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P2P Streaming for Mobile Nodes: Scenarios and Related Issues
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Abstract

The scenarios where a Peer-to-Peer Streaming Protocol (PPSP) contains mobile nodes need special considerations. An analysis of all the scenarios that involve mobile nodes is necessary to provide the guidelines to PPSP protocol design and applicability. This document describes some key issues for a PPSP network with mobile nodes, and proposes some additional requirements for PPSP to handle these scenarios.

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1. Introduction

The PPSP Working Group is developing protocols for Peer-to-Peer (P2P) streaming systems [[I-D.zong-ppsp-reqs](#)]. In the past P2P solutions

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have mostly targeted wired or fixed connections. Mobile P2P communications are expected to grow rapidly and the nature of mobile nodes and mobile environments cause specific challenges to P2P communications, specifically for streaming scenarios. This draft discusses some key mobility specific issues.

2. Conventions and Terminology

This document uses the same terminologies as [[I-D.zong-ppsp-reqs](#)]. For simplicity, this document illustrates scenarios showing a centralized Tracker architecture. However, it should be understood that all the scenarios also apply to the distributed architecture, e.g. using a Distributed Hash Table (DHT).

3. Mobile Node Issues

Mobile nodes are constrained by nature due to their limited battery, screen size, computational capability, etc. Also mobile nodes operate in variable and unpredictable environments. These attributes bring about the following problems that may adversely affect the P2P Streaming sessions.

3.1. Uplink vs. Downlink Bandwidth

Often mobile nodes have asymmetrical bandwidth capabilities. For instance, most mobile nodes are capable of handling higher bit rates in the downlink (to the mobile) than in the uplink (from the mobile). In addition, many mobile networks also have policies to assign bandwidth in this asymmetrical manner regardless of the capabilities of the mobile node. Since peer-to-peer streaming sessions can be either generated or terminated on a mobile node, this bandwidth asymmetry should be considered for the Tracker-Peer protocol (e.g. as

part of Peer status parameters reported to the Tracker), and may also affect Peer-Peer protocol in the peer information negotiation.

[3.2.](#) Battery Power

By definition, a mobile node is often disconnected from the electrical grid and runs on its own battery power. In this

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scenario, the user of the mobile node may want to restrict the types of P2P sessions that the mobile node should participate in because of battery drain issues. For example, the user may be willing to participate in a P2P session if the user herself is watching the content. However, the user may not want to participate in uploading large amounts of content to other peers.

Therefore, battery power (or battery status) of a mobile node should be considered in both the Peer-Peer and the Tracker-Peer protocols (e.g. as part of Peer status parameters reported to the Tracker and other peers).

