

Support of Layer 2 Triggers for Faster Handoffs

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About this contribution

Abstract

The contribution notes the benefits of providing layer 2 hints (triggers) to the network layer for facilitating faster handoffs essential to support real-time handoff performance.

Purpose

The contribution specific text recommending the inclusion of support for layer 2 triggers to the network layer for improving handoff performance. The proposed text is intended for section 4.5.1.1 of the requirements document.

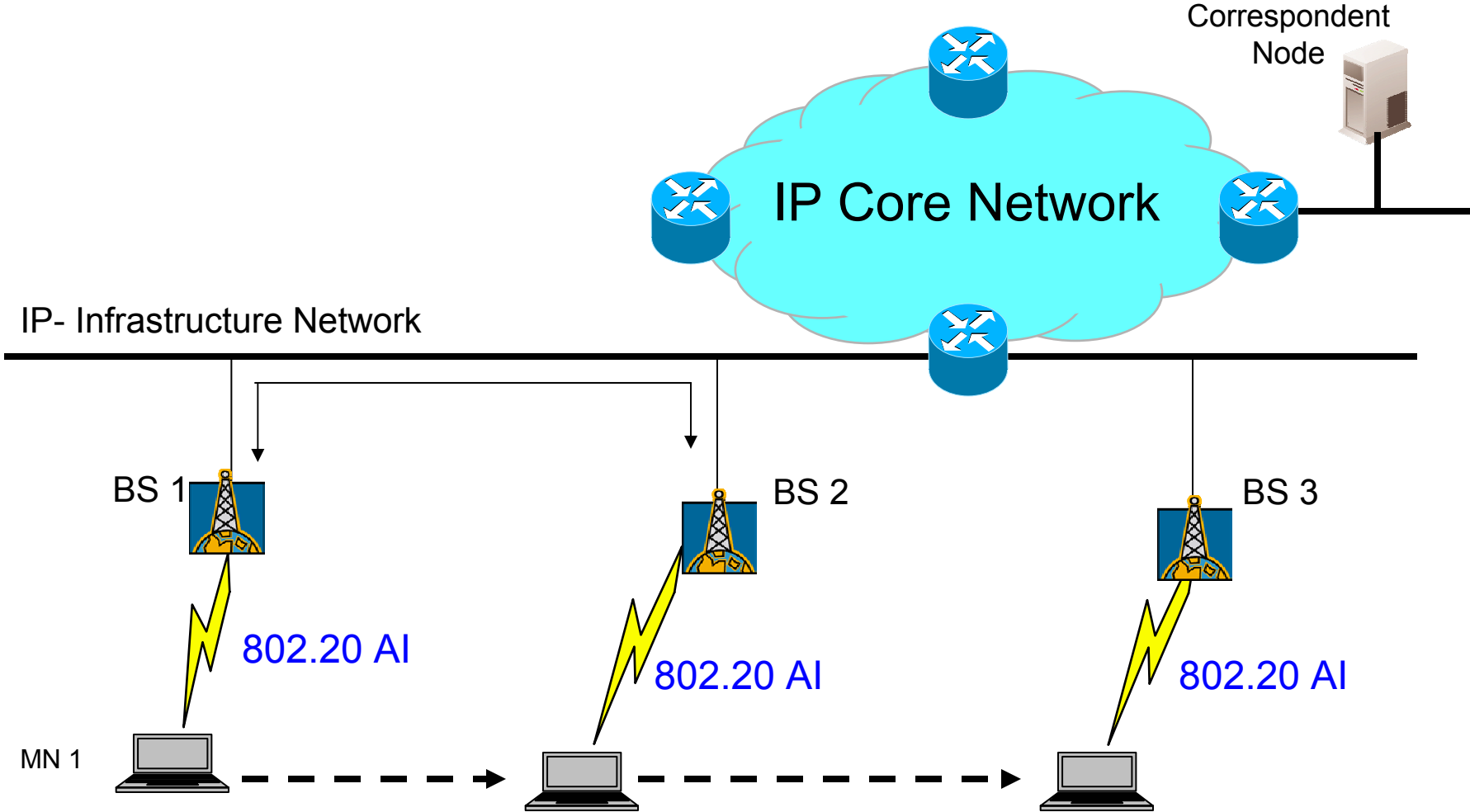


Fig 1. MN 1 is handed off from BS1 to BS2 (both in same subnet) to BS3 (in a different subnet)

