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Study on Continuity of Data Sessions to Local Networks
(Release 11)

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Contents

Foreword

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

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

1 Scope

The present document studies use cases and potential requirements for Continuity of Data Sessions of a UE to Local Networks.

Local IP Access (LIPA) signifies the capability of a UE to obtain access to a local residential/enterprise IP network (subsequently called a local network) that is connected to one or more H(e)NBs and to communicate with entities in the local network through Data Sessions. Basic functionality for Local IP Access (LIPA) has been specified in 3GPP Rel-10.

The current study item investigates extending LIPA functionality to allow access to the local network when a UE is under coverage of the macro network and provide related mobility support.

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 TS 22.220: "Service requirements for Home NodeBs and Home eNodeBs"

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].

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].

MRA   Managed Remote Access to home based network (see [2])

4   Background

4.1   General Description

Basic functionality for Local IP Access (LIPA) has been specified in TS 22.220 in Rel-10.

LIPA signifies the capability of a UE to obtain access to a local residential/enterprise IP network (subsequently called a local network) that is connected to one or more H(e)NBs. LIPA allows a UE to connect to devices in the local network – e.g. printers, video cameras, or a local web-server.

If the local network offers services that enable exchange of digital content (e.g. UPnP) LIPA also allows the UE to discover supporting devices and to be discovered.

Additionally to LIPA an operator may, e.g. as a chargeable user service, also wish to provide access to the local network when a UE is under coverage of the macro network or a H(e)NB that is not connected to that local network. Access to the local network when a UE is under coverage of the macro network or a H(e)NB that is not connected to that local network has been described in TS 22.220 section 5.8 under the name of "Managed Remote Access to home based network" (MRA).

From user's perspective LIPA and MRA describe the same service, namely access to a local network. The only difference is whether the UE is under coverage of a H(e)NB in that local network or not. Therefore an ongoing data session between the UE and the local network should continue when the UE changes access :

- between H(e)NB in that local network and (e)NB/H(e)NB that is not connected to that local network;

- between (e)NBs and H(e)NBs that are not connected to that local network.

SA2 is currently investigating solutions for LIPA (and SIPTO) mobility which should be enabled in Rel-11.

In the context of this TR "Continuity of service" signifies continuity of UE access to the local IP network

5   Use Cases

5.1   Description of use cases

5.1.1   Use Case 1: Continuity of service when UE moves from H(e)NB to the Macro Network

The situation:

A user has subscribed to the "Managed Remote Access to home based network" (MRA) service that had been offered to him by his operator in addition to LIPA.

The user has recorded a movie last night from TV on a server (e.g. set-top box, PC) connected to the local network (home-based LAN). During breakfast in the kitchen he starts watching the movie – it is streamed to his smart phone which is accessing the server in the local network via LIPA. Soon he walks out of the house, leaving the coverage of his H(e)NB. In the macro network he still can access his local network and the video streaming to his phone continues without disruption during the handover.
Streaming via LIPA or MRA is only supported by best effort QoS.

Continuity of Data Sessions
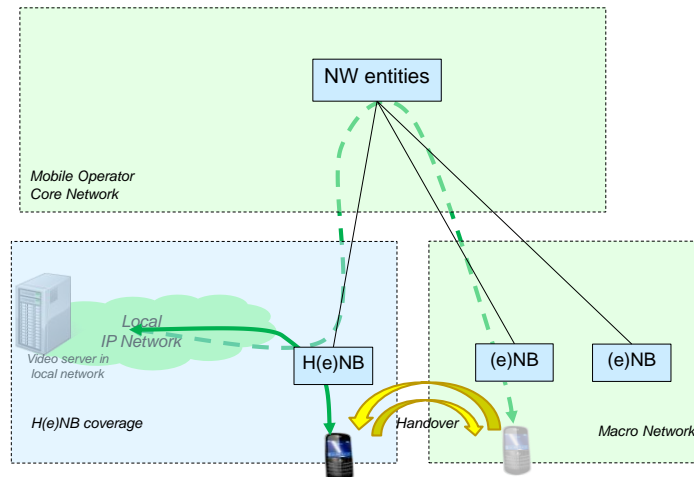
5.1.2 Use Case 2: Continuity of service when the UE moves from macro network to H(e)NB

The situation:

A company has a contract with the mobile operator, who enables "Local IP Access" (LIPA) to all employees of the company. With LIPA employees are able to access the company's intranet from their laptops (which are capable of 3GPP data connection) via the H(e)NBs installed at the premises of the company.
Additionally, the "Managed Remote Access to home based network" (MRA) service is provided to the employees. With MRA employees are able to access the company's intranet outside of the company's premises.