[3.3.](#) Multiple Interfaces

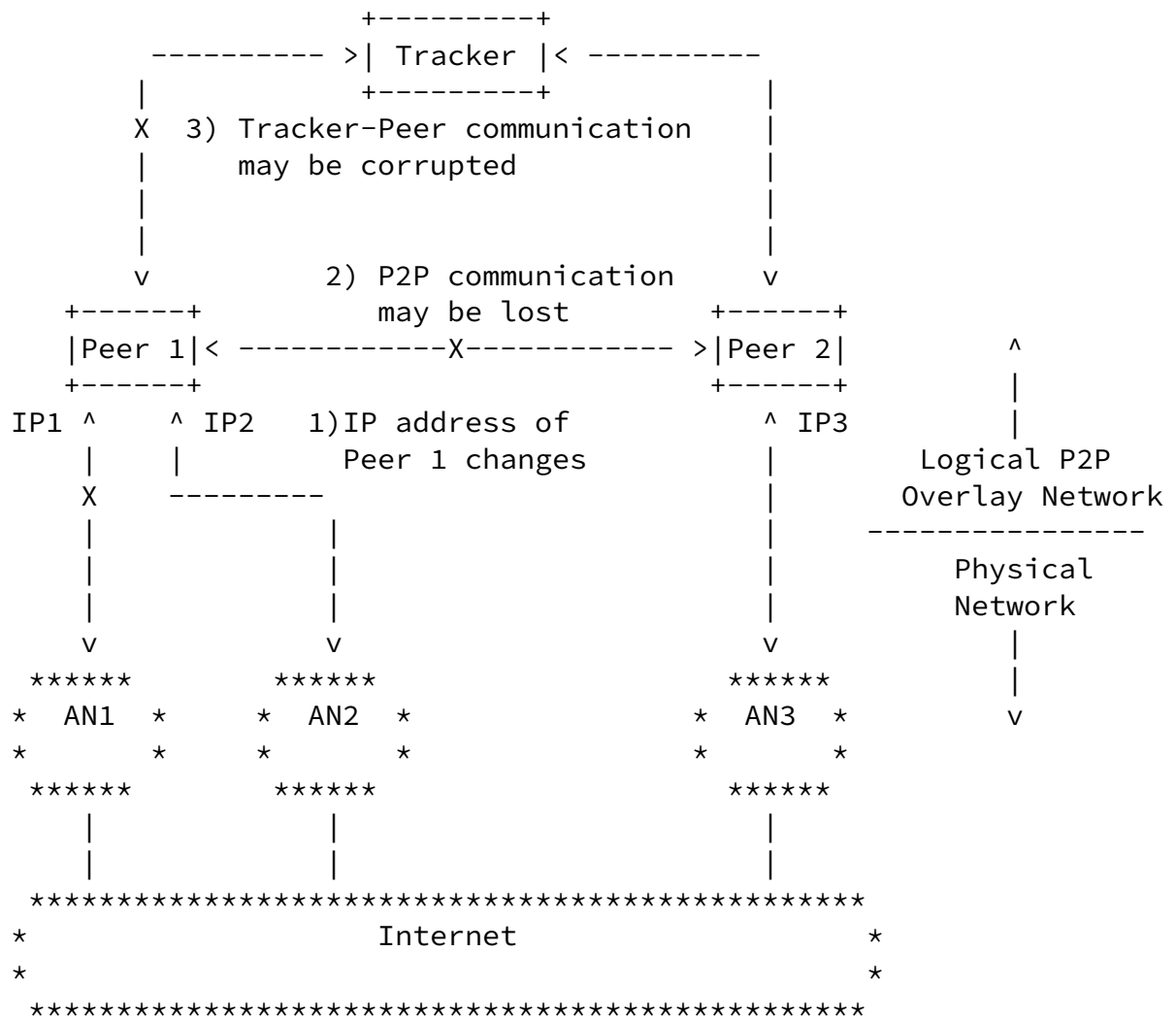
Simple IP refers to the scenario where there is no IP layer mobility protocol such as Mobile IP or Proxy Mobile IP, and a peer needs to obtain a new IP address through a standard method like DHCP after losing the previous IP address.

As illustrated in Figure 1, when Peer 1 moves from AN1 to AN2, its IP address changes from IP1 to IP2. This will impact both the Peer-Peer connection and the Tracker-Peer connection. For example, Peer-Peer communication maybe lost (e.g. Peer 2 incorrectly sends chunks to IP1 even though Peer 1 has now changed address to IP2). Also the Tracker-Peer communication may be compromised (e.g. Tracker has corrupted Peer lists containing incorrect IP Address for Peer 1).

These effects may be somewhat mitigated by having the mobile node update the tracker and corresponding peers with its new IP address. The key question then is the trade-off between signaling required to provide notification of the IP address change and the load this

causes on the system. Also race conditions must be carefully considered.

Therefore, reporting of change of the IP address of a mobile node should be considered in both the Peer-Peer and the Tracker-Peer protocols.



[3.4.](#) Geo-Targeting

Geo-targeting is a technique used to determine the physical location (i.e. geo-location) of a user. The geo-location is based on geographical and other personal information provided by the requester peer or a third party. Techniques to determine geo-location of a user can rely on civic location, GPS geographical coordinates, cellular base station ID, or most commonly IP address. The primary source for IP address geographical data is the regional Internet registries.

Depending on the location, different regulations and rules may apply. For instance, some content may not be distributed on certain locations or can only be distributed on some other locations.

Current content distribution policies can apply certain rules to fixed P2P Streaming clients. However, device mobility may hide the peer movement from one region to another where possibly different content distribution rules may apply hence rendering the set forth policies un-enforceable. This may also be the case where the peer is connecting through a Virtual Private Network (VPN).