Observations

- A significant percentage of handoffs between 802.20 base stations is likely to cause a Layer 3 handoff as well due to high speed mobility in a wide area environment
- If the 802.20 Base Stations (source & target BS) are located in different IP subnets, then a network layer mobility protocol would be a natural way and Mobile IP could be used (Layer 3) (see Figures 1 and 2)

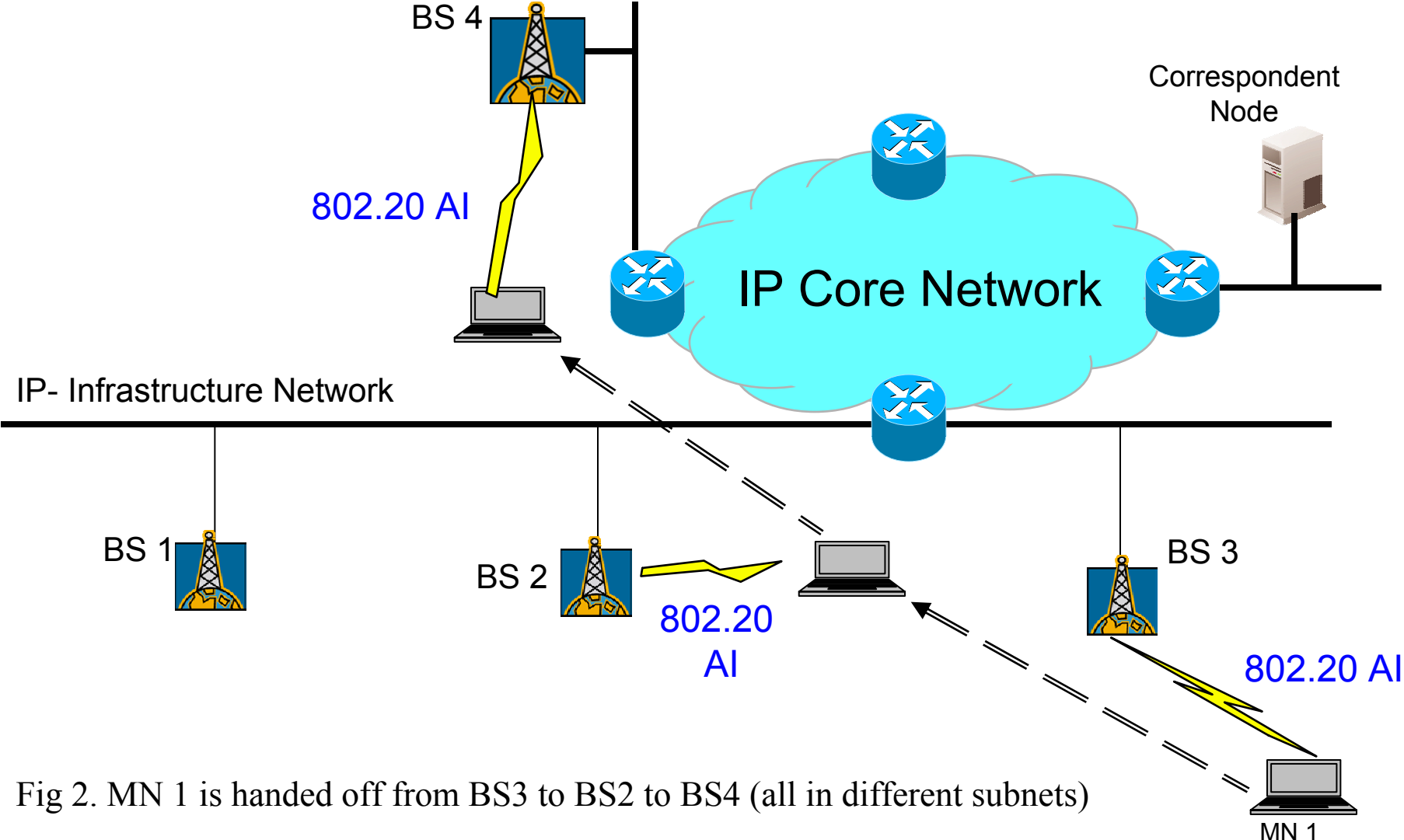
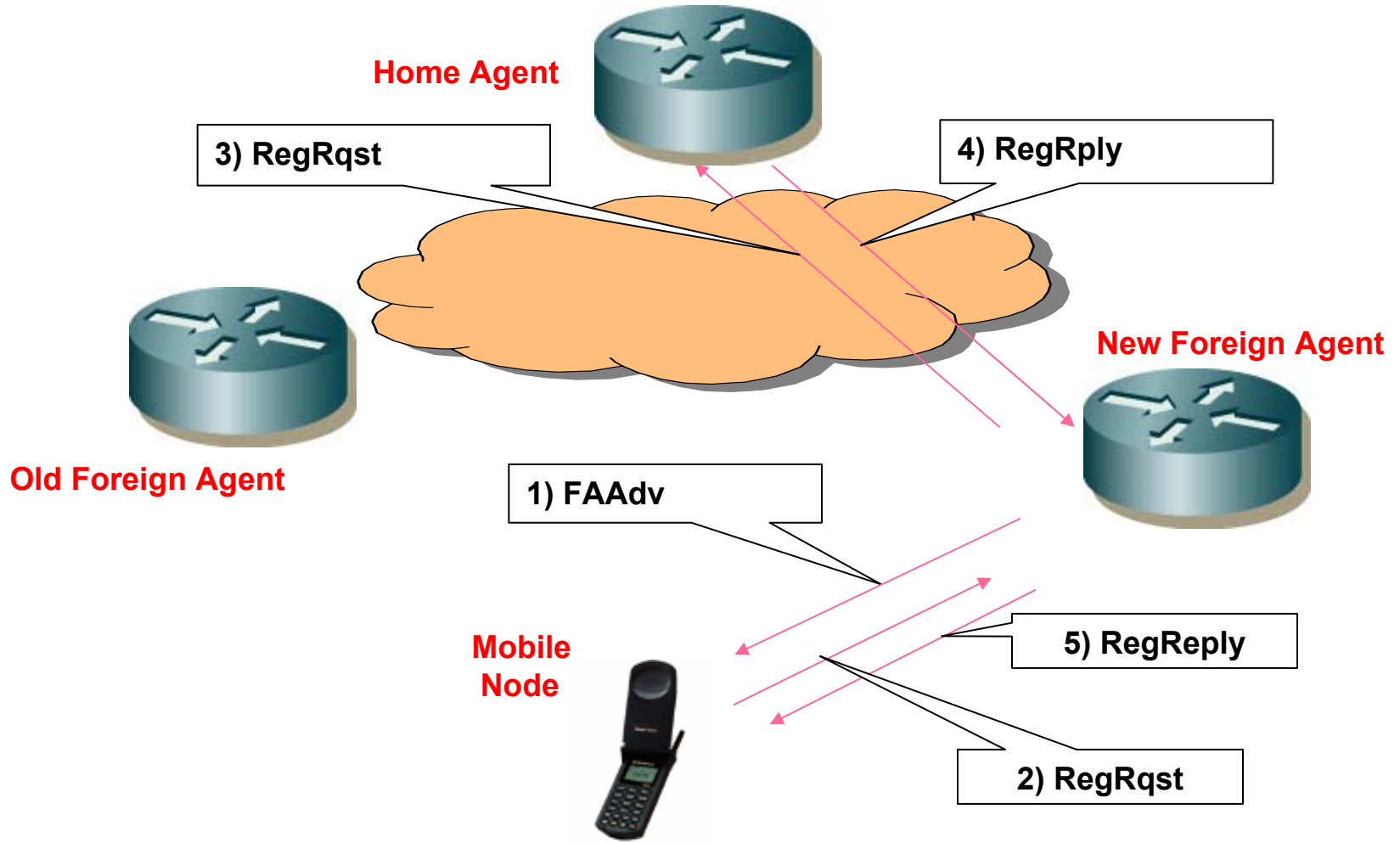


