HMIPV6) and fast handovers (FMIPv6) have been presented, so also the combination of the two called FHMIPv6
- Application layer mobility using SIP is shown as a complement to network layer mobility
- Three approaches for multicast mobility have been described
- The combination of network mobility and PEPs causes various problems which have been discussed
- Mobility gives a significant impact to the QoS management and generates new challenges for QoS provision.

Thanks for your attention!
Questions?