Therefore, geo-location reporting of a mobile node should be considered in both the Peer-Peer and the Tracker-Peer protocols.

[4.](#) Conclusion and Recommendations

The PPSP Working Group should consider the impacts of various aspects of mobility discussed in this draft. In particular, PPSP should consider how these issues can be mitigated in a mobile P2P streaming environment when designing both the PPSP Peer-Peer and the Tracker-Peer protocols. Therefore, it is recommended that the following requirements be added to the "Basic Requirements to PPSP Node" section of [[I-D.zong-ppsp-reqs](#)]:

PPSP.REQ-1: Change in IP address of a Peer device MUST immediately be

reported via the Tracker Protocol and Peer Protocol

PPSP.REQ-2: Available uplink and downlink bandwidth of a Peer device MAY be reported via the Tracker Protocol and Peer Protocol

PPSP.REQ-3: Battery status of a Peer device SHOULD be reported via the Tracker Protocol and Peer Protocol

PPSP.REQ-4: Location of a Peer device SHOULD be reported via the Tracker Protocol and Peer Protocol

5. Security Considerations

This draft does not introduce new threats to security.

6. IANA Considerations

This document makes no request of IANA.

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7. References

7.1. Normative References

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[RFC5213] Gundavelli, S., Leung, K., Devarapalli, V., Chowdhury, K., and B. Patil, "Proxy Mobile IPv6", [RFC 5213](#), August 2008.

7.2. Informative References

[I-D.zong-ppsp-reqs]

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Streaming Protocol (PPSP) Requirements", [draft-zong-ppsp-reqs-04](#) (Work in progress), July 7, 2010.

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[8.](#) Acknowledgments

The authors would like to thank Serhad Doken and Milan Patel for their thorough review and valuable inputs to this draft.

[9.](#) [Appendix A](#) - Other Mobility Considerations

This Appendix summarizes some other mobility considerations that were analyzed. However, these considerations are outside the scope of the current PPSP Working Group scope and thus are recorded here for purely informational purposes.

[9.1.](#) Processing Power

Some devices are more capable than others in terms of computational performance or processing power. Similarly, devices can have different performance for generating a session (e.g. video recording) or terminating it (e.g. video display). Taking these differences into account is important for maintaining a good quality of the P2P streaming session.

9.2. Link Layer Mobility

PPSP uses a P2P based overlay network on top of the transport network. Mobility or link quality at link layers is not visible to the peers.

As illustrated in Figure 1, if Peer 1 is connected to a poor quality link via mobile Access Network 1 (AN1), then the overall P2P streaming session quality can suffer from high error rate and low throughput due to poor link layer conditions. This will impact both the Peer-Peer connection and the Tracker-Peer connection. For example, on the Peer-Peer connection frame loss, audio/video synch loss, or streaming stalls are likely to be seen on the media transfer protocols.

```

+-----+
----->| Tracker |<-----
|           +-----+
| 3)Tracker-Peer communication
X   is poor
|
|
```

