3GPP TR 23.844 V1.0.0 (2012-06)

Technical Report

3rd Generation Partnership Project;
Technical Specification Group Services and System Aspects;
Feasibility Study on IMS Based Peer-to-Peer Content Distribution Services;
Stage 2
(Release 11)

Keywords
3GPP, Architecture, IMS, Peer-to-peer

3GPP

Postal address

3GPP support office address
650 Route des Lucioles - Sophia Antipolis
Valbonne - FRANCE
Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Internet
http://www.3gpp.org

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Foreword

This Technical Report has been produced by the 3rd Generation Partnership Project (3GPP).

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1 Scope

This study focuses on the enhancement of IMS to support Peer-to-Peer Content Distribution Services in respect of GPRS, EPC and other underlying access network technologies but not intend to modify GPRS or EPC for P2P mechanism.

The objectives are to study IMS based Peer-to-Peer Content Distribution Services on the architectural level with the following aspects:

- Creating solutions in order to fulfil the use cases and requirements as defined by SA WG1 while avoiding duplicate work in other SDOs, such as IETF [e.g., PPSP, P2PSIP, ALTO, and DECADE], and re-using their work. The solutions should:
  - Apply the same IMS user management/registration procedure as other IMS services;
  - Be able to provide the UE with the appropriate AS to obtain the addresses of other Peers, from which the UE can retrieve the requested content;
  - Re-use ISC interface for service triggering;
  - Be able to select qualified User Peers among available UEs according to the policies preconfigured in the network.
- Elaborate alternative solutions, which support the following network access technologies:
  - Mobile access only (e.g. UTRAN, E-UTRAN, I-WLAN);
  - Fixed access only (e.g. xDSL, LAN);
  - Fixed and mobile convergence scenarios.
- Evaluate possible impacts and improvements on network when IMS based Peer-to-Peer Content Distribution Services are deployed, such as the interactions that are needed to adapt the peer-to-peer overlay properties to the configuration and the resources of the network.
- Identify QoS, mobility, charging and security related requirements in the case of Peer-to-Peer Content Distribution Services on IMS.

The assessment on alternative solutions and the final conclusion of this study should not only take TR 22.906 [2] into consideration but also comply with the related normative work in SA WG1.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TR 22.906: "Study on IMS based peer-to-peer content distribution services".

[3] draft-ietf-ppsp-reqs-02 (February 2011): "P2P Streaming Protocol (PPSP) Requirements".

Editor's note: The above document cannot be formally referenced until it is published as an RFC.

[4] draft-ietf-alto-protocol-09 (June 2011): "ALTO Protocol".

Editor's note: The above document cannot be formally referenced until it is published as an RFC.

[5] 3GPP TS 23.203: "Policy and charging control architecture".

[6] 3GPP TS 23.228: "IP Multimedia Subsystem (IMS); Stage 2".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1].

P2P: Peer-to-Peer, as defined in TR 22.906 [2].

Tracker: A directory server which maintains a list of peers storing segments for a specific content, and answers queries from peers for peer lists.

User Peer: As defined in TR 22.906 [2].

Network Peer: As defined in TR 22.906 [2].

Content Source Server: As defined in TR 22.906 [2].

Content Cache Server: As defined in TR 22.906 [2].

Content Delivery Network: Is the network for content distribution services.

DRM Server: The entity which manages the digital rights of digital contents to be shared within the Content Delivery Network.

Origin Server: Stores the original content resources.

Edge Server: Is the content server located on the edge of a CDN for content delivery.

CDN Controller: Is responsible for allocating of content resources from the Origin Server to the Edge Servers as well as for allocating of a neighbouring Edge Server to the CDN.

Bitmap: Describes which parts of the content are stored in a User Peer or Network Peer.

Swarm: A swarm refers to a group of clients (i.e., Peers) who exchange data to distribute the same content (e.g. video/audio program, digital file, etc) at a given time.

Cost Map: Defines Path Costs amongst sets of source and destination Network Locations. Path Costs are generic costs and can be internally computed by a network provider according to its own needs.

Network Map: Is the resulting set of endpoints which are grouped together according to the Network Location endpoint property to indicate their proximity.

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

IMS P2P CDS	IMS based P2P Content Distribution Services
CDN	Content Delivery Network
CSS	Content Source Server
CCS	Content Cache Server
DRM	Digital Right Management

4 Use cases

The use cases of the IMS P2P CDS are described in clause 5 of TR 22.906 [2].

5 Architectural requirements

Editor's note: This clause will identify the architectural requirements.

5.1 Assumptions for the IMS P2P CDS

- This document only considers large data volume services like content on demand, video streaming, etc. It does not consider voice services.

5.2 Requirements for the IMS P2P CDS

- The system shall support a mechanism to provide address information for accessing an IMS based P2P content distribution service for an IMS P2P CDS UE.
- The system shall support a mechanism to provide to User Peers an optimal selection of User Peers and Network Peers for obtaining requested media content from, based upon metrics including:
  - access type such as UTRAN, E-UTRAN, I-WLAN, xDSL and LAN.
  - offloading capability.
  - traffic conditions such as traffic congestion in the radio access network and carrier network, assigned uplink/downlink bandwidth of User Peer and Network Peer.

Editor's note: What traffic condition information consists of is for further study.

  - path cost information (e.g. least hop routing).
  - location information such as proximity of peers, peer IP addresses (including IPv4 and/or IPv6 types), and peer identities.
  - capabilities and workload of the IMS P2P CDS UE such as cache volume, current battery left and number of P2P clients being served by it.

NOTE: The above lists of parameters used for optimal peer selection are not definitive and can include other metrics upon which optimal lists of peers can be generated.

- The system shall provide QoS for IMS P2P CDS.
- The IMS P2P CDS sessions shall minimize the negative impact on QoS for ongoing sessions to the same UE and shall minimize the negative impact on QoS for the operator network.
- The system shall support a content delivery function to distribute contents or content segments from the Content Source Server to the Content Cache Servers.
- The system shall support an interworking mechanism, which is able to utilize an enhanced existing CDN, to distribute contents or content segments from the Content Source Server/Origin Server to the Content Cache Servers/Edge Servers.
- The system shall provide a mechanism to guarantee the copyright protected digital contents to be shared among the IMS P2P CDS users in a legal way.

6 Alternative Solutions

Editor's note: This clause will describe the solution(s) for IMS based peer-to-peer content distribution services.

6.1 Alternate 1 - Signalling between User Peer and other Peers not traversing IMS core

Editor's Note: It is proposed to include in each alternative at least the description of architecture, reference point and necessary information flows. The description of service instances is optional but preferred.

6.1.0 General

All signalling messages between User Peer and Tracker go through IMS core.

Signalling (e.g. for bitmap fetching) between User Peer and Network Peer does not go through IMS core.

6.1.1 Architecture Reference Model

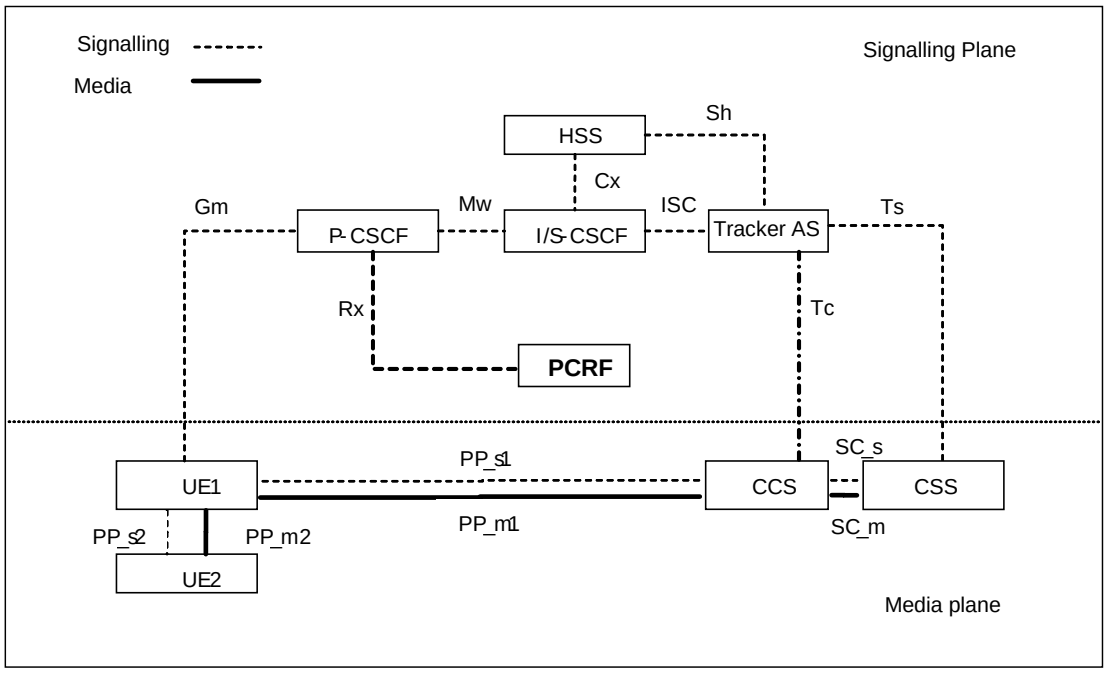

Figure 6.1.1-1: Overview of the IMS P2P CDS architecture for alternative 1

Editor's note: In this architecture, P-CSCF shall act as AF of the PCC model. Whether Tracker AS should be involved in CDS control is for further study.

Editor's note: The specific QoS mechanism should be considered based on the CDS procedure, which is for further study.

6.1.2 Functional Entities

P-CSCF, I-CSCF, S-CSCF and HSS are already defined in TS 23.228 [6].

PCRF is already defined in TS 23.203 [5].

Newly introduced network entities include CCS, CSS and Tracker AS.

The UE should support the functionality of User Peer if it is used to provide IMS P2P CDS applications to the user.

6.1.2.1 Content Source Server (CSS)

The CSS provides content resources and executes segmenting of content resources. It may also execute content encoding and transcoding.

6.1.2.2 Content Cache Server (CCS)

CCS caches the content and/or content segments, and provides them to the IMS P2P CDS UEs under the direction of Tracker AS.

6.1.2.3 Tracker AS

The Tracker AS is an IMS AS that also executes the functionality of Tracker. The functions include:

- Records a Peer list and updates it according to the activity of User Peers and Network Peers.
- Records and maintains the index of contents/content segments and where the contents/contents segments are cached.
- Feedbacks Peer list when queried by an IMS P2P CDS UE.
- The information attached to each Peer ID in the Peer list should include e.g. the access type, traffic conditions, location, capabilities and workload of that Peer.
- Directs the procedure of pre-distribution of contents/contents segments from the CSS to the CCSs.

Editor's note: Whether the Tracker AS should be involved in QoS control for IMS P2P CDS and how this works is for further study.

Editor's note: Whether the existing IMS entities, such as P-CSCF, should be upgraded to monitor and control the P2P information transferred to the Tracker AS is for further study.

6.1.3 Interfaces

6.1.3.1 Gm, Mw, ISC

These interfaces are SIP interfaces with the functionality as defined in TS 23.228 [6].

For IMS P2P CDS, these interfaces are also used as follows:

- The IMS P2P CDS UE sends a Content ID to the Tracker AS for fetching a Peer list through these interfaces.
- The Tracker AS collects a set of information from the IMS P2P CDS UE through this interface, such as the index of contents/content segments cached in that IMS P2P CDS UE, the access type, traffic conditions, location, capabilities and workload of that IMS P2P CDS UE.

6.1.3.2 PP_s1

PP_s1 is an interface between the IMS P2P CDS UE and the CCS mainly for bitmap exchange.

6.1.3.3 PP_m1

PP_m1 is an interface between the IMS P2P CDS UE and the CCS for media data transfer.

6.1.3.4 PP_s2

PP_s2 is an interface between the IMS P2P CDS UE and another IMS P2P CDS UE, which acts as a User Peer, mainly for bitmap exchange.

6.1.3.5 PP_m2

PP_m2 is an interface between the IMS P2P CDS UE and another IMS P2P CDS UE media data transfer.

6.1.3.6 Tc

Tc is an interface between the Tracker AS and the CCS. The Tracker AS collects a set of information from the CCS through this interface, such as the index of contents/content segments cached in that CCS, the location, workload, and aggregated bandwidth of that CCS.

6.1.3.7 Ts

Ts is an interface between the Tracker AS and the CSS. The CSS registers the content source to the Tracker AS for creating corresponding swarms. The Tracker AS instructs the CSS to distribute contents/content segments to the CCSs.

6.1.3.8 SC_s

SC_s is an interface between the CCS and the CSS mainly for message exchange for content acquisition.

6.1.3.9 SC_m

SC_m is an interface between the CCS and the CSS mainly for media transmission.

6.1.3.10 Rx

The Rx reference point resides between AF and PCRF. It enables transport of application level session information from AF to PCRF.

The functions of Rx reference point conform to TS 23.203 [5].

6.1.4 Message flows

6.1.4.1 IMS P2P CDS UE registration procedure

This procedure is a normal registration procedure as already defined in TS 23.228 [6].

Editor's note: What kind of information should be transferred to the Tracker AS through this procedure is for further study. This information may include e.g. the access type, traffic conditions, location, capabilities and workload of that IMS P2P CDS UE.