Fig 2. MN 1 is handed off from BS3 to BS2 to BS4 (all in different subnets)

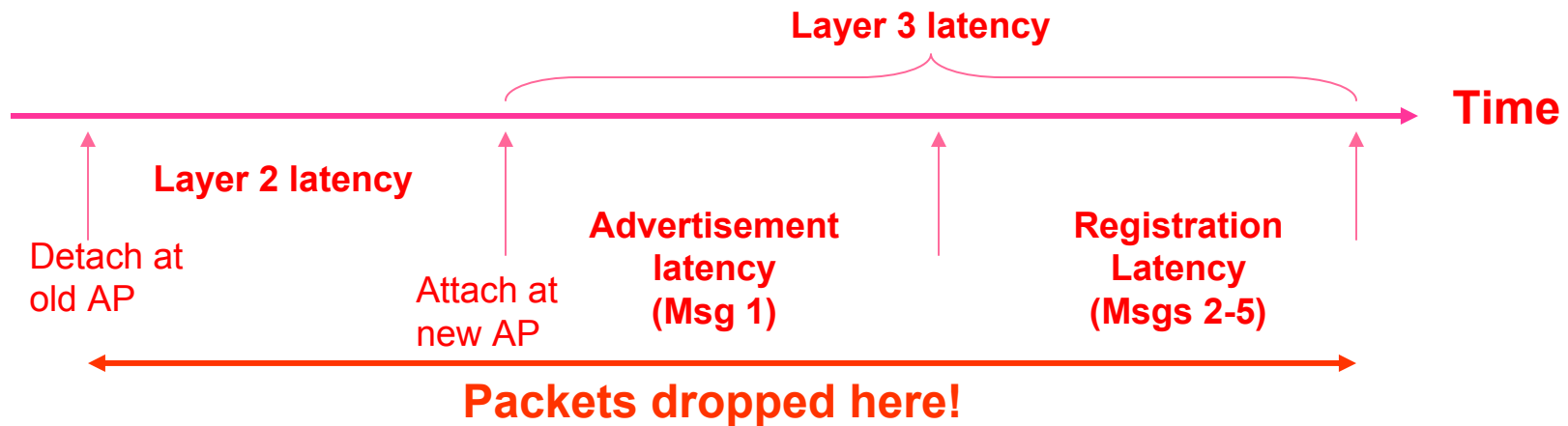
- The expected number of Layer 3 handoffs in 802.20 is in contrast with a low mobility 802.11 Wireless LAN network, where Access Points that are within the same ESS (and IP subnet) handle handoffs at Layer 2 only (using IEEE 802.11f standard based Inter Access Point Protocol)
- Mobile IP based handoffs can also functionally handle in a natural way any handoffs that may be required between two different access technologies (e.g. 802.20 and 802.11)
- Protocols for improving the performance of Mobile IP handoffs are nearing completion at the IETF [1] and are expected to become accepted as standard soon