An employee regularly uses the train for his way to the office. Since his commuting time on the train is relatively long he starts his laptop, connects via MRA to the company intranet, and starts working on a document which is stored on a server in the intranet. As he couldn't finish his work during the train ride he leaves the train with his laptop still running – the data session is still ongoing – and resumes his work sitting at his desk in the office.
At that time the UE has changed access from the macro network to a H(e)NB in the company's premises and the data session continues as a LIPA session.

5.1.3 Use Case 3: Continuity of service when the UE moves between local H(e)NB and a H(e)NB whose CSG is considered as a 'visited' CSG

Bob has subscribed to the MRA service that had been offered to him by his operator in addition to LIPA.
Bob is watching a movie stored in a server in his home network using his smart phone via LIPA. Then he wants to share this movie with his neighbour John. So he takes his smart phone to John's home, leaving the coverage of his H(e)NB. Since Bob has subscribed to the MRA service, Bob still can access his server as a MRA session through the H(e)NB in John's home, as shown in figure1 and the movie continues without disruption during the handover. When Bob returns home, the MRA session could still continue as a LIPA session.
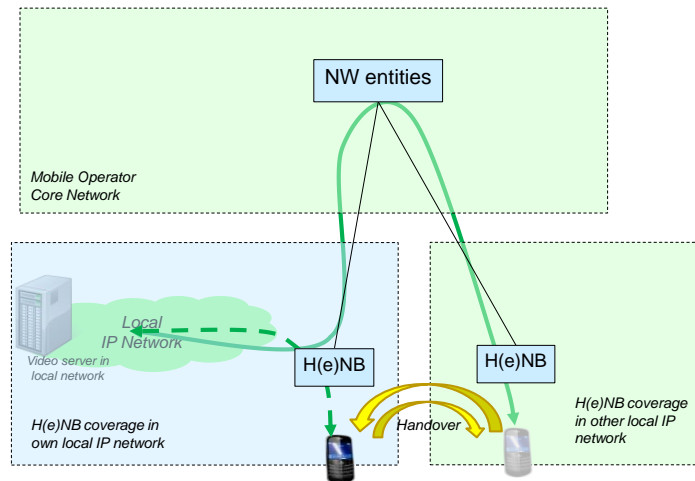
Figure2 Continuity of service when UE moves between the local network and a a H(e)NB whose CSG is considered as a 'visited' CSG

5.1.4 Use Case 4: Continuity of service when the UE moves between a H(E)NB in local network and a H(e)NB as a supplementary coverage of macro network

Bob has subscribed to the MRA service that had been offered to him by his operator in addition to LIPA. Bob is downloading a file in his office from a server connected to the enterprise local network using his smart phone via LIPA. Then he needs to meet his customer in the coffee shop on the opposite side of his office. So he takes his smart phone to the coffee shop, leaving the coverage of his H(e)NB in the local network. Since Bob has subscribed to the MRA service, Bob still can access his local network as a MRA session through the H(e)NB in the coffee shop, which is deployed by the operator as a supplementary coverage of macro network, as shown in figure2. And the file downloading to his phone continues without disruption during the handover. When Bob returns his office, the access to local network could still continue.