6.1.4.2 Content Distribution Procedure

6.1.4.2.1 Content Delivery Establishment Procedure

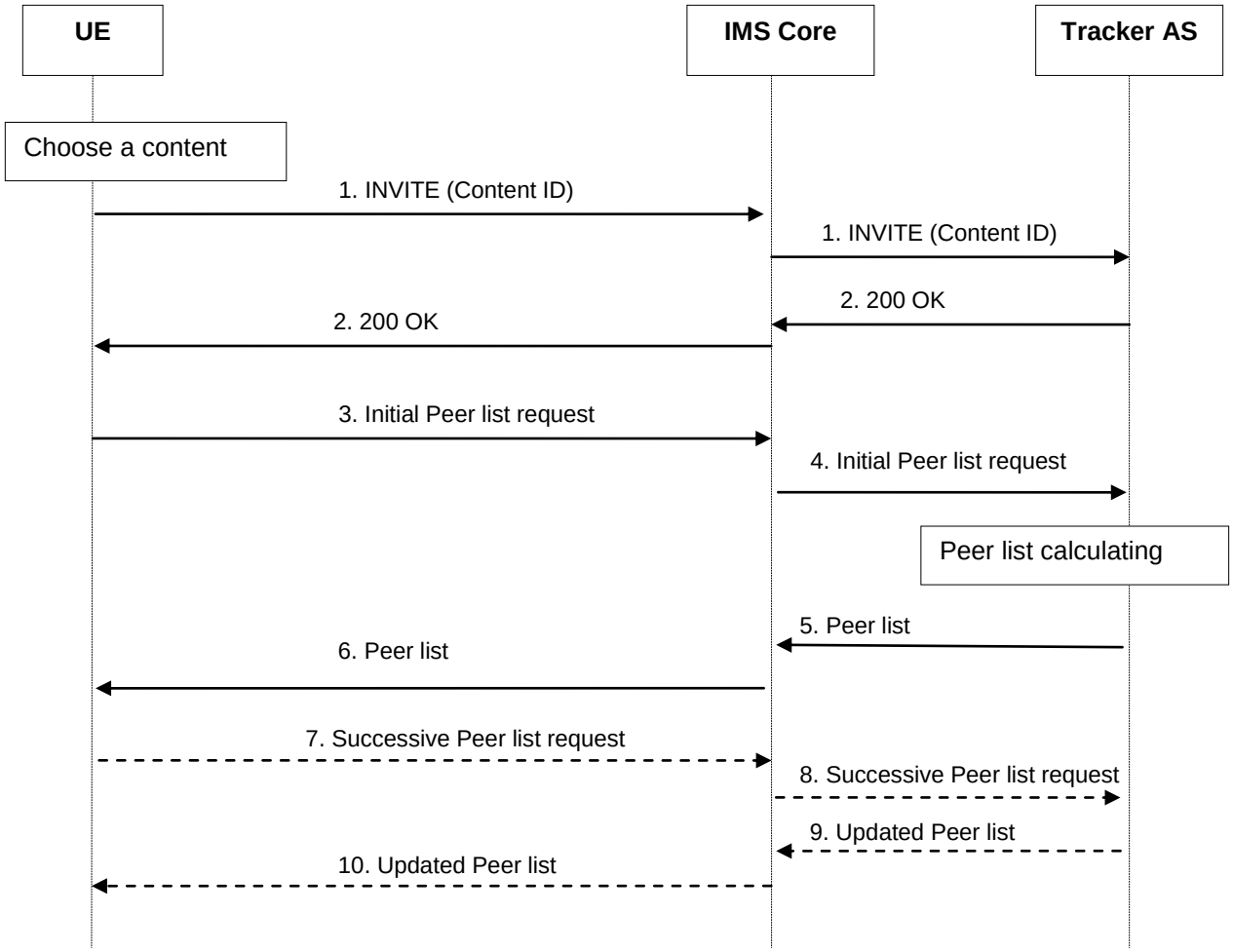

Figure 6.1.4.2.1-1: Delivery Establishment Procedure for alternative 1

1~2 After the user chooses a content, e.g. from a Web portal maintained by the IMS P2P CDS system, a Content ID is assigned and then sent from the IMS P2P CDS UE to the Tracker AS carried by an INTIVTE message, through IMS entities, e.g. P-CSCF, S-CSCF. Tracker AS replies 200 OK if the IMS P2P UE is allowed to receive P2P service.

Editor's note: The feasibility of using INVITE to carry Content ID for Peer list request is for further study.

Editor's note: The usage of the ISC interface in the above procedure needs further discussion.

Editor's note: The mechanism for the IMS core to trigger another AS, e.g. for playing an advertisement video in advance to playing the content requested by the user is for further study.

3~4 After the IMS P2P CDS UE receives a confirmed message, it sends a request to the Tracker AS for Peer list through IMS entities.

5~6 The Tracker AS calculates a Peer list and then sends it back to the IMS P2P CDS UE.

7~10 The IMS P2P CDS UE may request Peer list again in the case of e.g. some Peers become inaccessible.

Editor's note: The feasibility of carrying the request and response for Peer list in SIP message needs further assessment.

6.1.4.2.2 Media Transmission Procedure

After attaining a Peer list from the Tracker AS, the IMS P2P CDS UE should request a Bitmap from each Peer in the Peer list and then decide, according to a certain algorithm, from which CCSs or other IMS P2P CDS UEs (acting as User Peers) to acquire the content segments. After that, the IMS P2P CDS UE fetches content segments from selected other Peers.

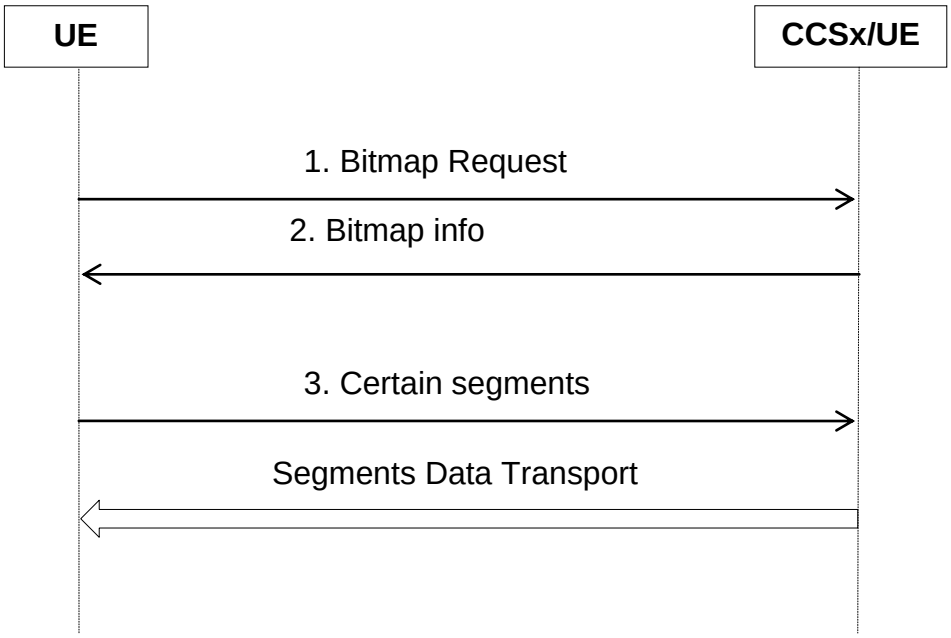

Figure 6.1.4.2.2-1: Media Transmission Procedure for alternative 1

1~2 The IMS P2P CDS UE fetches a Bitmap from each Peer in the Peer list segments.

3 According to a certain algorithm, the IMS P2P CDS UE decides from which CCSs or other IMS P2P CDS UEs (acting as User Peers) to acquire the content and then sends the request messages to them.

6.1.4.2.3 Content Delivery Termination Procedure

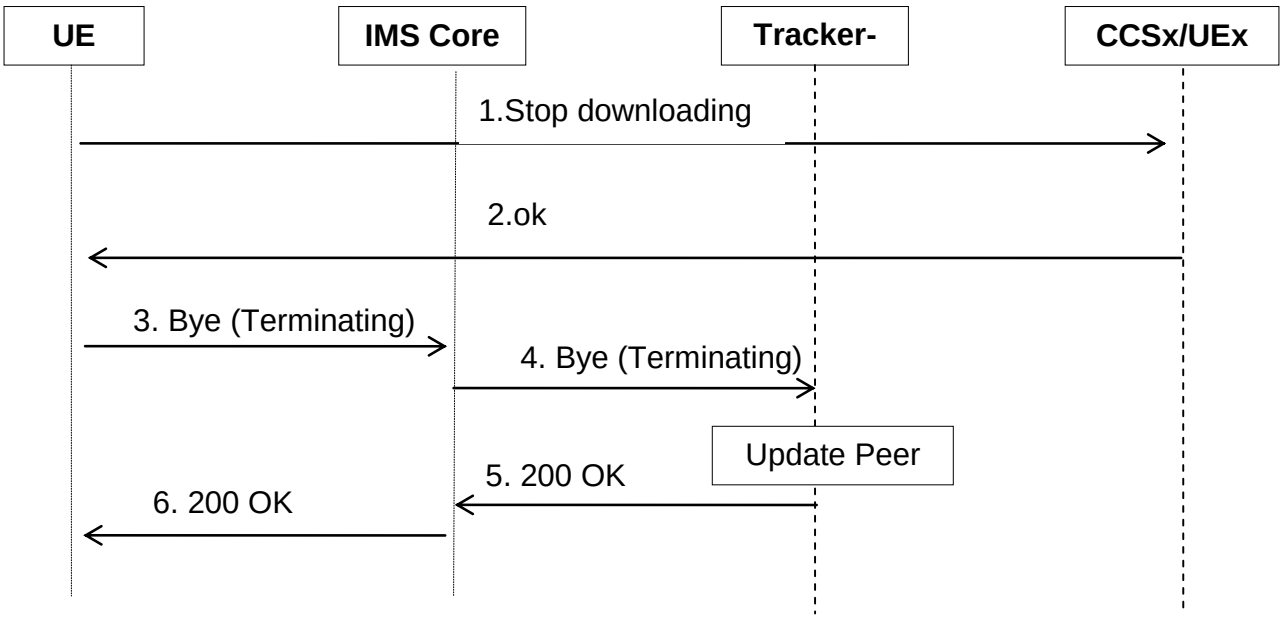

Figure 6.1.4.2.3-1: Content Delivery Termination Procedure for alternative 1

When the IMS P2P CDS UE terminates the existing P2P session, e.g. due to switching to another content or closing the programme, it releases all the current P2P media connections and then notifies the Tracker AS to remove itself from all related Peer lists.

1~2 The IMS P2P CDS UE releases all the current P2P media connections.

3~6 The IMS P2P CDS UE terminates the existing P2P session through SIP Bye message.

6.1.4.2.4 CCS Joining Procedure

The tracker AS may instruct a CCS to join a P2P swarm based on the status of a P2P swarm, e.g. underlying network condition change, new UE joining/leaving, changes in traffic conditions, location, capabilities and workload of peers, etc. The tracker AS may also instruct the CCS to retrieve the corresponding content/content segments from a CSS if the P2P content is not available at the CCS. This signalling flow can use the Tc interface between the tracker AS and the CCS.

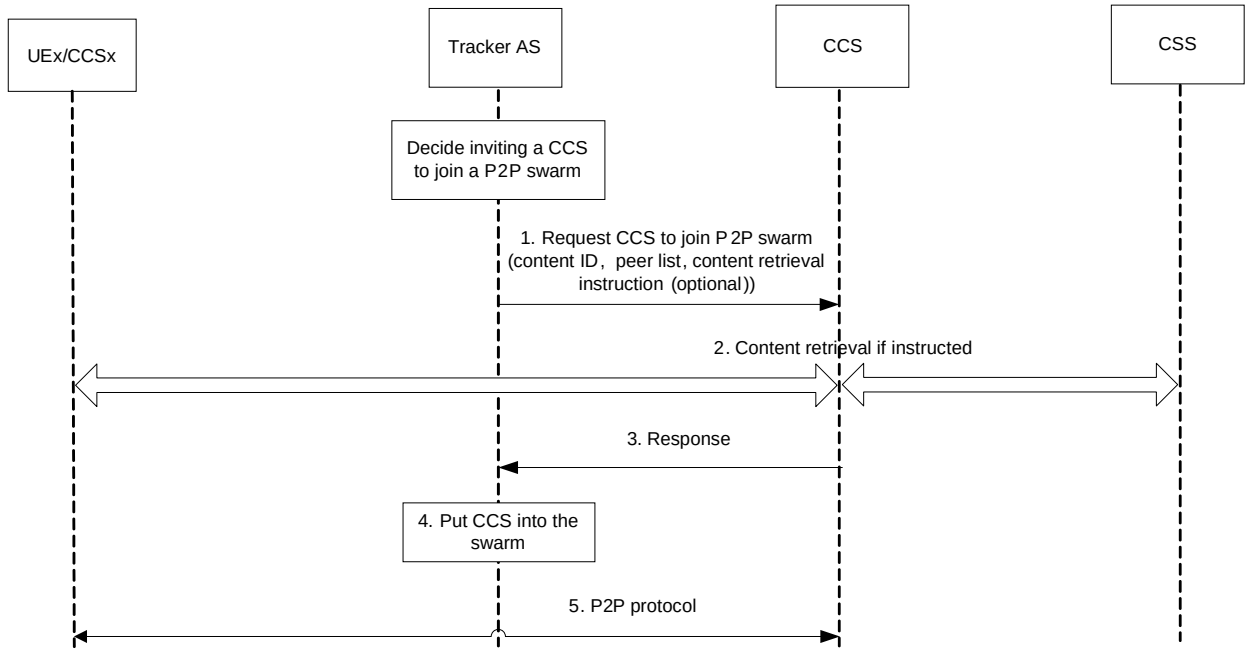

Figure 6.1.4.2.4-1: CCS Joining Procedure

1 After decided inviting a CCS to join a P2P swarm, the Tracker AS sends a message to request the CCS to join a P2P swarm. The INVITE should include the content ID and peer list, may also include the instruction to retrieve the content/content segments from a CSS.

2 The CCS retrieves the content/content segments if it is instructed by the Tracker AS to do so.

3 The CCS sends a response to the Tracker AS.

4 The Tracker AS puts CCS into the peer list of this swarm.

5 The CCS then joins the P2P swarm using the peer-to-peer protocol.

6.1.4.3 QoS Control Procedure

6.1.4.3.1 Alternative 1

After attaining a Peer list from the Tracker AS, the UE selects Peers and requests to establish dedicated bearer with the QoS policy from PCRF and the packet filters generated from the local and remote addresses and port numbers. The content data is then transmitted on the established dedicated bearer.

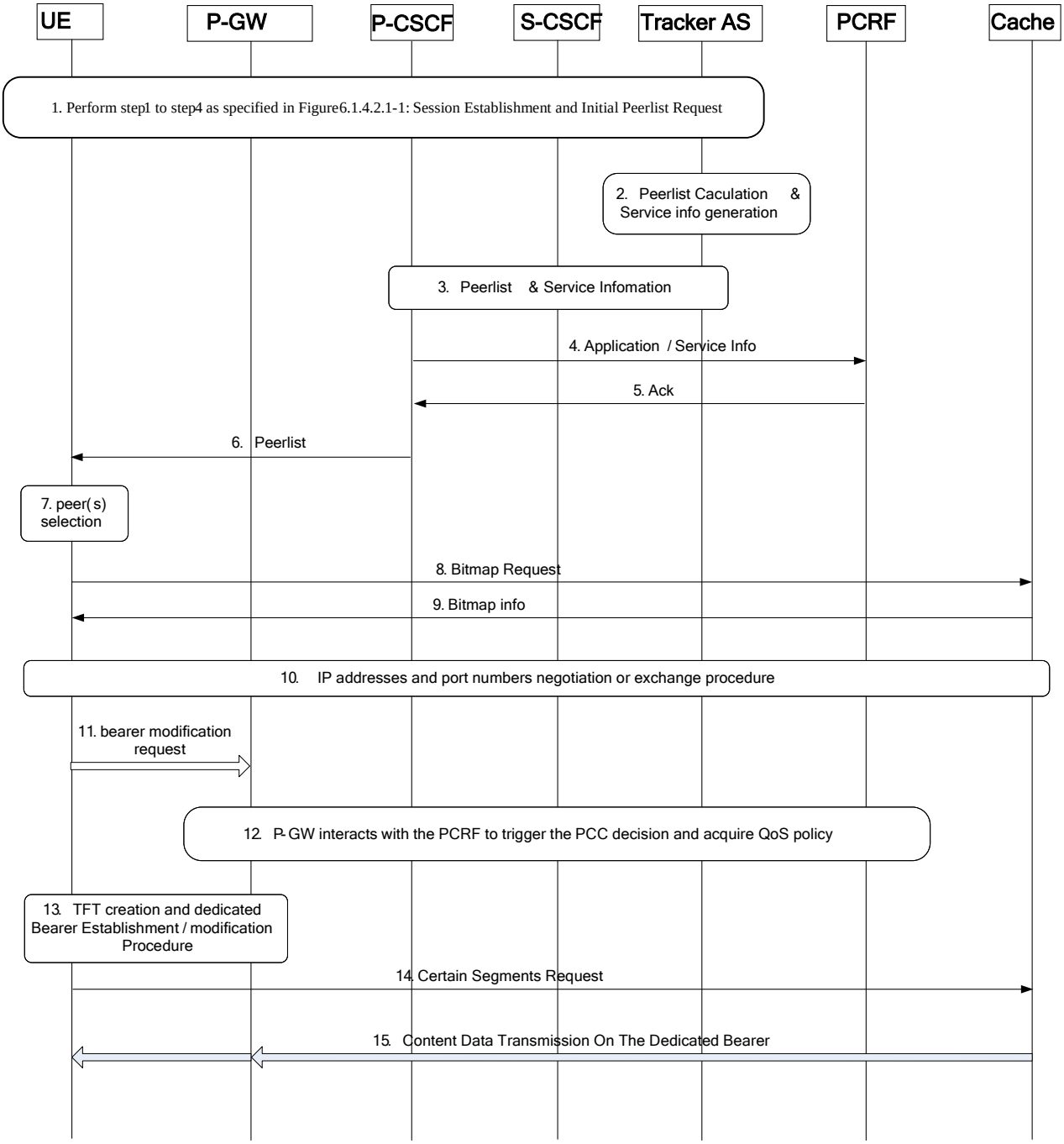

Figure 6.1.4.3.1-1: QoS control Procedure for Alternative 1

1 Perform step1 to step4 as specified in Figure 6.1.4.2.1-1: Session Establishment and Initial Peer list Request.

Editor's note: It is for further study whether the invite message needs to carry the UE's address(es) and port(s) for the media plane.