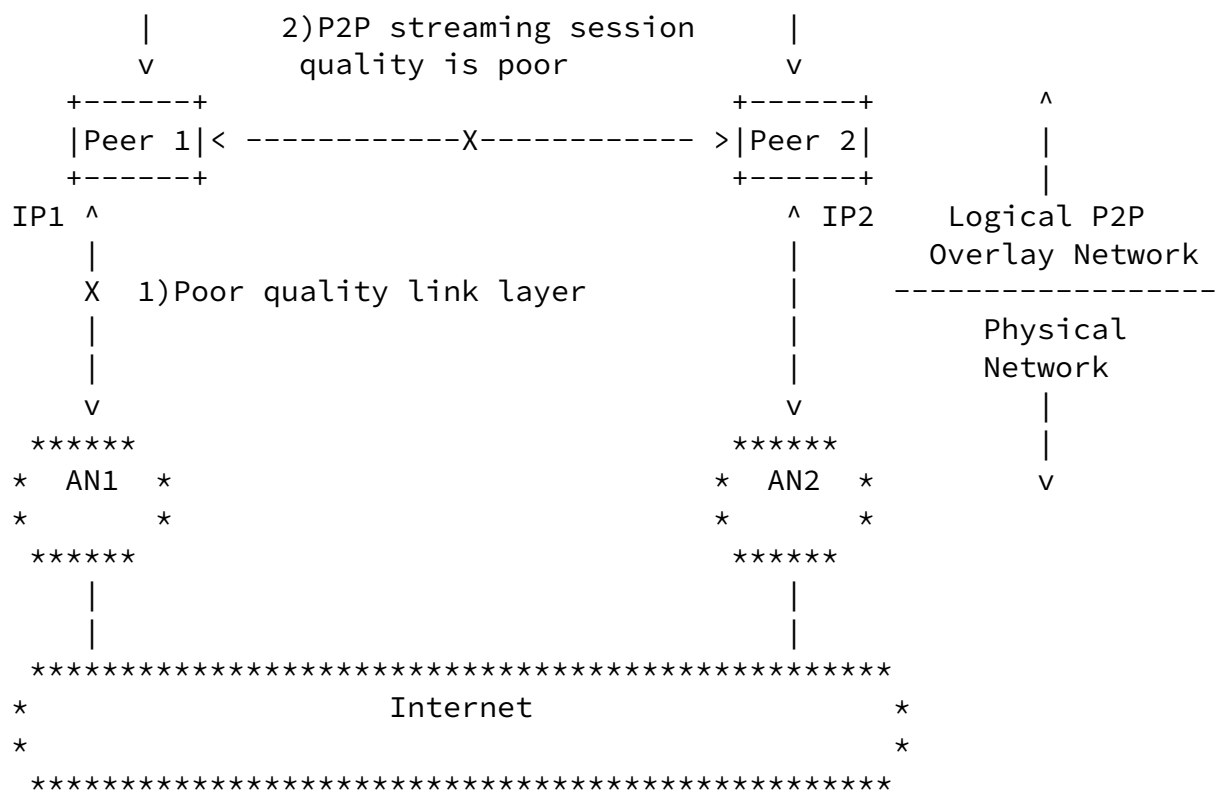


Figure 2 P2P Streaming with Link Layer Mobility

9.3. Mobile IP

Mobile IP (MIP) provides IP mobility and hides the mobile's movement from the Correspondent Node (CN) [RFC3775].

Figure 3 illustrates the case when Peer 1 moves from AN1 to AN1'. Because of Mobile IP, neither the Tracker nor Peer 2 are aware of the change of network for peer 1. However, due to the inherent tunneling and triangular routing of the Mobile IP protocol (through the Home Agent) the P2P session may in some scenarios experience extra latency. This may adversely affect the user experience of the P2P

streaming session. As seen above, Mobile IP will impact primarily the Peer-Peer connection (and the Tracker-Peer connection is not significantly affected).