Standard Mobile IPv4 Handover



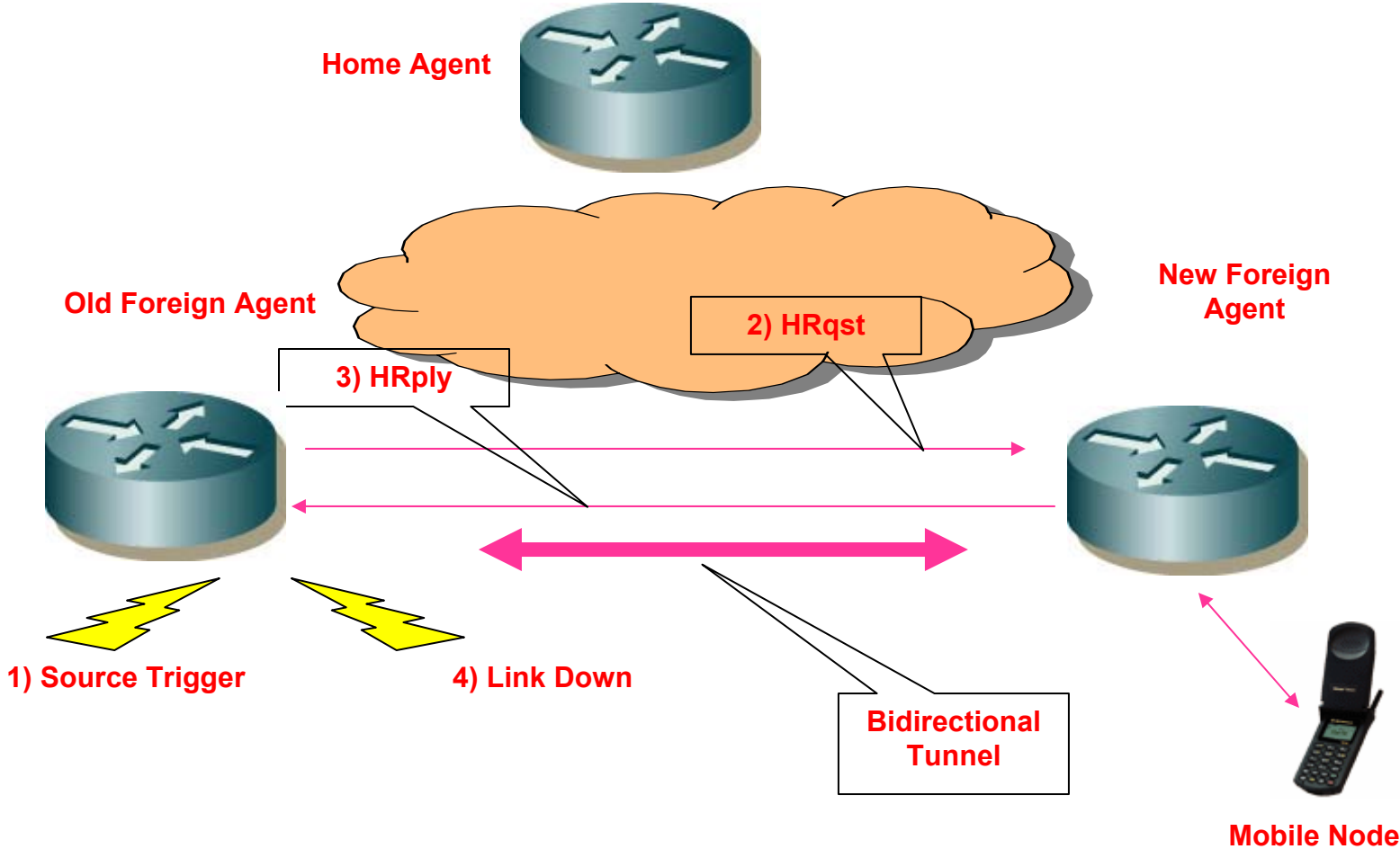
Sources of Handover Latency

- Layer 2 latency – Time between link layer detachment at old attachment point and reattachment at new.
- Advertisement latency -Latency at Layer 3 between the Mobile Node arriving on the new link and detecting a broadcast Foreign Agent Advertisement.
- Registration latency - Latency at Layer 3 between the Mobile Node receiving the Foreign Agent Advertisement and completing registration with the Foreign Agent and Home Agent.



Need to overlap latencies at Layer 2 and Layer 3 and minimize overall handoff latency. Become proactive in dealing with handoffs.

Example: Postreg Algorithm using triggers



- In order to support a variety of applications (both non-real-time data and real-time VoIP and more) in a fast mobile environment with 802.20, it is desirable to provide all possible help to the network layer so that handoffs perform well.
- The use of a standardized interface to convey helpful information (hints) from L2 to L3 will be valuable.
- Use of such hints may be made to improve handoff performance (such as reduced packet loss and/or handover delay) of Mobile IP (both MIPv4 and MIPv6), as well as for any other purpose the designer may wish to use them.
- In the default case, the hints may be ignored with no loss of functionality.

- The benefits of link layer triggers to accomplish fast handoffs with Mobile IP have been measured and verified independently by a number of research teams [2, 3]
- Earlier contributions to various 802 groups have made recommendations pointing out the value of having formal definition of 802 link-layer events using a standardized API that can be communicated to IP layer [3]
- Layer 2 triggers will be needed to support different types of handover, such as, planned handovers suggested in section 2.1 of [4]
- Use of triggers to aid network layer handoffs is also within the scope of handoff discussions in 802 Handoff ECSG [5] as well as within the IETF [6]

- This contribution recommends an explicit inclusion of the following text in Section 4.5.1.1 (IP-Level Handoff) of the requirements document.

802.20 shall support L2 to L3 communication of helpful hints (triggers) that can facilitate faster handoff performance and other potential benefits based on the use of such hints.

In conclusion:

- Our proposal is also consistent with the emerging idea of optimizing network layer performance based on physical (usually RF) and link conditions.
- Reference [7] notes the following with respect to the idea of optimizing network layer performance based on RF conditions:
 - The idea is not commonly used by network designers because they often think about “protocol layering” with minimal information passing between layers.
 - Currently there is insufficient differentiation between congestion related losses and wireless channel related losses.
 - By doing away with the firm boundary that currently exists between the PHY and MAC layers and the higher layers of the network protocol stack, significant gains can be accrued by cross-layer techniques.

References

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3. Gang Wu and Alper Yegin, “Link Layer Triggers for Fast Handovers”, IEEE P802 Handoff ECGS Meeting, May 2003.
4. Jessie Jewitt, “France Telecom – Service Provider Requirements for 802.20, IEEE P802.20 submission, Oct. 20, 2003.
5. David Johnston, “Handoff Scope Discussion Points”, IEEE P802 Handoff ECGS Meeting, May 2003.
6. Spencer Dawkins, Carl Williams and Alper Yegin, “Problem Statement for Triggers for Transport (TRIGTRAN)”, draft-dawkins-trigtran-probstmt-01.txt, March 2003.
7. Sanjay Shakkottai, Ted Rappaport and Peter Karlsson, “Cross-Layer Design for Wireless Networks”, IEEE Communications Magazine, October 2003.