2 Tracker AS selects peers that can provide the specific content and identifies the Service information needed, e.g. IP address of the IP flow (s), port numbers to be used, information on recommended QoS parameters such as recommended bandwidth or rate, etc.

Editor's note: How to generate the recommended QoS parameters is for further study. A possible solution is the service provider provides Tracker AS the recommended QoS parameters such as the minimum bandwidth for the contents, which could guarantee the content could be downloaded in time in most occasions. And Tracker AS selected proper QoS parameter according to UE's property (such as caching size, access mode, etc.) and corresponding QoS parameters recommended for the specific content.

3 Tracker AS returns service information and list of candidate peers that can provide requested content. The message is forwarded to P-CSCF.

4 P-SCSF records candidate Peers list and provides the Service Information to the PCRF. In the Service Information, the address(s) and port(s) corresponding to the candidate peers could be set to wild card or omitted.

Editor's note: It is for further study whether P-CSCF or Tracker AS acts as AF in PCC architecture.

5 The PCRF stores the service information and responds with the Acknowledgement to P-SCSF.

6 P-CSCF provides UE with the candidate Peer list.

7 According to a certain algorithm, the UE selects one or more peers as the content delivery node from the candidate Peers list.

8-9 The UE fetches a Bitmap from each Peer in the Peer list segments.

According to a certain algorithm, the UE decides from which peer(s) to acquire the content or chunks.

10 Optionally, the UE can negotiate or exchange with the selected peers about the IP addresses and port numbers used to send/receive the content.

Editor's note: The mechanism for negotiating or exchanging the information above is for further study.

11 The UE requests for creation of the dedicated bearer or modification of the packet filters(if there's already a dedicated bearer) according to the local and remote final IP addresses and port numbers by initiating the bearer resource modification procedure, as specified in TS 23.401.

In this procedure the UE signals a Traffic Aggregate Description (TAD) which includes the packet filter information and requested operation (add/modify/delete packet filters). The packet filter information is derived from the local and remote final IP addresses and port numbers.

12 The P-GW saves packet filter(s) and interacts with the PCRF to trigger the PCC rules and acquire QoS policy.

13 The P-GW creates TFT with the packet filter(s) , and initiates dedicated bearer modification procedure to establish or modify the dedicated bearer with the TFT and the QoS policy, as specified in TS 23.401.

14-15 UE sends the request messages to the selected peers to acquire content. The Peers send the requested chunks to UE through P-GW. The corresponding IP flows are transmitted on the dedicated EPS bearer that is associated with the TFT of the matching downlink packet filter.

Editor's note: This solution could solve the problem that the number of initial Candidate Peers exceeds the limitation of TFT by limiting the number of final peers selected by UE in 15, so it might have some impact on UE.

6.1.4.3.2 Alternative 2

The operator allocates a particular APN for Content delivery service and defines the corresponding QoS policy (such as APN-AMBR, QCI) to the APN. When UE uses the IMS P2P CDS service, the content data is transmitted on the bearer which is established based on the QoS policy associated with the IMS P2P CDS APN.

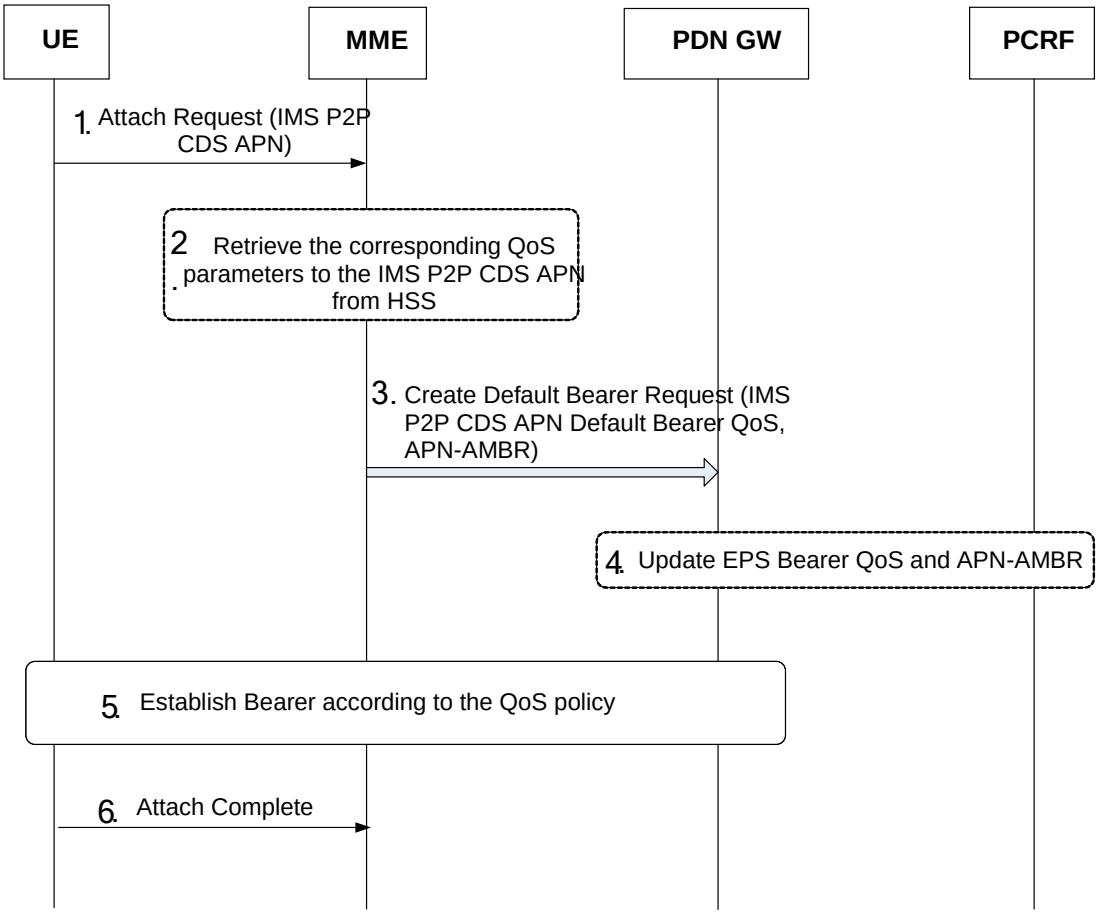

Figure 6.1.4.3.2-1: QoS Control Procedure for Alternative 1

1 The UE initiates the Attach procedure with IMS P2P CDS APN carried in the message.

2-3 MME initiates create default bearer request with APN, QoS related parameters in the message. Optionally, MME can retrieve the QoS parameters associated with IMS P2P CDS APN from HSS.

4 Optionally, PCRF can be requested to update EPS bearer QoS and APN-AMBR.

5-6 P-GW enforces the QoS policy and establish default bearer.

Editor's note: In this solution, the bearer is established based on the QoS policy of the specific IMS P2P CDS APN. The IP flows of the requested content data will be transmitted on this bearer. Therefore, it's a simple QoS mechanism. But since the QoS is pre-defined, so it can't meet all the QoS requirements of contents' delivery when different contents have individual service QoS requirement for delivery.

6.1.4.3.3 Alternative 3

This solution introduces a new entity "MediaProxy" to solve the problem of excessive IP filters generated from the large numbers of Caches.

6.1.4.3.3.1 Architecture of using MediaProxy for QoS control

The QoS architecture with MediaProxy is as follows:

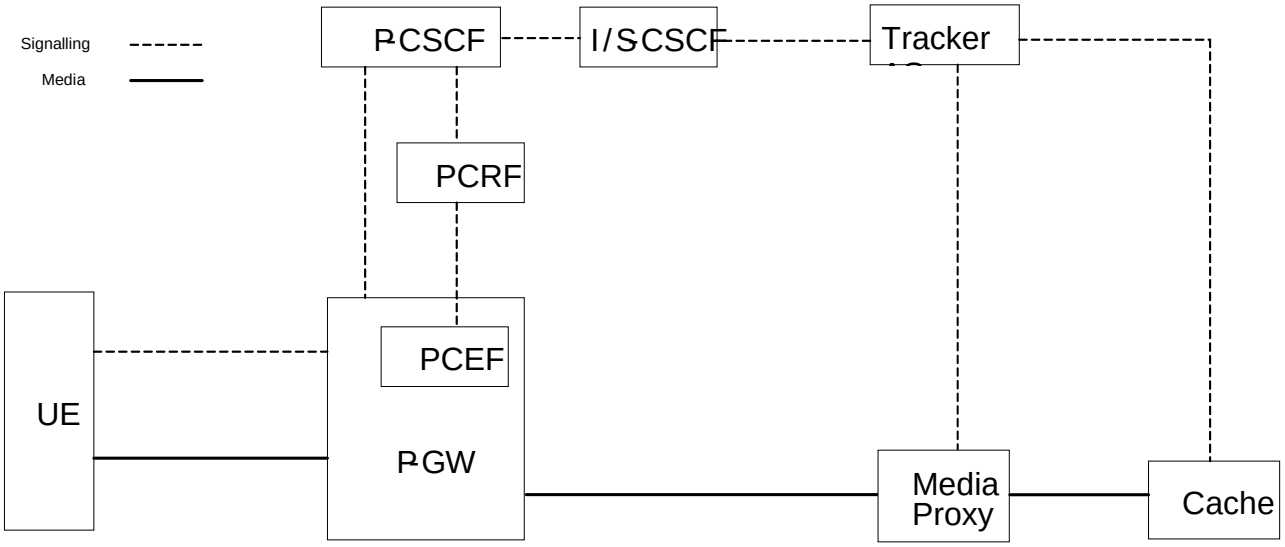

Figure 6.1.4.3.3.1-1: QoS architecture with MediaProxy

The MediaProxy allocates the local IP addresses and port numbers corresponding to the original ones for the Caches, establishes the addresses and ports mapping relationship, modifies the corresponding IP addresses and/or ports of the data packets of downlink media flow according to the mapping relationship, and forwards the modified packets to the P-GW.

The Tracker sends the MediaProxy the original IP addresses and port numbers of the Caches and retrieves the corresponding proxy allocated ones through the interface between Tracker and MediaProxy.

Editor's note: The protocol used on the interface of Tracker and MediaProxy is for further study.

Editor's note: Whether Tracker AS should be involved in QoS control is for further study.

6.1.4.3.3.2 QoS Control Procedure

The procedure of QoS control with MediaProxy is as follows:

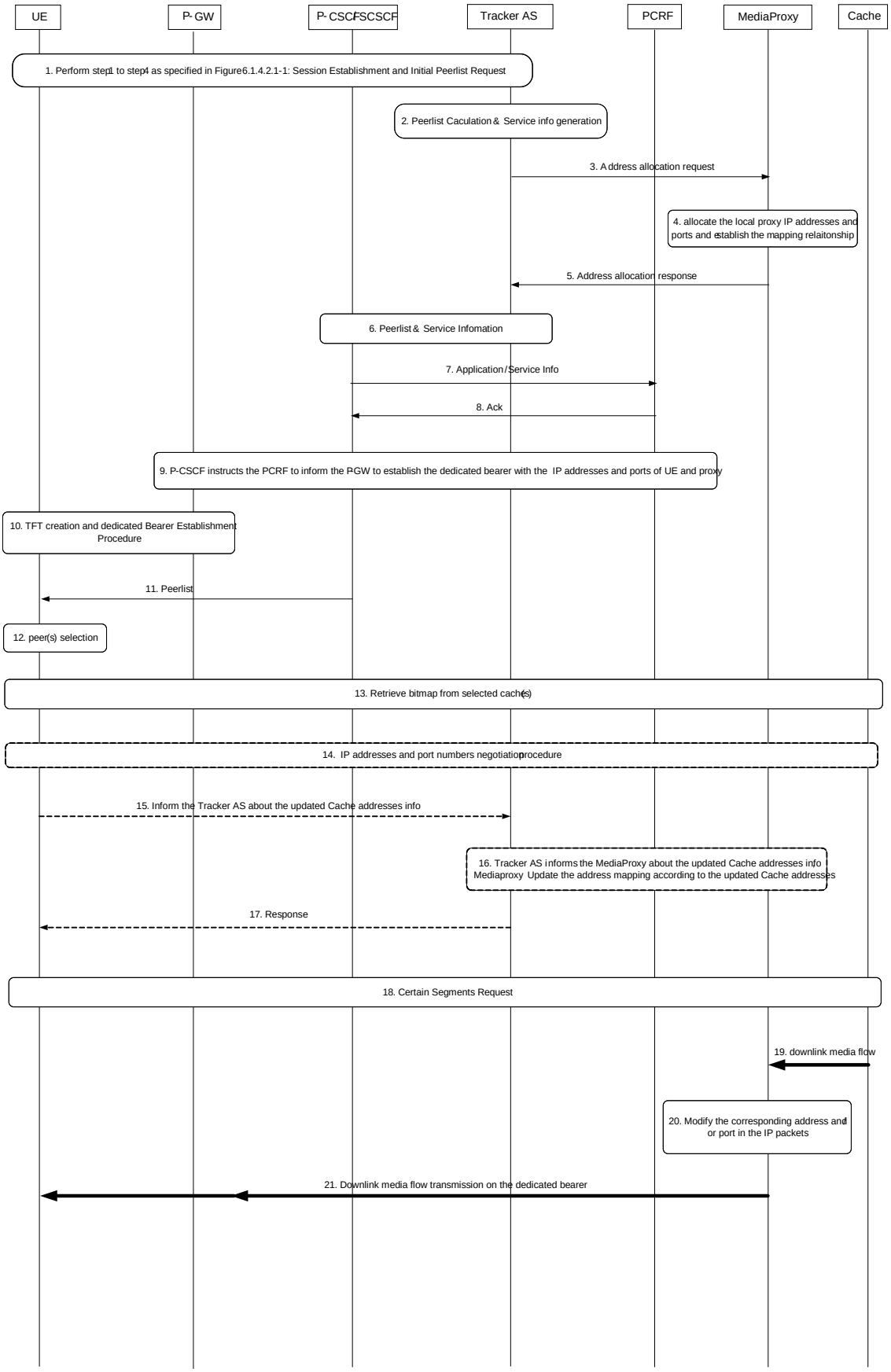

Figure 6.1.4.3.3.2-1: QoS control Procedure for Alternative 1

1 Perform step1 to step4 as specified in Figure 6.1.4.2.1-1: Session Establishment and Initial Peer list Request. The invite message needs to carry the UE's address(es) and port(s) for the media plane .