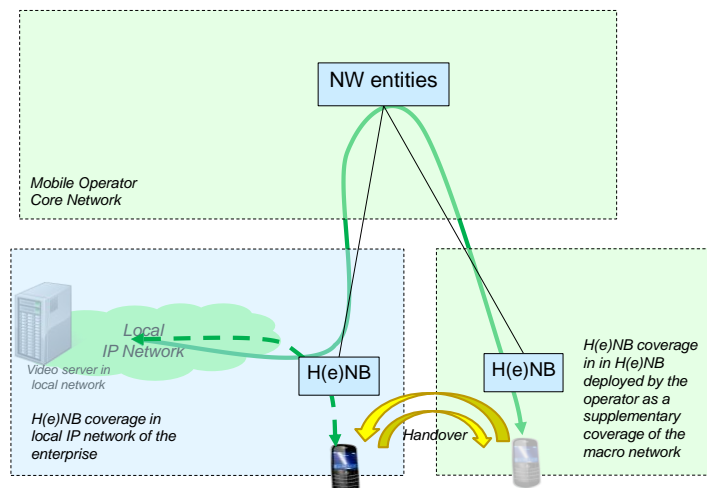Figure3 Continuity of service when UE moves between a H(e)NB in the local network and a H(e)NB as a supplementary coverage of macro network

5.1.5 Use Case 5: Continuity of a LIPA session during/after CSFB

Target Fallback RAT offers PS

Alice is performing a file transfer between her phone and a local server via a HeNB using LIPA service. The operator does not yet offer voice services through EUTRAN. When there is an incoming voice call for Alice, the CS-Fallback procedure is used to switch Alice's phone from the EUTRAN HeNB to a macro cell in the target fallback RAT. As the PS service is also offered in the target fallback RAT, the file transfer session can be continued using MRA over the macro cell. When the voice call is completed, Alice's phone should switch back to using LIPA over EUTRAN HeNB for better transfer bandwidth and avoid unnecessary traffic injection into the operator's network.

Target Fallback RAT does not offer PS

Alice is performing a file transfer between her phone and a local server via a HeNB using LIPA service. The operator does not yet offer voice services through EUTRAN. When there is an incoming voice call for Alice, the CS-Fallback procedure is used to switch Alice's phone from the EUTRAN HeNB to a macro cell in the target fallback RAT. As the PS service is not offered in the target fallback RAT, the file transfer session cannot be continued over the macro cell but may be suspended at the HeNB. When the voice call is completed, Alice's phone should switch back to using LIPA over EUTRAN HeNB and attempt to resume the file transfer.

5.2 Impact on the 3GPP System:

The "Managed Remote Access to home based network" (MRA) service

The operator that enables LIPA access for the H(e)NB may additionally offer "Managed Remote Access to home based network" (MRA) as a service to its customers.

This service can be offered to

    a) the Hosting Party of the H(e)NB as an optional – additional – feature to LIPA (could be separately charged) and

    b) UEs that have subscribed to LIPA and MRA to the same local network.

If a UE has subscribed to MRA for a specific CSG and the Hosting Party of a H(e)NB of that CSG also has activated MRA then the network supports access of the UE from the macro network or H(e)NBs which are not connected to that local network to the local network of that H(e)NB.

Continuity of data sessions

Additionally, depending on operator settings in its network, the network may support continuity of data sessions to the local network according to the following scenarios:

- If a UE has an ongoing data session to the local network via the H(e)NB using LIPA and the UE is moves out of coverage into the coverage of a macro (e)NB or a H(e)NB which is not connected to that local network and the UE changes access to the macro network or a H(e)NB which is not connected to that local network then the data session is continued.

- If a UE is under coverage of the macro network, or a H(e)NB which is not connected to that local network and has an ongoing data session to the local network and the UE is moving into coverage of the H(e)NB and the UE changes access to the H(e)NB then the data session is continued.

Continuity of data sessions to the local network implies in particular that the UE can be reached from the local network even after handover. Interruption of data sessions should be kept to a minimum, however the user may notice different QoS before and after handover.

For the case of incoming CSFB involving a UE that is currently having a LIPA session in a HeNB,

- the network may support session continuity by returning the UE to the HeNB provided the UE is still within coverage of that HeNB. Currently, the UE remains connected to the target fallback RAT if there is no network command to hand over the UE back to EUTRAN after a CSFB call. Given that it is desirable for both the network and the user that the UE uses LIPA rather than MRA, it might be necessary to provide a mechanism to hand over the UE back to the HeNB cell after a CSFB CS call has finished.