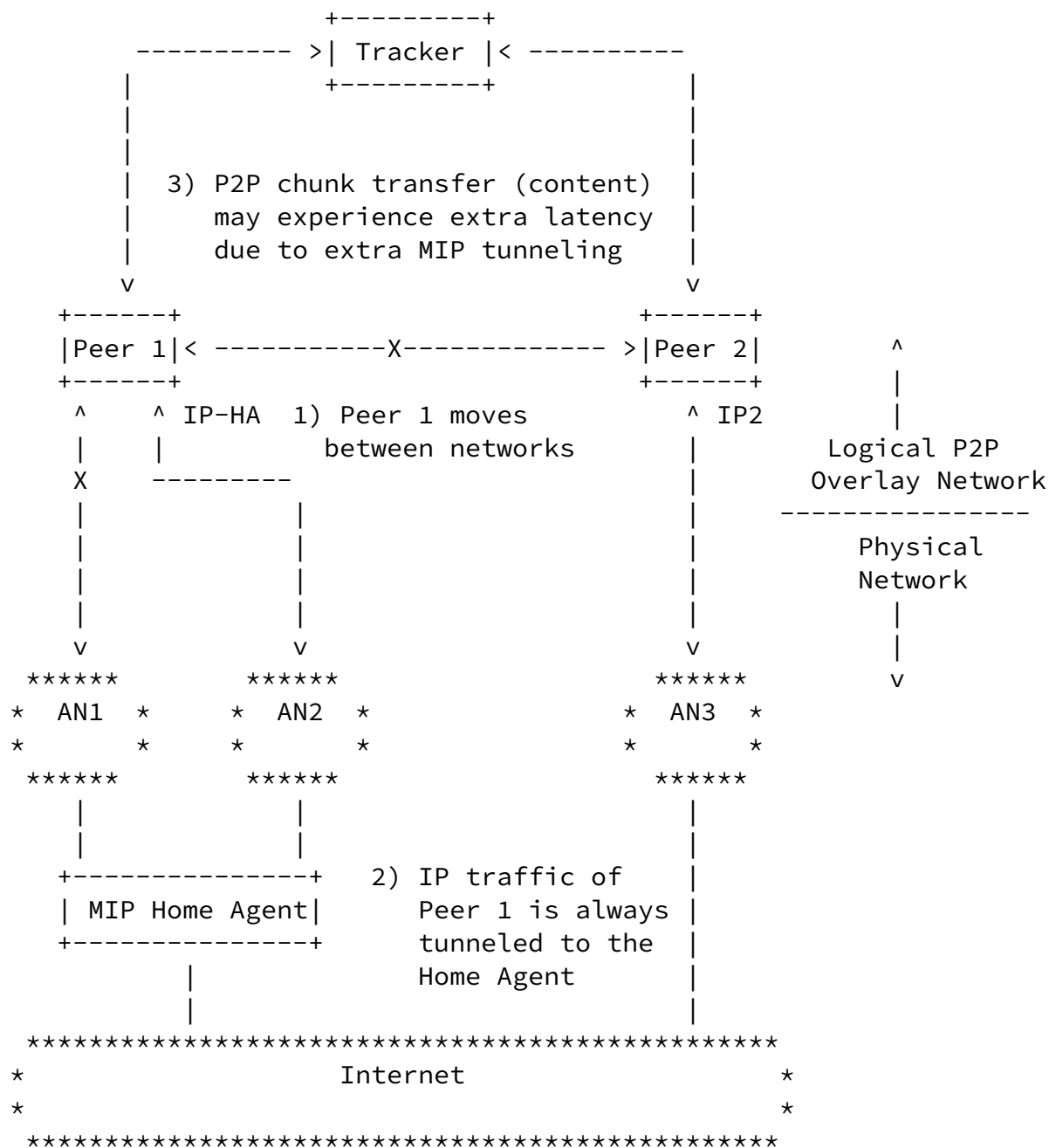


Figure 3 P2P Streaming with Mobile IP

[9.4.](#) Proxy Mobile IP

The use of Proxy Mobile IP [[RFC5213](#)] causes similar issues as the ones mentioned for Mobile IP in the above section. On top of these, Proxy Mobile IP also introduces a new issue for P2P streaming sessions. Since Proxy Mobile IP is a network based solution, the mobile node (peer) is not aware of its IP mobility so it cannot inform the Tracker, P2P Cache, CDNs or other peers of the IP level mobility. Therefore IP mobility is totally invisible to the P2P Streaming session entities and harder to detect and respond accordingly. Thus Proxy Mobile IP will impact both the Peer-Peer connection and the Tracker-Peer connection.

[9.5.](#) Mobility support with RELOAD

It has already been identified in the proposed WG charter that any PPSP developed protocol should be analyzed for interactions with the RELOAD protocol. The RELOAD protocol provides a signaling and routing mechanism for P2P overlay networks over the general Internet. The latest RELOAD draft [[I-D.ietf-p2psip-base](#)] also has a future consideration section for support of HIP ([section 5.6.1.1](#)). HIP is an experimental mobility protocol with good security properties.

In addition to HIP, the following mobility protocols should also be considered for PPSP-RELOAD interactions:

- . Mobile IP
- . Proxy Mobile IP

[9.6.](#) Tracker Mobility

Normally Trackers are assumed to be fixed nodes. However, in a mobile environment mobile nodes can also become Trackers. In this sense, similar considerations to the ones described above for mobile peers should be applied to mobile Trackers.

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