2 Tracker AS selects peers that can provide the specific content and identifies the Service information needed, e.g. IP address of the IP flow (s), port numbers to be used, information on recommended QoS parameters such as recommended bandwidth or rate, etc.

Editor's note: How to generate the recommended QoS parameters is for further study.

3 Tracker AS sends a message to the MediaProxy to request for address allocation, with the candidate Caches' IP addresses and port numbers contained in the message.

4 The MediaProxy allocates the corresponding local proxy IP addresses and ports for the candidate Caches according to their original IP addresses and port numbers , and establishes the mapping relationship between the local ones and the original ones. The MediaProxy could allocate the local IP addresses and port numbers according to the operator policy, for example, there're 30 Candidate Caches, it could allocate the same IP address and 30 consecutive or partly consecutive port numbers, the packet filters are generated from the proxy allocated IP addresses and port numbers instead of the original ones, so according to the generation rules of the packet filter, the number of the generated packet filters could be controlled in the limitation of 15 as specified in TS 24.008.

5 MediaProxy informs the Tracker AS of the proxy allocated IP addresses and port numbers of the candidate Caches with a response message.

6 Tracker AS returns to P-CSCF the service information and list of candidate peers which contains the corresponding proxy addresses and port numbers

7 P-SCSF records candidate Peers list and provides the Service Information to the PCRF.

Editor's note: It is for further study whether P-CSCF or Tracker AS acts as AF in PCC architecture.

8 The PCRF stores the information and responds with the Acknowledgement to P-SCSF.

9 The P-CSCF instructs the PCRF to inform the P-GW of the packet filters which contains the Caches' proxy allocated IP addresses and port numbers as well as the UE's IP addresses and port numbers. The P-GW establishes the dedicated bearer with the received packet filters information. As described in step4, the MediaProxy may allocate the local IP addresses and port numbers using the policy like allocating consecutive or partly consecutive port numbers, so according to the generation rules of the packet filter, the excessive packet filters problem could be avoided.

10 The P-GW creates TFT with the packet filter(s) , and initiates dedicated bearer modification procedure to establish the dedicated bearer with the TFT and the QoS policy, as specified in TS 23.401.

11 P-CSCF provides UE with the candidate Peer list which contains the corresponding proxy allocated addresses and port numbers of the Candidate Caches

12 According to certain algorithm, the UE selects one or more peers as the content delivery node from the candidate Peers list.

13 The UE fetches the Bitmap from each Peer in the Peer list.

According to certain algorithm, the UE decides from which peer(s) to acquire the contents or chunks.

14 Optionally, the UE can negotiate with the selected peers about the IP addresses and port numbers used to send/receive the content.

Editor's note: The mechanism for negotiating or exchanging the information above is for further study.

15 If the negotiation process in step 14 happens and the original Caches' IP addresses and/or port numbers are changed, the UE needs to inform the Tracker AS of the updated Caches' IP addresses and/or port numbers.

16-17 The Tracker AS informs the MediaProxy about the updated Caches' addresses and/or port numbers. The MediaProxy modifies the mapping relationship according to the updated information.

18 UE sends the request messages to the selected peers to acquire the content segments.

Editor's note: It is for further study whether the messages in the content segments request process should to be transmitted by MediaProxy or not.

19-21 The Peers send the requested chunks to UE through MediaProxy. The MediaProxy modifies the corresponding IP addresses and/or port numbers in the data packets of the downlink media flow with the corresponding local IP addresses and/or port numbers according to the mapping relationship, and then forwards the modified packets to the P-GW. The media flow is transmitted on the dedicated bearer that is associated with the TFT generated in step10.

Editor's note: This solution can implement the QoS control and solve the problem of excessive IP filters by introducing MediaProxy, so it causes some impact on the architecture, and also, the Tracker AS needs to be enhanced to implement the interface to MediaProxy.

6.2 Alternate 2 - Signalling between User Peer and other User Peers traversing IMS core

6.2.0 General

All signalling messages between User Peer and Tracker go through IMS core.

Signalling (e.g. for bitmap fetching) between User Peer and other User Peers also go through IMS core.

The QoS related architecture, functional entity and interface are the same as depicted in alternate 1.

6.2.1 Architecture Reference Model

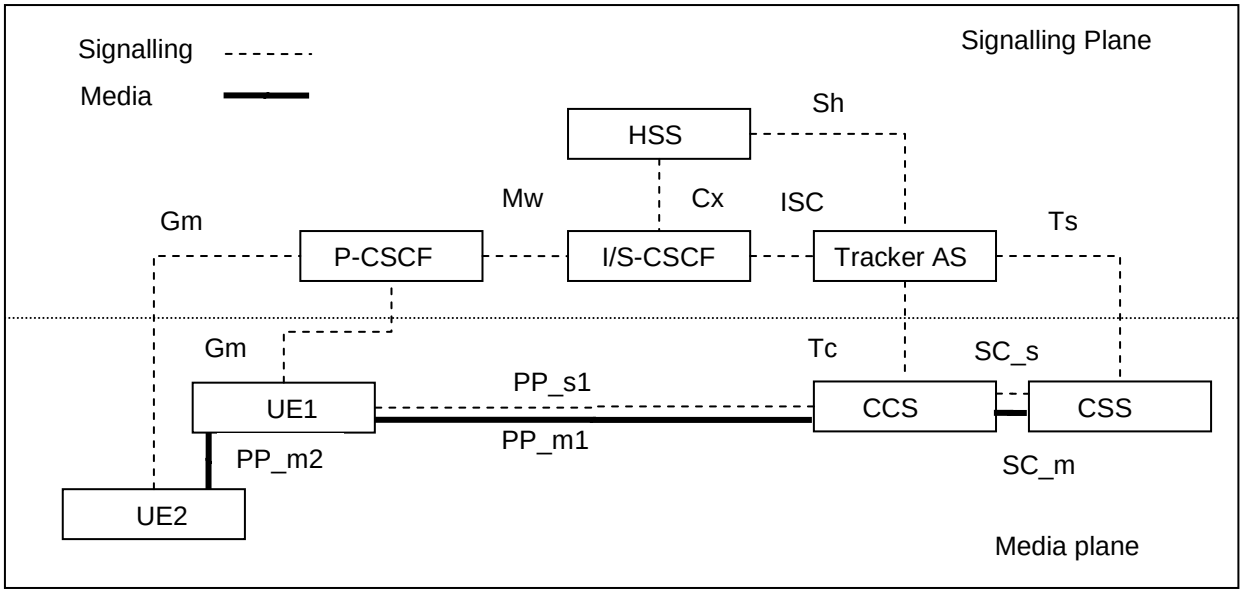

Figure 6.2.1-1: Overview of the IMS P2P CDS architecture for alternative 2

Editor's note: It is for further study whether signalling messages between User Peer and Network Peers shall traverse IMS core.

6.2.2 Functional Entities

P-CSCF, I-CSCF, S-CSCF and HSS are already defined in TS 23.228 [6].

The functions of CCS, CSS and Tracker AS are the same as depicted in clause 6.1.2.

The UE should support the functionality of User Peer if it is used to provide IMS P2P CDS applications to the user.

6.2.3 Interfaces

6.2.3.1 Gm, Mw, ISC

These interfaces are SIP interfaces with the functionality as defined in TS 23.228 [6].

For IMS P2P CDS, these interfaces are also used as follows:

- The IMS P2P CDS UE sends a Content ID to the Tracker AS for fetching a Peer list through these interfaces.
- The Tracker AS collects a set of information from the IMS P2P CDS UE through this interface, such as the index of contents/content segments cached in that IMS P2P CDS UE, the access type, traffic conditions, location, capabilities and workload of that IMS P2P CDS UE.
- A User Peer fetches the bitmap information from other User Peers through these interfaces.

Editor's note: It is for further study whether signalling messages between User Peer and Network Peers shall go through these interfaces.

6.2.3.2 PP_s1

The interface is the same as depicted in clause 6.1.3.2.

Editor's note: This interface should be removed from the architecture if it is decided that signalling messages between User Peer and Network Peers shall traverse IMS core.

6.2.3.3 PP_m1

The interface is the same as depicted in clause 6.1.3.3.

6.2.3.4 PP_m2

The interface is the same as depicted in clause 6.1.3.4.

6.2.3.5 Tc

The interface is the same as depicted in clause 6.1.3.5.

6.2.3.6 Ts

This is for further study.

6.2.3.7 SC_s

This is for further study.

6.2.3.8 SC_m

This is for further study.

6.2.4 Message flows

6.2.4.1 IMS P2P CDS UE registration procedure

This procedure is the same as depicted in clause 6.1.4.1.

6.2.4.2 Content Distribution Procedure

6.2.4.2.1 Content Delivery Establishment Procedure

This procedure is the same as depicted in clause 6.1.4.2.1 except that in the present procedure the identification of a User Peer in the Peer list uses IMPU rather than IP address yet for Alternative 1 IP addresses are used for both User Peer and Network Peer.

6.2.4.2.2 Media Transmission Procedure

The purpose of this procedure is the same as depicted in clause 6.1.4.2.2. However the signalling messages between one User Peer and another go through IMS core and Tracker AS to achieve better management and charging capabilities.

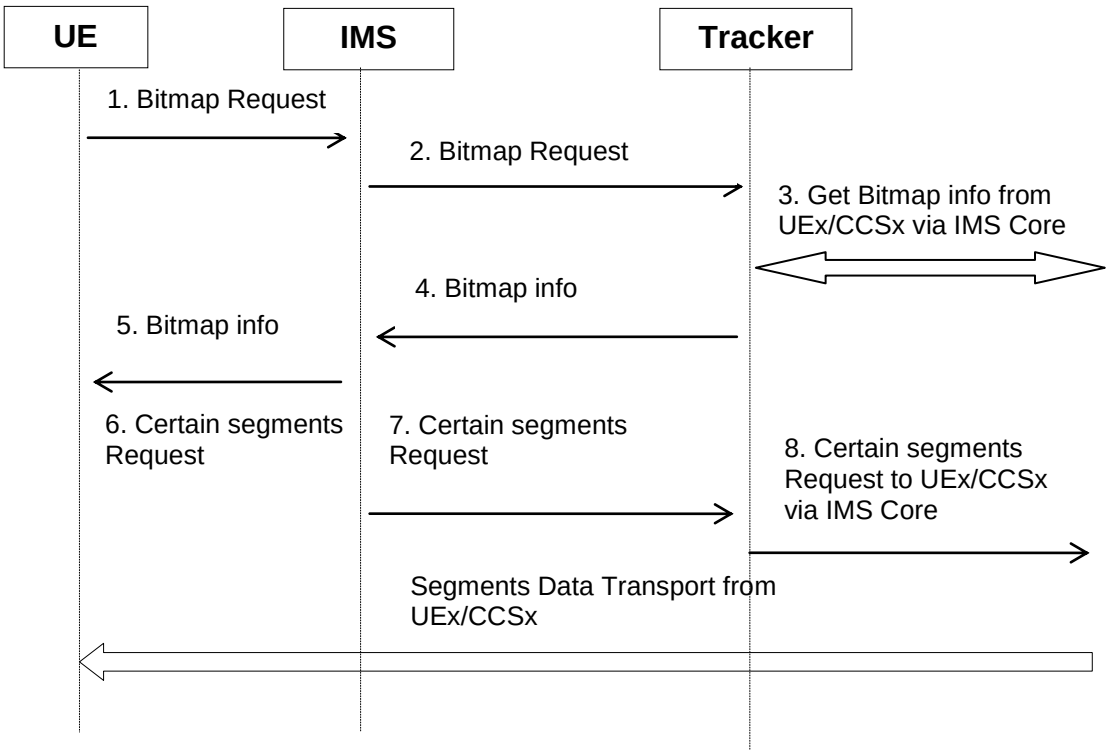

Figure 6.2.4.2.2-1: Media Transmission Procedure for alternative 2

1~5 The IMS P2P CDS UE fetches the bitmap information from each User/CCS Peer in the Peer list across IMS Core and Tracker AS.

6~8 According to a certain algorithm, the IMS P2P CDS UE decides from which IMS P2P CDS UEx/CCSx (acting as Peers) to acquire the content and then sends the request messages to them, across IMS Core and Tracker AS.

Editor's note: It is for further study whether signalling messages between UE Peer and Network Peers shall traverse IMS core.

Editor's note: It is for further study in which way the message delivery in Step1~9 can utilize SIP signalling.

6.2.4.2.3 Content Delivery Termination Procedure

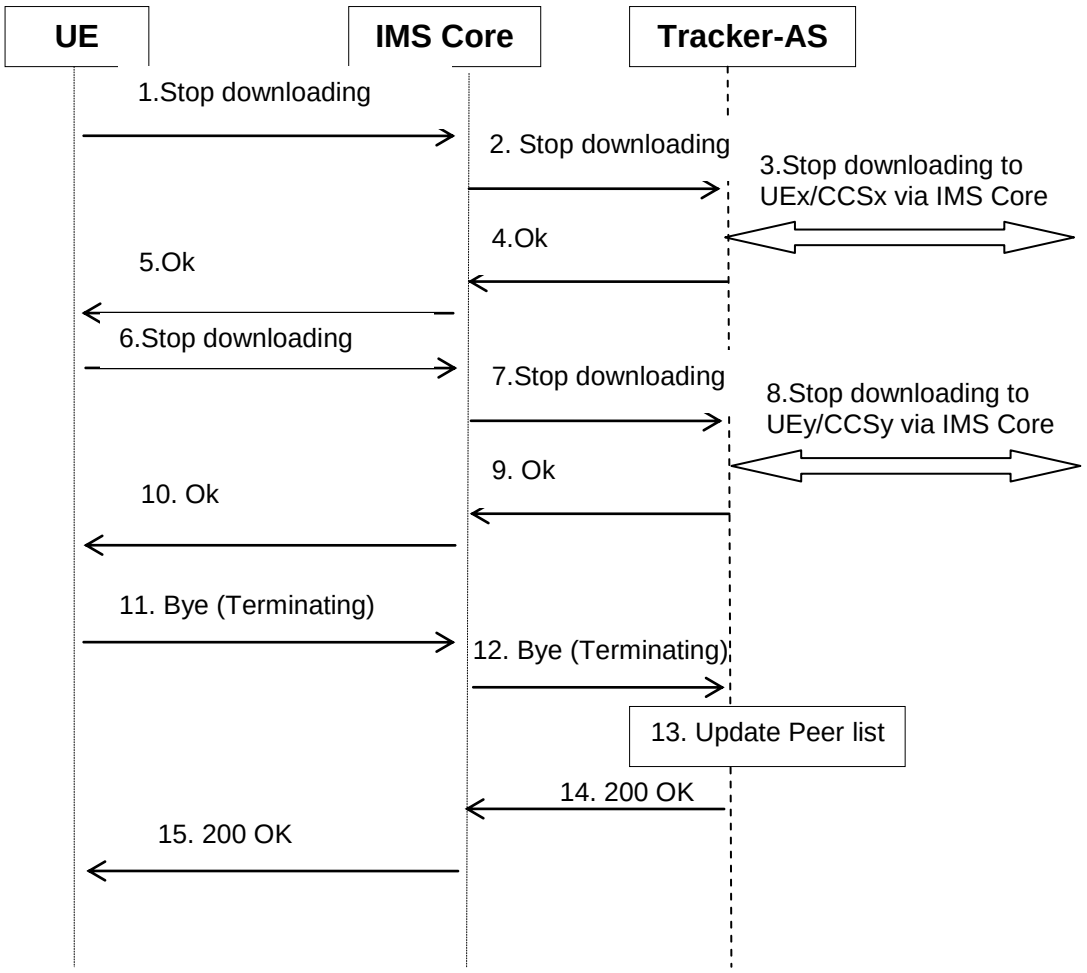

Figure 6.2.4.2.3-1: Content Delivery Termination Procedure for alternative 2

When the IMS P2P CDS UE terminates the existing P2P session, e.g. due to switching to another content or closing the programme, it releases all the current P2P media connections and then notifies the Tracker AS to remove itself from all related Peer lists.