- Currently, for normal macro cell CSFB in the case where target fallback RAT has no PS capability, it is possible for the network to suspend the data session the UE may have in the EUTRAN. Such session continuity support can be extended to LIPA as well by providing a mechanism for a UE to suspend a LIPA session at the HeNB upon receiving a CSFB indication, and a mechanism for a UE to resume the LIPA session upon returning to the HeNB cell after the CSFB call has finished.

Charging

Access of a UE from the macro network or from H(e)NBs which are not connected to that local network to the local network of a H(e)NB (MRA) may be charged independently from (or in addition to) LIPA. E.g. an operator may wish to charge for the traffic generated in the macro network when the UE has access from the macro network to the local network of that H(e)NB.

This potential difference in charging implies that the user should be made aware if a data session to a local network is ongoing and if the UE changes access between macro network or H(e)NBs which are not connected to that local network and H(e)NB.

In addition the user should be given the opportunity to reject continuation of the ongoing data session after such handovers.

Alternatively the user may wish to configure his UE as to always accept or reject continuation of the ongoing data sessions.

Security

Access to the local network behind a H(e)NB – through LIPA as well as through MRA – is only allowed to authorized UEs. Therefore no protective measures (firewalls) by the H(e)NB's Hosting Party are required.

In addition to the operator enforced access restrictions the H(e)NB should implement an access control mechanism that would allow a H(e)NB Hosting Party to restrict access of UEs to the local home or enterprise network. However, such additional access control is out of scope of 3GPP standardisation.

If the UE accesses the local network from an (e)NB of the mobile operator network or from a H(e)NB which is not connected to that local network, the security of the traffic routed to the local network shall be comparable with security of LIPA traffic.

6 Potential Service Requirements

6.1 Requirements on Managed Remote Access

The following general requirements need to be added to TS 22.220:

- A UE shall have a valid subscription with the mobile operator in order to use MRA.

- The mobile operator shall be able to enable/disable MRA to the home based network on per-subscriber basis.

NOTE: It is possible for the H(e)NB Hosting Party that enables access to the home based network to use additional access control mechanisms (e.g. using a password) to restrict access of UEs to the residential/corporate IP network. However, such additional access control is out of scope of 3GPP standardisation.

- A UE shall have a valid LIPA subscription to access the home based network in order to use MRA.

- Simultaneous access from a UE to the mobile operator's core network (e.g. internet, PLMN services) and MRA shall be supported and shall not affect services running on the UE.

6.2   Requirements on UE access continuity to the local IP network

The following requirements on service continuity need to be added to TS 22.220:

- The network shall be able to provide continuity of UE access to the home based network when the UE changes access from H(e)NB in the local network to the macro network.

- The network shall be able to provide continuity of UE access to the home based network when the UE changes access from H(e)NB in the local network to a H(e)NB which is not connected to that local network.

- The network shall be able to provide continuity of UE access to the home based network when a UE changes access from macro network to the H(e)NB in the local network.

- The network shall be able to provide continuity of UE access to the home based network when a UE changes access from a H(e)NB which is not connected to the local network to the H(e)NB in that local network.

- The network shall be able to provide continuity of a UE access to the home based network when the UE changes access between (e)NBs in the macro network.

- The network shall be able to provide continuity of a UE access to the home based network when the UE changes access between the H(e)NBs that are not connected to the local network;

- The network shall be able to provide continuity of a UE access to the home based network when the UE changes access between the macro network and a H(e)NB that is not connected to the local network;

- The network shall be able to provide continuity so that any interruption of IP data flow as a result of a change of access by the UE should be kept to a minimum.

- Based on operator policy the user shall be made aware of a change of access by the UE with an ongoing access to home based network if the change of access by the UE occurs between macro network and H(e)NB.

- Based on operator policy the user shall be made aware of a change of access by the UE with an ongoing access to home based network if the change of access occurs between a H(e)NB which is not connected to the local network and the H(e)NB in that local network.