1~10 The IMS P2P CDS UE releases all the current P2P media connections.

11~15 UE terminates the existing P2P session, the same defined in clause 6.1.4.2.3-1.

Editor's note: It is for further study whether signalling messages between UE Peer and Network Peers shall traverse IMS core.

Editor's note: It is for further study in which way the above message delivery can utilize SIP signalling.

6.3 Alternate 3 - Using direct interface for signalling between User Peer and Tracker AS

6.3.0 General

User Peers interact with Tracker AS directly via direct interface (e.g. Ut) rather than traversing IMS core.

Signalling (e.g. for bitmap fetching) between User Peer and Network Peer does not go through IMS core.

The QoS related architecture, functional entity and interface are the same as depicted in alternate 1.

6.3.1 Architecture Reference Model

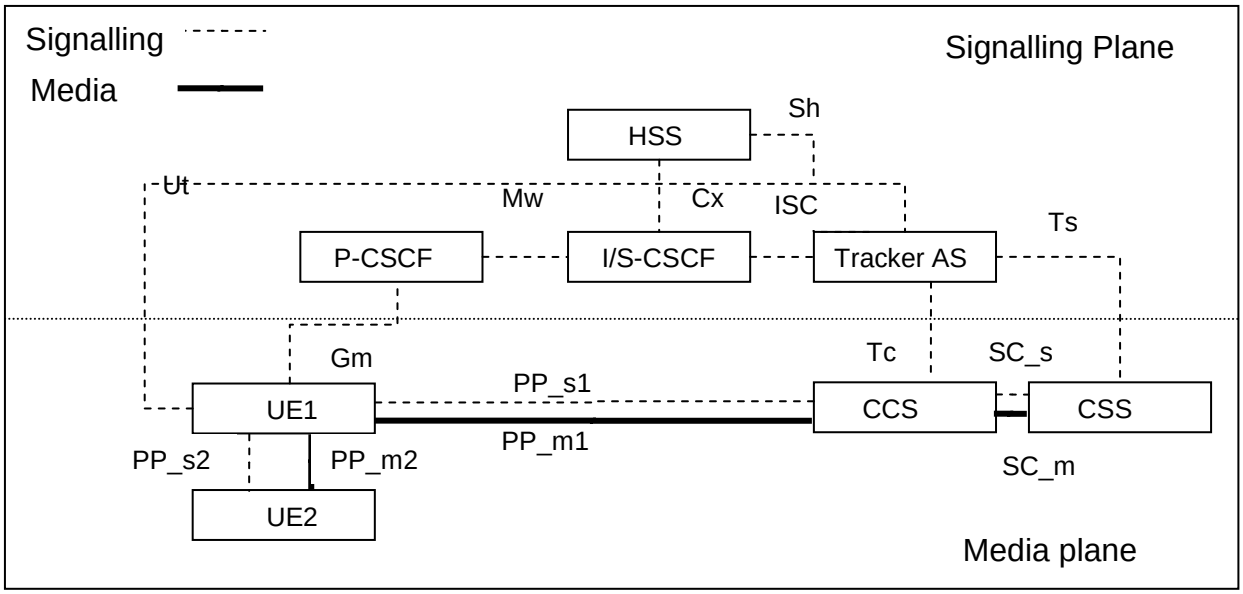

Figure 6.3.1-1: Overview of the IMS P2P CDS architecture for alternative 3

The major difference between the present alternative and Alternative 1 (defined in clause 6.1) is that UE shall directly interact with Tracker AS to do the following via Ut interface rather than going through IMS core.

- The IMS P2P CDS UE sends a Content ID to the Tracker AS for fetching a Peer list.
- The Tracker AS collects a set of information from the IMS P2P CDS UE, such as the index of contents/content segments cached in that IMS P2P CDS UE, the access type, traffic conditions, location, capabilities and workload of that IMS P2P CDS UE.

There are two ways for IMS P2P CDS UEs to retrieve the address of Tracker AS.

- The Tracker AS address (e.g. FQDN) can be pre-configured in UE statically.
- The tracker AS address (e.g. FQDN) can be obtained via Gm interface during IMS registration.

6.3.2 Functional Entities

The functions are the same as depicted in clause 6.1.2.

6.3.3 Interfaces

The interfaces are the same as depicted in clause 6.1.3.

6.3.4 Message flows

The procedures of IMS P2P CDS UE registration, Media Transmission are the same as depicted in clause 6.1.4. The procedures of Content Delivery Establishment and Content Delivery Termination are similar to those in clause 6.1.4 with the only difference that the signalling doesn't go through IMS Core.

6.3.4.1 Peer list retrieval

Figure 6.3.4-1 shows how the IMS P2P CDS UE requests a peer list from the Tracker AS for the desired content. In this example, the signalling between IMS P2P CDS UE and Tracker AS does not traverse the IMS core network entities.

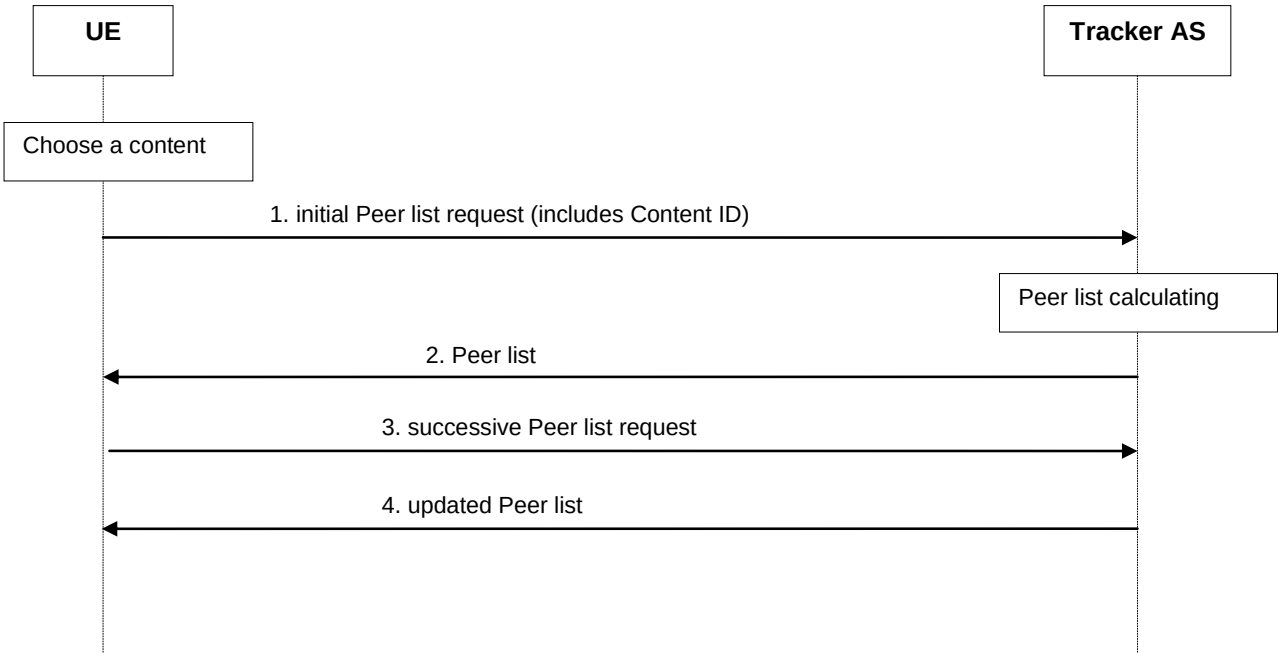

Figure 6.3.4.1-1: Peer list retrieval

1 After the user chooses a content, e.g. from a Web portal maintained by the IMS P2P CDS system, a Content ID is assigned. The IMS P2P CDS UE sends a request to the Tracker AS to obtain a list of peers from where the content segments are available. The Content ID is included in the peer list request.

2 The Tracker AS calculates a Peer list and then sends it back to the IMS P2P CDS UE.

3~4 The IMS P2P CDS UE may request Peer list again in the case of e.g. some Peers become inaccessible.

Editor's note: The interface between the IMS P2P CDS UE and the Tracker AS is for further study. One option might be to re-use the Ut interface, however this is also dependent on if the signalling between IMS P2P CDS UE and Tracker AS is compatible with that defined for the Ut reference point.

6.4 Architectures for IMS P2P CDS used in conjunction with CDN

6.4.0 General

This clause provides alternative architectures for IMS P2P CDS used in conjunction with Third Party CDN networks.

6.4.1 CDN component registered in IMS

If CDN components like Origin Server and Edge Server are registered in IMS, UE is able to contact them directly through IMS core. In the following steps, content is chopped into three pieces and stored in three places separately. All UEs and servers are IMS registered. These servers has dedicated interface with the Tracker AS. Network peer and User Peer already updated their information in the Tracking List resides at the Tracker AS. Data traffic path is not shown in the provided architecture.

- In steps 1 and 2, UE requests for content service and the Tracker AS replies it a peer list.

Editor's note: The signal path for UE to obtain this peer list is for further study.

- In step 3, UE selects peers from the list and send request to P-CSCF.
- In step 4, IMS core forward request to corresponding devices for pieces as original UE requested.

Editor's note: There is another option that P2P request does not go through IMS core.

- In step 5, UE update its status to the Tracker AS.

Editor's note: The signal path for UE to update its status is for further study.

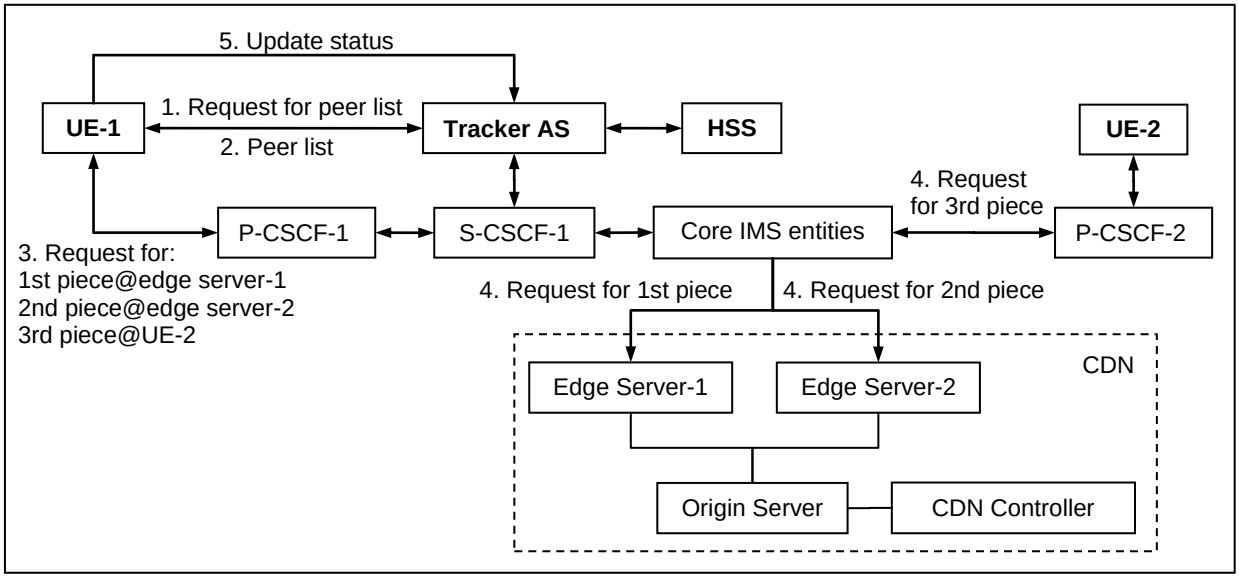

Figure 6.4.1-1 CDN component registered in IMS CDS

6.4.2 CDN component not registered in IMS

If CDN components like Origin Server and Edge Server are not registered in IMS, UE should contact them through CDN Controller. In the following steps, Content is chopped into three pieces and stored in three places separately. In CDN-1, only CDN Controller registered in IMS. The CDN controller has dedicated interface with the Tracker AS. CDN Controller and User Peers already updated their information in the Tracking List resides at the Tracker AS. Data traffic path is not shown in the provided architecture.

- In step 1&2, UE requests for content service and the Tracker AS replies it a peer list.

Editor's wote: The signal path for UE to obtain this peer list is for further study.

- In step 3, UE selects peers from the list and send request to P-CSCF.
- In step 4, IMS core forward request to CDN Controller.

Editor's note: There is another option that P2P request does not go through IMS core.

- In step 5, CDN Controller forwards the request to corresponding edge servers.
- In step 6, UE update its status to the Tracker AS.

Editor's note: The signal path for UE to update its status is for further study.

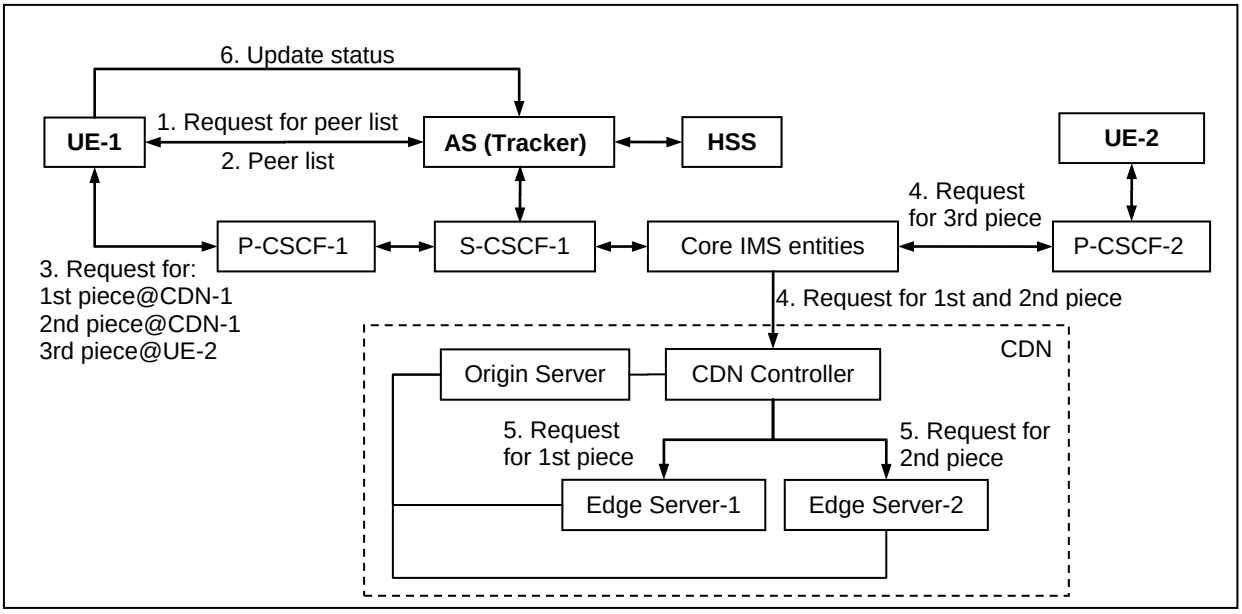

Figure 6.4.2-1 CDN component not registered in IMS CDS

6.4.3 Integration with CDN using Network Storage Control Peer

In this alternative architecture, integration with CDN is achieved by introducing into the IMS P2P CDS a network peer that consists of CCS functionality as well as allowing nodes in the P2P network to dynamically advertise content pieces available in the CDN, directly upload content pieces to the CDN, and redirect a peer to get content from the CDN. Network Storage Control Function is added to the IMS P2P CDS to interface to CSS and/or CDN as shown in Figure 6.4.3-1. Its role is to make available to peers involved in a swarm, the necessary content segments to be downloaded, either from its own storage or by adding them to the CDN. The Network Storage Control Function can retrieve content segments from a CSS within network peers.

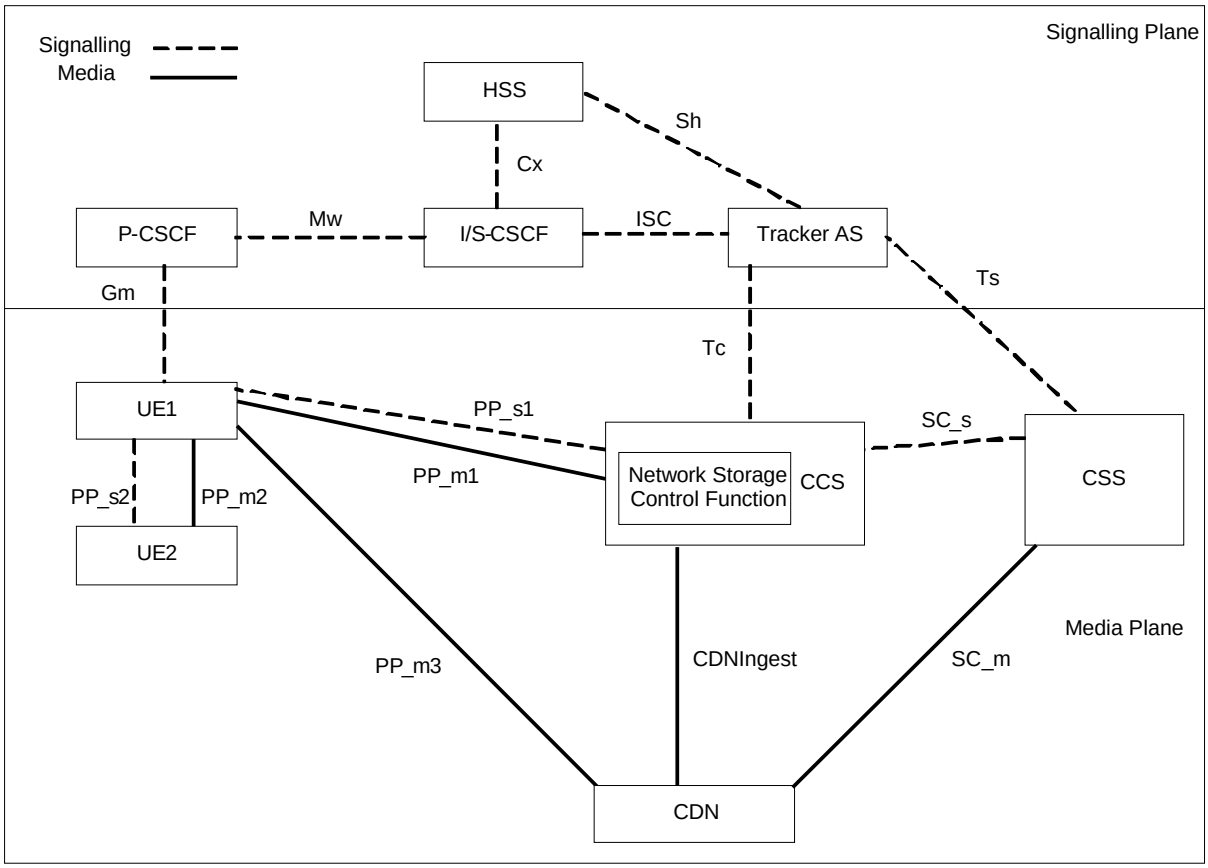

Figure 6.4.3-1: Architecture for CDN Integration in P2P CDS Using a Network Storage Control Peer

The following information flows in Figure 6.4.3-2 show how the Network Storage Control Function can be invited to a swarm and then distribute content segments from the CSS to the CDN such that peers can then access such content from the CDN. The CCS could also use its own storage but this is not represented here.

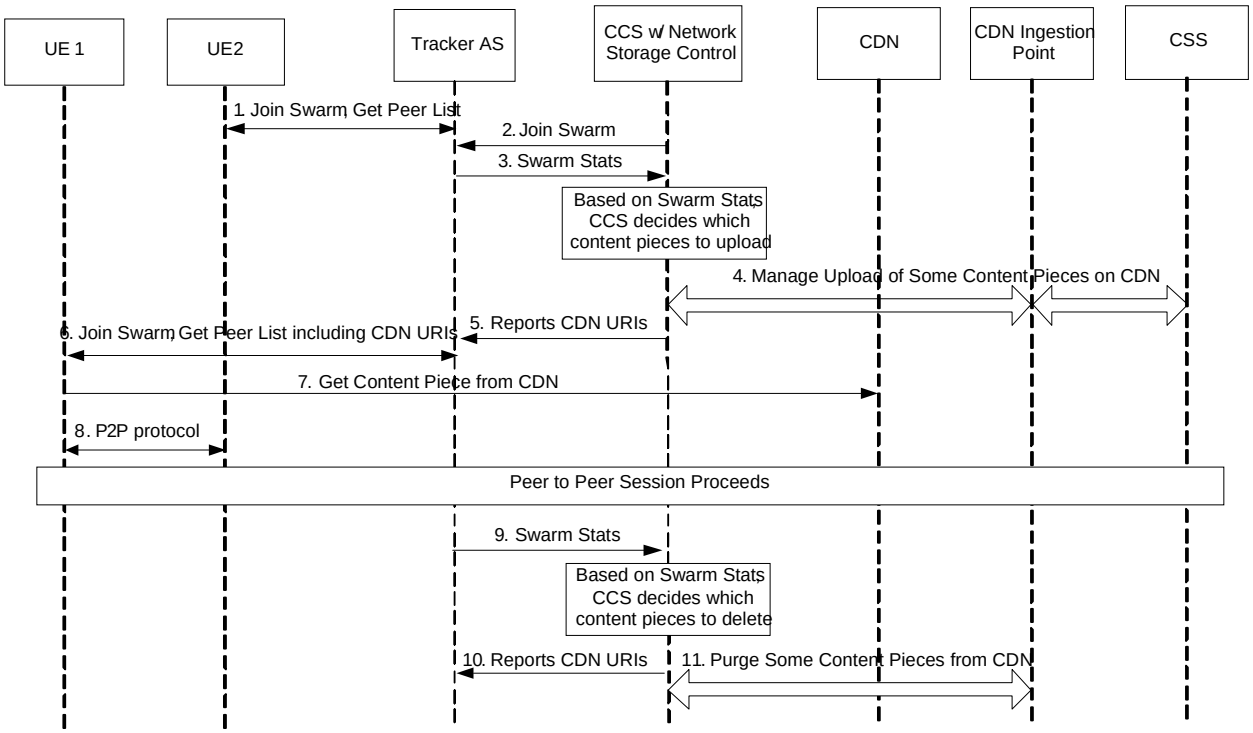

Figure 6.4.3-2: CDN Integration in P2P CDS Using a Network Storage Control Peer

1. UE2 joins an existing swarm and obtains a peer list
2. CCS with Network Storage Control Function joins the swarm. This operation may be triggered in various ways (e.g. Tracker AS may request CCS to join).
3. Tracker AS provides swarm statistics to CCS. These statistics may for example contain the number of copies of content pieces in the swarm, and should be sent periodically or on demand to the CCS to enable dynamic management of CDN hosted content.
4. CCS uses the CDN ingestion interface to upload the content from CSS to CDN.
5. CCS provides the URIs of the content pieces located in the CDN to the Tracker AS
6. UE1 joins the swarm and obtains a peer list, now including a list of CDN URIs as well as regular peers
7. UE1 obtains a content piece from the CDN using HTTP GET. This phase typically includes DNS name resolution. During this phase, the CDN uses its normal redirection mechanism (e.g. DNS based or HTTP redirection based) to redirect UE1's request towards one of its surrogate.

Editor's note: It is for further study if authentication and security considerations need to be taken into account for UE access to CDN.

8. Peer to peer protocol is used as well between UEs to exchange content pieces.
9. At a later point in the peer to peer session, swarm statistics are sent again to CCS by the Tracker
10. Based on the swarm statistics, CCS decides to remove some of the content pieces from the CDN, for example because they are now very popular in the swarm. CCS updates its list of CDN URIs to the Tracker AS.
11. CCS uses the CDN ingestion interface to purge the selected content pieces from the CDN. Alternatively from using a purge, CCS could also have associated a Time-to-Live to the content pieces uploaded in step 4.

6.5 Including ALTO server in IMS P2P CDS

6.5.1 General

User peers and network peers may query an ALTO (Application Layer Traffic Optimization) Server for cost values between peers in a swarm to be used to rank a list of peers of the requested content as described in draft-ietf-alto-protocol [4]. A query may consist of a peer's location and the type of information the peer requires from the ALTO Server. An ALTO Server may provide the following:

- a Cost Map which may rank available peers for the requested content in a specific order depending on the cost metric used, e.g. routing hop count, access network characteristics, peer battery capabilities;
- a Network Map which may consist of a list of peer identities and/or peer IP addresses, or peers in close proximity to the peer requesting content, e.g. same cell, same access, or same operator domain.

An ALTO server may obtain information from a Tracker AS, HSS, and other sources such as distributed hash tables which may or may not be a part of the IMS architecture.

ALTO client to ALTO server communication may traverse IMS entities.

6.5.2 Architecture

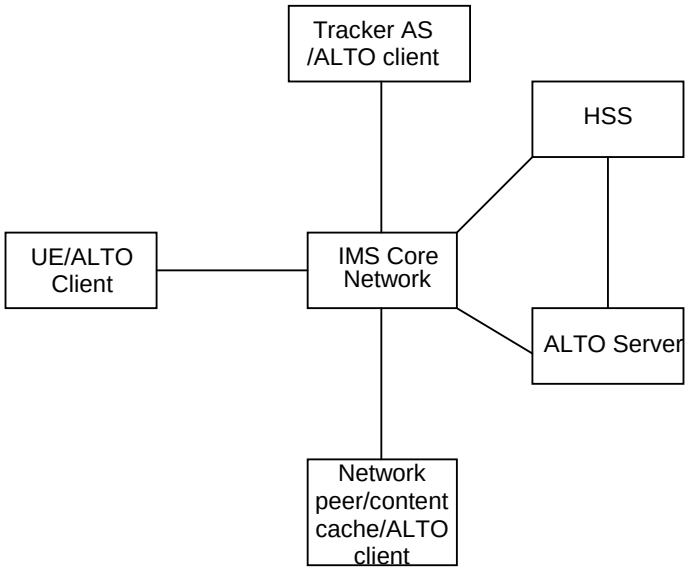

Figure 6.5.2-1: ALTO service architecture

The ALTO Client may be implemented in Tracker AS, UE Peers and Network Peers such as content cache servers. It may communicate with the ALTO Server directly or through IMS core. To be simplified, the direct interface between the ALTO Client and the ALTO Server is not depicted in the ALTO service architecture.

The ALTO Server may re-use the ISC reference point in the case ALTO Client to ALTO Server communication traverses the IMS Core Network.

The ALTO Server may interface with the HSS re-using the Sh reference point in order to retrieve subscriber specific information, e.g. registration state, user identities.

The ALTO client may discover peer lists from the Tracker AS.

The ALTO client shall query the ALTO Server, including the peer list, current location, and Cost type required.

The ALTO Server shall return to the ALTO Client, a response including a Network Map, and/or Cost Map, and ranking available peers, based on the received input.

6.5.3 ALTO procedures

The ALTO protocol is a client-server protocol which allows an ALTO client to query an ALTO server for information related to endpoints. In the case of a list of peers from which content is available to an IMS P2P CDS UE, information from the ALTO server can aid the IMS P2P CDS UE to determine the optimal set of peers to contact in order to retrieve the desired content segments. Figure 6.5.3-1 shows the interaction between ALTO client and ALTO server, and describes the content of the messages exchanged between these entities.

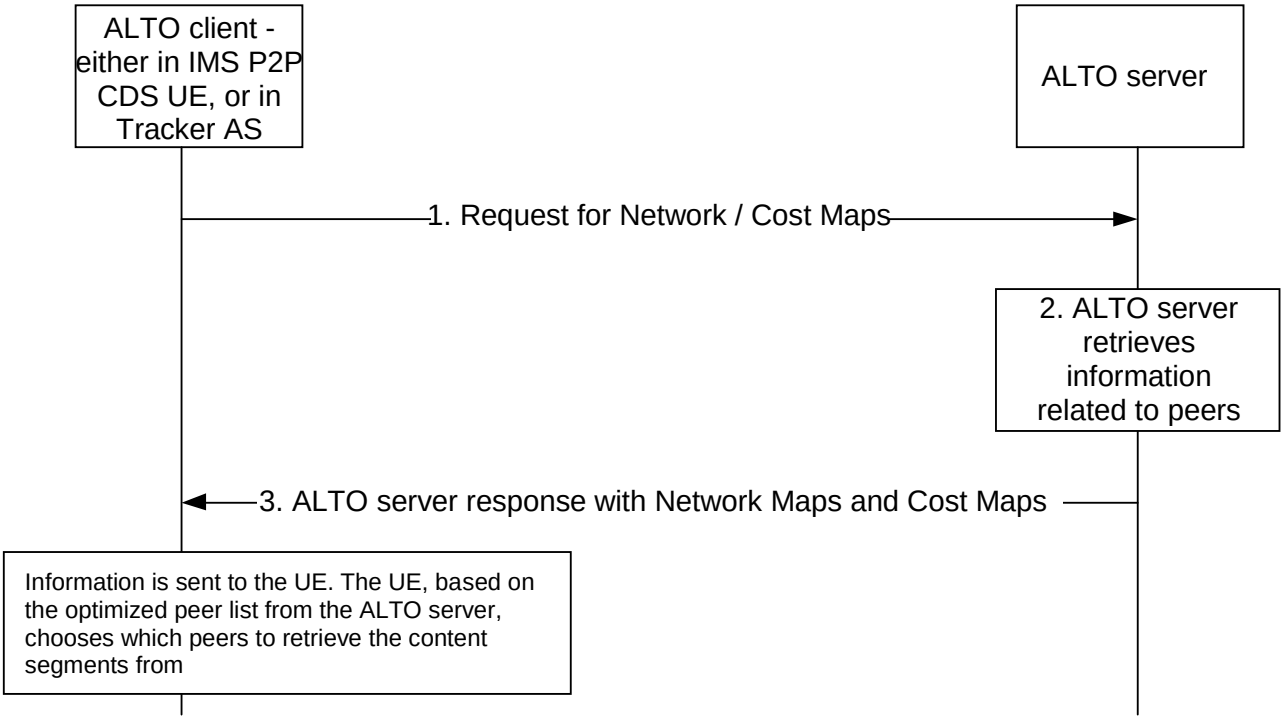

Figure 6.5.3-1: ALTO message exchange for peer list optimization

1. The ALTO client, residing in either the IMS P2P CDS UE, or in the Tracker AS, sends a request for Network/Cost maps to the ALTO server. The following information may be included in the request:

   - the request includes the peer list retrieved from the Tracker AS;

   - indications of what information is desired from the ALTO server. The following can be requested from the ALTO server:

     - Network Map - grouping peers from the peer list - grouping can be for example per cell ID, per access type, per network domain;

     - Cost Map, including path costs for the peers such as hope count from the IMS P2P CDS UE, or physical proximity (e.g. determined by geolocation);

     - the client may ask for properties of the peers in the peer list such as the access over which peers are connected.

     - the location of the requesting peer (alternative 2).

   NOTE: There can be other endpoint properties that can be requested from the ALTO server. The above list is not exhaustive.

2. The ALTO server retrieves information related to peers.

   Editor's note: The mechanisms by which the ALTO server retries peer related information is for further study.

3. The ALTO server organizes the peers in the peer list into groups and assigns a cost weighting to each group and/or each peer according to the cost type requested. Also provided is the cost mode to indicate if the cost weighting is a numerical value or an ordinal/ranking value.

The ALTO client may query the ALTO server subsequently, in order to retrieve updated metrics on peers, since the Cost Map may have changed due to the dynamic nature of peers and the IMS P2P CDS UE.

6.5.3a ALTO Redirection Procedure

Whenever the ALTO client needs to retrieve alto information of the peers, it sends request to the ALTO server. But in some cases, the ALTO server is only responsible for some of the peers, for some other peers, it doesn't have the most

appropriate information to reply. In such case, the ALTO server could redirect the request to the other proper ALTO server(s) for those peers it couldn't handle. An alternative redirection flow is showed in Figure 6.5.3a-1.

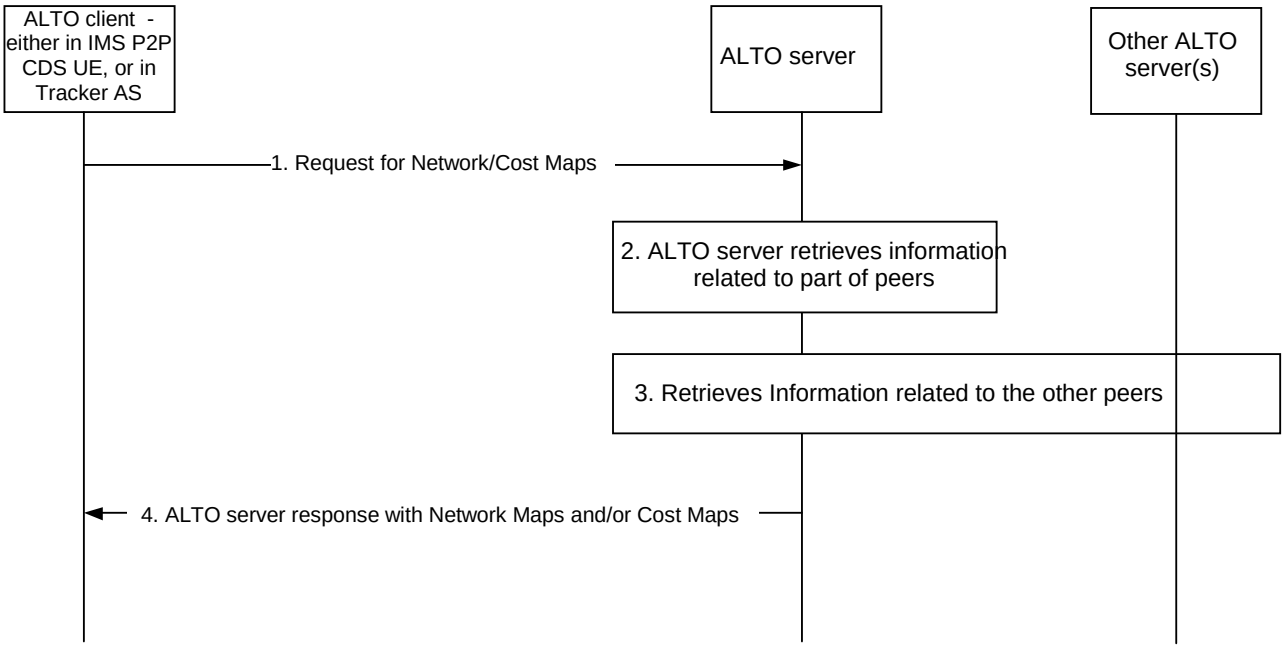

Figure 6.5.3a-1: ALTO redirection procedure

1 The ALTO client, residing in either the IMS P2P CDS UE, or in the Tracker AS, sends a request for Network/Cost maps of the peers to the ALTO server.

2 The ALTO server retrieves information related to part of the peers that it's responsible for.

3 For the other part of peers that the ALTO server is not in charge of, it redirects the request to the other ALTO server(s) to retrieve the related alto information.

Editor's note: How to select the other ALTO server(s) is for further study.

4 The ALTO server organizes the peers in the peer list into groups and assigns a cost weighting to each group and/or each peer according to the cost type requested. Also provided is the cost mode to indicate if the cost weighting is a numerical value or an ordinal/ranking value.

6.5.4 Information flows

6.5.4.1 Alternative 1: UE performs ALTO query

Figure 6.5.4.1-1 shows the information flows for IMS P2P CDS procedure including ALTO query. In this alternative, the IMS P2P CDS UE performs the ALTO query. Two options are included for the peer list retrieval: firstly, the UE requests the peer list from the Tracker AS and secondly, the Tracker AS sends to the UE the peer list as a result of the UE requesting a session for content retrieval/streaming.

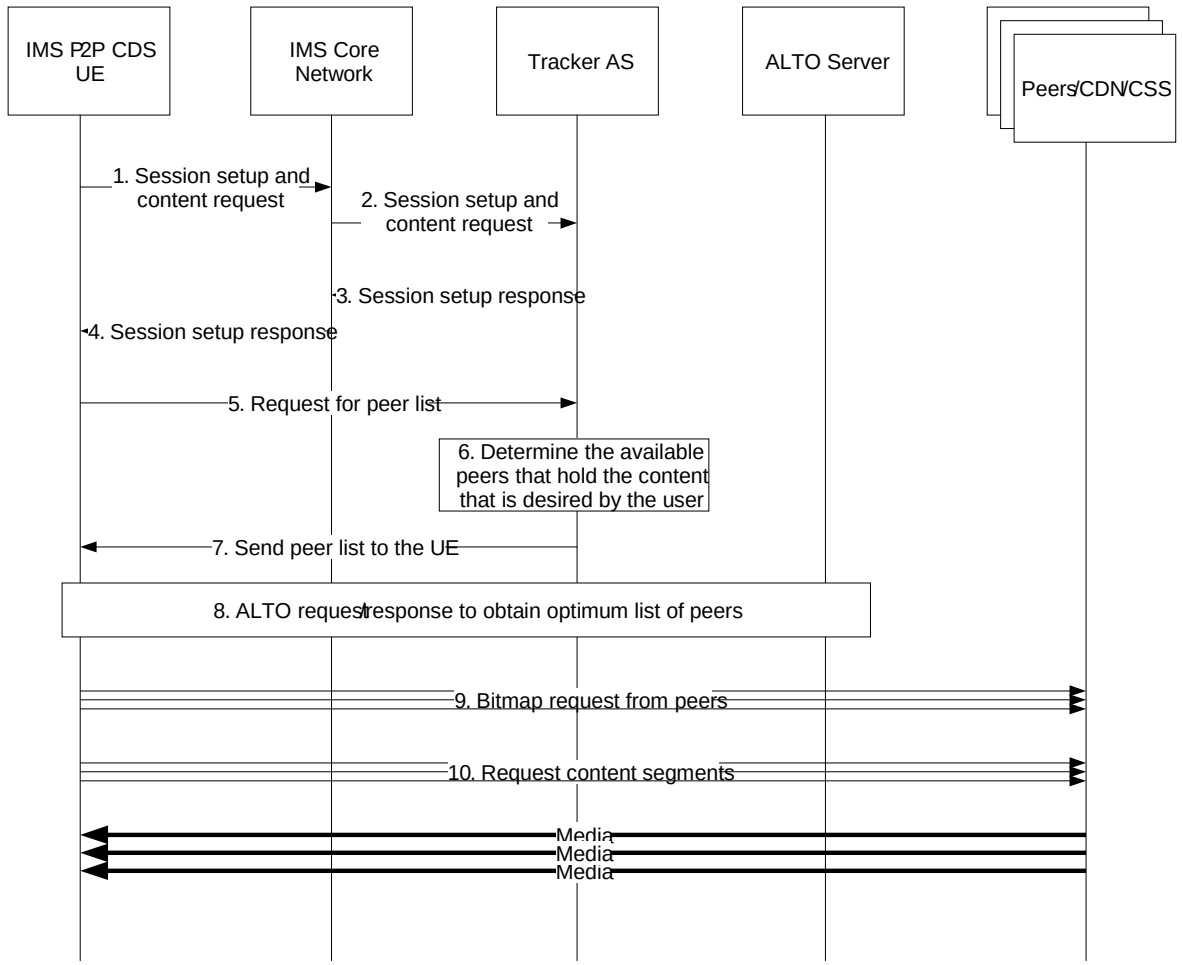

Figure 6.5.4.1-1: IMS P2P CDS procedures including ALTO query performed by UE

1-2. The IMS P2P CDS UE sends s session establishment request for a desired content stream or download.

3-4. The Tracker AS returns back a session setup response to the IMS P2P CDS UE.

5. The IMS P2P CDS UE requests a list of peers that are known to have all or part of the content requested. This request may go through the IMS core network or be transparent to the IMS core network.

6. The Tracker AS determines the available peers that hold the content desired by the user.

7. As an alternative to steps 3-5, the Tracker AS, in response to the content request received in step 2, responds with the peer list for the requested content. In this case, the peer list can be included in a response to the session setup request. If this step is a response to step 5, then the peer list is sent to the IMS P2P CDS UE as requested. The request may go through the IMS core network or be transparent to the IMS core network.

8. The IMS P2P CDS UE performs ALTO query as described in clause 5.6.3, with the ALTO server responding as described in clause 5.6.3.

9. The IMS P2P CDS UE requests bitmaps from peers chosen from the peer list, based on the result from the ALTO query.

10. The IMS P2P CDS UE requests the desired content segments from peers.

6.5.4.2 Alternative 2: Tracker AS performs ALTO query

Figure 6.5.4.2-1 shows the information flows for IMS P2P CDS procedure including ALTO query. In this alternative, the Tracker AS performs the ALTO query. The response to the peer list request is an optimized peer list with ALTO metrics such as Cost and Network maps and endpoint properties.

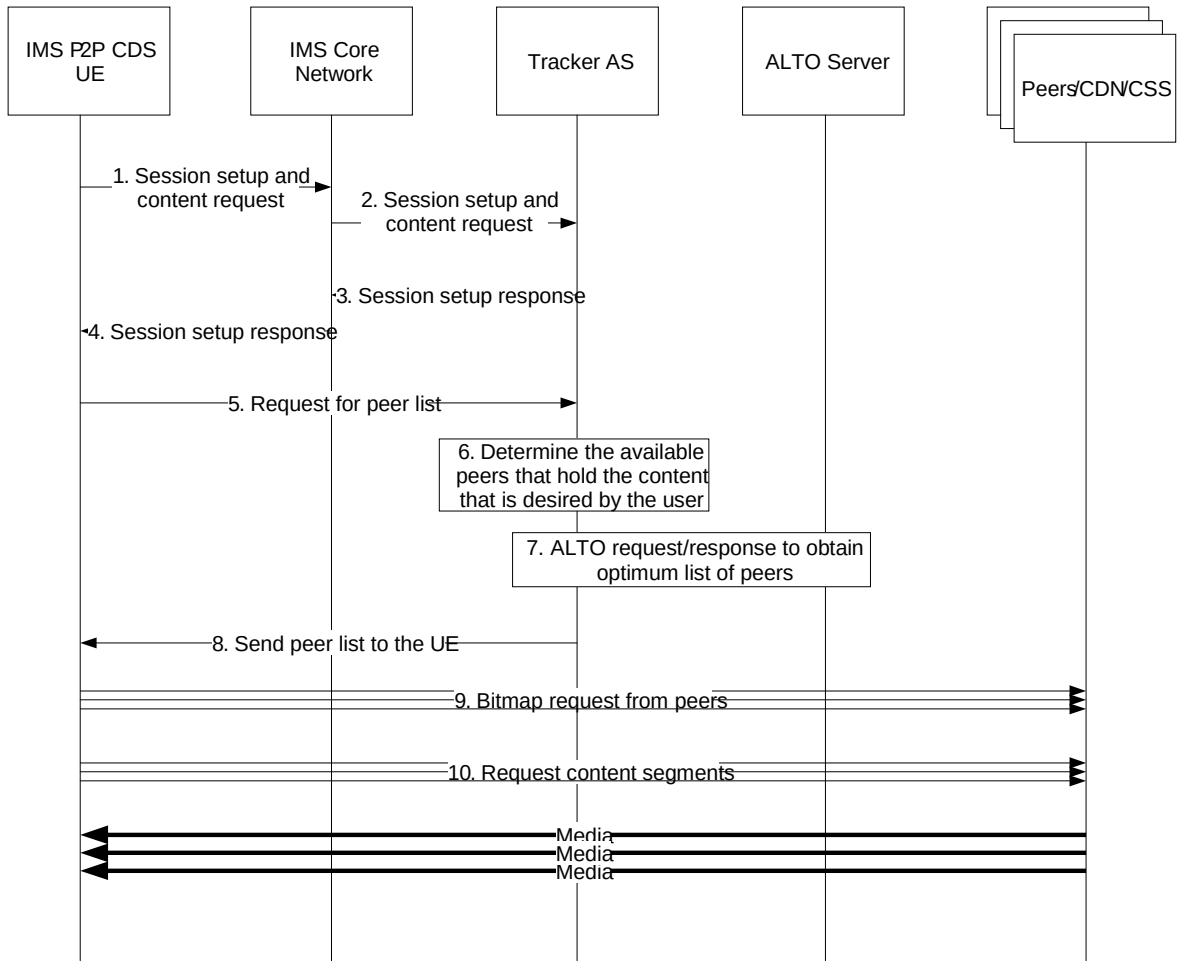

Figure 6.5.4.2-1: P2P CDS procedures including ALTO query performed by Tracker AS

1-2. The IMS P2P CDS UE sends s session establishment request for a desired content stream or download.

3-4. As an option, where the UE is required to perform peer list retrieval, the Tracker AS returns back a session setup response to the IMS P2P CDS UE.

5. As an option, the IMS P2P CDS UE requests a list of peers that are known to have all or part of the content requested. This request may go through the IMS core network or be transparent to the IMS core network.

6. The Tracker AS determines the available peers that hold the content desired by the user.

7. The Tracker AS performs ALTO query as described in clause 5.6.3, with the ALTO server responding as described in clause 5.6.3.

8. As an alternative to steps 3-5, the Tracker AS, in response to the content request received in step 2, responds with the optimized peer list and ALTO metrics (Network and Cost Maps and endpoint properties) for the requested content. In this case, the optimized peer list and ALO metrics can be included in a response to the session setup request. If this step is a response to step 5, then the optimized peer list and ALTO metrics are sent to the IMS P2P CDS UE as requested. The request may go through the IMS core network or be transparent to the IMS core network.

9. The IMS P2P CDS UE requests bitmaps from peers chosen from the peer list, based on the result from the ALTO query.

10. The IMS P2P CDS UE requests the desired content segments from peers.

6.5.4.3 Assessment of alternatives

In clauses 6.5.4.1 and 6.5.4.2 information flows for IMS P2P CDS procedures are described for the cases where ALTO query is performed by the IMS P2P CDS UE (alternative 1) and Tracker AS (alternative 2), respectively.

Alternative 1 - IMS P2P CDS UE performs ALTO query:

Advantages:

- In the case of roaming, the IMS P2P CDS UE may contact an ALTO server in the home network or an ALTO server in the visited network, regardless of the location of the Tracker AS. ALTO server in the visited network has better metrics/maps for peers in the visited network, while ALTO server in the home network has better metrics/maps for peers in the home network.

The IMS P2P CDS UE may subsequently contact the ALTO server to request updated metrics for the available peers. This might be necessary in the case the user has requested content of long duration and where the peers may be mobile and as a result the information the IMS P2P CDS UE has on peers may become out dated. This can be useful especially in the case where the ALTO and the Tracker AS are located in different domains (e.g. a roaming UE contacts a local ALTO server).

Disadvantage:

- Extra signalling burden (signalling towards the ALTO server) on the IMS P2P CDS UE.
- If the signalling between IMS P2P CDS UE and ALTO server doesn't go through the IMS core network then the signalling is invisible for the network.

Alternative 2 - Tracker AS performs ALTO query:

Advantages:

- Reduced signalling burden (signalling towards the ALTO server) on the IMS P2P CDS UE.
- In the case the IMS P2P CDS UE requires subsequent updated ALTO information on peers; it would contact the tracker for an updated peer list. The tracker can contact the ALTO server with an actual peer list and provide the related results to the IMS P2P CDS UE. Additional new peers with the requested content can be taken into account with this method.

Disadvantages:

- In the case the IMS P2P CDS UE requires subsequent updated ALTO information on peers, it would be required to contact the Tracker AS for ALTO information and not only for peer list retrieval.
- The ALTO information available to the IMS P2P CDS UE is restricted to the ALTO server(s) that the Tracker AS can communicate with, thus the ALTO information sent to the IMS P2P CDS UE, may not be optimal.
- If the signalling between IMS P2P CDS UE and ALTO server doesn't go through the IMS core network then the signalling is invisible for the network.

7 Evaluation

Editor's note: This clause will include solution(s) assessment.

7.1 Criteria for the evaluation of QoS alternative solutions

Some criteria for the evaluation of QoS alternative solutions are listed as following:

- Criterion1: can meet the QoS requirements for different subscribers and different contents.
- Criterion2: impact on the current PCC architecture.
- Criterion3: impact on the existing 3GPP specifications related to PCC and LTE.
- Criterion4: can apply the existing solutions (such as PCC roaming mechanism) in roaming scenario.
- Criterion5: impact on the current content service flows.
- Criterion6: can meet the resources control and monitoring control requirements from the operator.

It is proposed to use the above criteria to evaluate QoS solutions. And with the study of QoS control, more criteria are expected.

8 Conclusion

Editor's note: This clause will provide conclusions with respect to what further specification work is required in order to provide IMS based peer-to-peer content distribution services.

The study has been investigating a number of alternatives for the IMS Based Peer-to-Peer Content Distribution Services. The study has concluded without any firm recommendations on a specific solution, but the alternatives are viewed to be possible to reuse for future discussion on the subject if or when firm requirements are defined.

Annex A:
IETF work on P2P Streaming Protocol (PPSP)

A.1 IETF PPSP WG overview

The IETF PPSP WG focuses on the Peer-to-Peer paradigm of delivering streaming traffic (live, time-shifted media content with near real-time requirement and VoD), standardizing signalling operations on two important components, Peer and Tracker, for information exchange.

The goal of PPSP is to serve as an enabling technology, building on the development experiences of existing P2P streaming systems. Its design will allow it to integrate with IETF protocols on distributed resource location, traffic localization, and streaming control and data transfer mechanisms for building a complete streaming system or a streaming delivery infrastructure.

It has been discussed and concluded in the problem statement draft of PPSP that, in essence, there are two kinds of basic entities in P2P streaming, i.e., the Tracker and the Peer. According to the definition in PPSP, a Tracker refers to a directory server which maintains a list of peers storing chunks for a specific channel or streaming file and answers queries from peers for peer lists, while a Peer refers to a participant in a P2P streaming system that not only receives streaming content, but also stores and uploads streaming content to other participants.

PPSP designs a protocol for signalling between trackers and peers (the PPSP "tracker protocol") and a signalling protocol for communication among the peers (the PPSP "peer protocol") as shown in Figure A.1. The tracker protocol handles the initial and periodic exchange of meta information between trackers and peers, such as peer-list and content information. The peer protocol controls the advertising and exchange of media data between the peers.

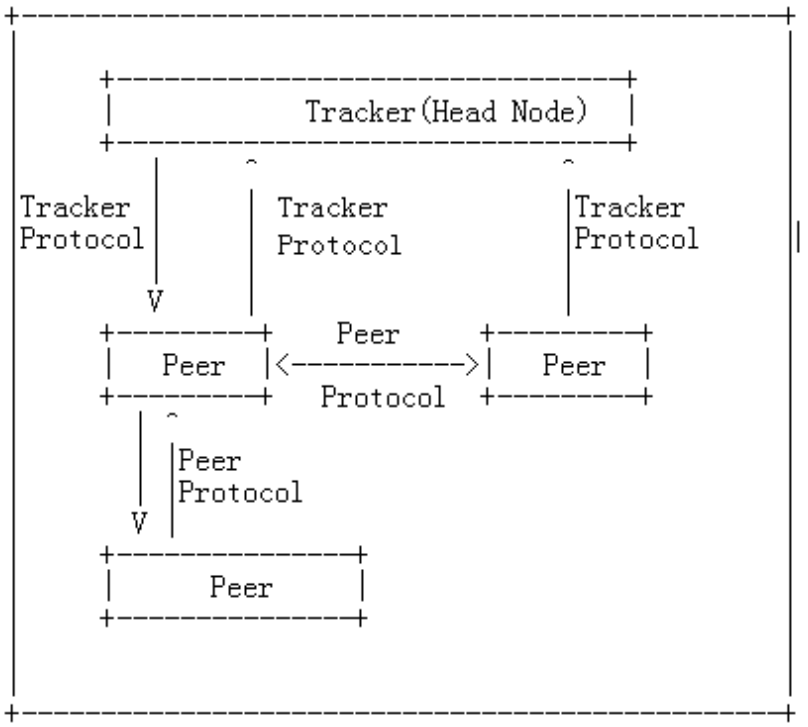

Figure A.1-1: PPSP System Architecture

NOTE: in the above figure, the upward arrow in the right-upper corner refers to the Peer's periodically reporting its status, e.g. the content segments cached in the Peer, to the Tracker, while the dual direction arrow in the left-upper corner refers to the procedure of the Peer's fetching peer list from the Tracker.

The outputs from IETF PPSP WG that may be related to this study are listed in the following table for tracking:

Table A.1-1

File Name	Title	Status
draft-ietf-ppsp-problem-statement-01	Problem Statement of P2P Streaming Protocol (PPSP)	WG draft
draft-ietf-ppsp-reqs-01	P2P Streaming Protocol (PPSP) Requirements	WG draft
draft-gu-ppsp-peer-protocol-02	Peer Protocol	Personal draft
draft-gu-ppsp-tracker-protocol-04	Tracker Protocol	Personal draft
Draft-lu-ppsp-mobile-04	P2P Streaming for Mobile Nodes	Personal draft

Editor's note: The above table may be updated according to the progress of PPSP in IETF.

A.2 Mobility Issues in PPSP

A.2.1 Introduction

When designing IMS P2P CDS, a number of issues related to mobility need to be taken into account. The IETF PPSP WG requirements in draft-ietf-ppsp-reqs [3], also takes into account issues that are exacerbated by mobility of user peers. The following describes these issues.

A.2.2 Asymmetric bandwidth

Often, in mobile/wireless access, the available bandwidth on the downlink is greater than that available for the uplink. Such bandwidth restrictions need to be taken into account by the tracker-peer communication, since a peer acting as a resource consumer, i.e. a peer that requests streaming content, may not capable, or may be inefficient in acting as a resource provider, i.e. a peer that can upload content. Therefore, when generating a peer list, the Tracker AS, and/or other network entities need to be mindful of the access type or even actual uplink/downlink bandwidth, a peer is using, since this restricts the peer's usefulness as a content provider.

A.2.3 Battery powered device

Mobile devices normally rely on a battery for their power source, rather than connected to the mains electricity. Thus, it is not often "fair" to assign such a peer as a resource provider, even though the mobile device may be used for the downloading of content. Therefore, when generating a peer list, the Tracker AS, and/or other network entities need to be mindful of the power limitations that a peer may have. It could be an option for a mobile peer to "opt in" or "opt out" of acting as a resource provider, especially when operating on battery power.

A.2.4 Multiple interfaces

Since Release 7, IMS has supported UEs with multiple accesses and facilitating the transfer of IMS session across access legs. When changing access type, either due to transfer, or loss of connectivity, the UE's IP address is also changed. This is illustrated in Figure 1. The change in Peer 1's IP address from IP1 to IP2, has a negative impact on Peer-to-Tracker communication and also Peer-to-Peer communication. If Peer 2 is not updated of the change in Peer 1's IP address, and in the case Peer 2 is sending Peer 1 content segments, it may incorrectly send data to IP1. Furthermore, the Tracker AS may send peer lists with incorrect or corrupted data about available peers. If Peer 1's IP address is changed, it may no longer receive updates from the Tracker AS.

These effects may be mitigated by a UE updating the Tracker AS and other peers of changes in IP address.

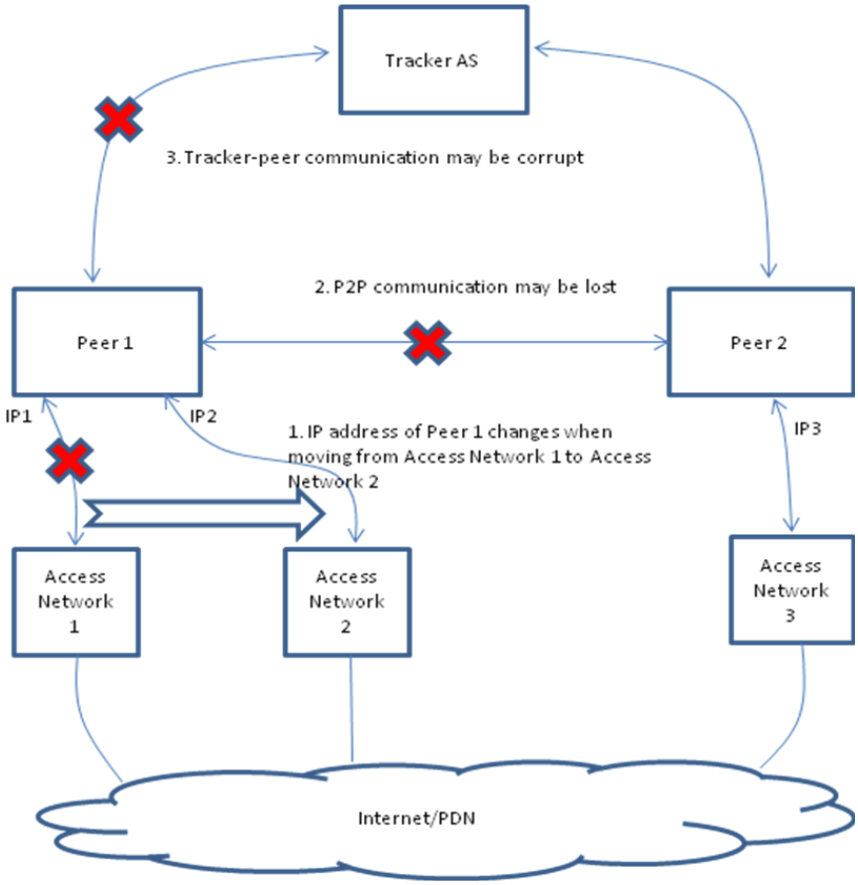

Figure A.2.4-1: Peers supporting multiple access network types

A.2.5 Location

A peer list may be provided by a Tracker AS and/or other network entity based upon location of peers. A mobile peer is free to move to a different location. Such a change in location may be undesirable for a number of reasons:

- the mobile peer is roaming and thus does not want to experience unnecessary charges when acting as a resource provider.
- the mobile peer is roaming and is not eligible to receive specific content (content which is restricted to a specific country).
- the mobile peer is roaming to an area where the visited operator/network/regulation has limitation on P2P behaviour, e.g. the number of multi-paths for a single UE within a P2P session is limited.

If the Tracker AS and/or other peers are not updated of a change of location, then, content policy, undesirable charging and inefficient download may be experienced by P2P users. Therefore, location update can be considered when designing the IMS P2P CDS.

Annex B:
Change history

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
2010-10	SA2#81		-	-	Skeleton	-	0.0.1
2010-10	SA2#81		-	-	S2-104990, S2-104991	0.0.1	0.0.2
2011-02	SA2#83		-	-	S2-110598, S2-110842, S2-110843, S2-110844	0.0.2	0.1.0
2011-04	SA2#84		-	-	S2-111880, S2-111881, S2-111883, S2-111887, S2-111889, S2-111894, S2-111904	0.1.0	0.2.0
2011-07	SA2#86		-	-	S2-113255, S2-113256, S2-113257, S2-113258, S2-113259, S2-113260, S2-113261, S2-113262, S2-113322, S2-113326, S2-113480, S2-113481, S2-113482, S2-113483,	0.2.0	0.3.0
2011-08	SA2#86		-	-	Modification due to implementation error of S2-113482	0.3.0	0.3.1
2011-10	SA2#87		-	-	S2-114298, S2-114299, S2-114420, S2-114421	0.3.1	0.3.5
2012-02	SA2#89		-	-	S2-120618, S2-120619, S2-120620, S2-120621, S2-120622, S2-120623, S2-120624, S2-120625, S2-120626, S2-120628, S2-120841	0.3.5	0.4.0
2012-04	SA2#90		-	-	S2-121610	0.4.0	0.5.0
2012-06	SP#56	SP-120281	-	-	MCC editorial update for presentation to TSG SA for information and approval	0.5.0	1.0.0