- Based on operator policy the user shall be given the opportunity to reject continuation of the ongoing access to home based network after such change of access by the UE. Alternatively the UE may be configurable to always accept or reject continuation of the ongoing access.

Additional potential requirements that should be assessed given that CSFB might be an interim solution:

- When a LIPA session via a HeNB is interrupted by a CSFB call, the UE should be returned to the HeNB provided the UE is still within coverage of the HeNB.

- The system may provide a mechanism for a UE to suspend a LIPA session through a HeNB upon receiving a CSFB indication.

- The system may provide a mechanism for a UE to resume a LIPA session through a HeNB upon returning to the HeNB cell after a CSFB call.

- Based on operator policy the user shall be able to set a default behaviour of the UE in the case of a LIPA session via a HeNB being interrupted by a CSFB call:

  o continue the LIPA session as MRA session in the macro network if supported by the network

  o suspend the LIPA session at the HeNB

NOTE 1: An application may not survive a suspension of a session.

NOTE 2: Dual-mode H(e)NBs might solve the problem of CSFB.

6.3 Requirements on Charging

The following requirements on charging need to be added to TS 22.220:

- The network shall support differential charging depending on whether a UE is accessing the residential/corporate IP network using LIPA or accessing it from the macro network via Managed Remote Access.

- The network shall support differential charging depending on whether a UE is accessing the residential/corporate IP network using LIPA or accessing it from a H(e)NB which is not connected to that residential/corporate IP network via Managed Remote Access.

6.4 Requirements on Security

The following requirements on security need to be added to TS 22.220:

- The network shall provide access to the residential/corporate IP network via LIPA as well as via MRA only to authorized UEs.

- MRA shall not compromise the security of the mobile operator's network.

- Security for MRA traffic shall be comparable to LIPA traffic.

7 Conclusion

In the course of conducting the current Study on Continuity of Data Sessions to Local Networks a set of use cases based on Local IP access (LIPA) and on Managed Remote Access to home based network (MRA) have been collected. The study indicates that from user's perspective these two services, which both provide data sessions of a UE to the local network, are perceived almost identical. Since situations where a UE enters or leaves coverage of the H(e)NB(s) that are connected to the local network may easily arise the current study proposes to support continuity of data sessions in these cases (A LIPA session becomes MRA and vice versa).

In addition, e.g. for charging reasons, – a LIPA session may be charged differently to a MRA session – it may become necessary to inform the user that a LIPA session becomes MRA and vice versa and the user should be given the opportunity to reject continuation of the ongoing data session after such handovers.

In section 6 of the current TR potential requirements on Continuity of Data Sessions to Local Networks have been collected.

Annex <X>:
Change history

It is usual to include an annex (usually the final annex of the document) for reports under TSG change control which details the change history of the report using a table as follows:

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
2011-02					*Initial Skeleton - proposed by rapporteur*		*0.0.0*
2011-02					*Skeleton revised in SA1 CSN WG*	*0.0.0*	*0.0.1*
2011-02					*Inclusion of S1-110268 TSG-SA WG1 Meeting #53*	*0.0.1*	*0.1.0*
2011-05					*TSG-SA WG1 Meeting #54: Inclusion of: S1-111074, S1-111075, S1-111127, S1-111263, S1-111264, S1-111265, S1-111266*	*0.1.0*	*0.2.0*
2011-05					*TSG-SA WG1 Meeting #54:Editorial corrections*	*0.2.0*	*0.2.2*
2011-08		*S1-112277*			*TSG-SA WG1 Meeting #54: Inclusion of: S1-112274, S1-112112, S1-112275, S1-112276*	*0.2.2*	*1.0.0*
Sept-2011	*SP-53*	*SP-110585*			*Slightly cleaned up by MCC before presentation to SA#53*	*1.0.0*	*1.0.1*
2011-11		*S1-113291*			*TSG-SA WG1 Meeting #55: Inclusion of: S1-113287, S1-113288, S1-113289, S1-113290*	*1.0.1*	*1.1.0*
2011-12		*SP-110818*			*Raised to v.2.0.0 for approval at SA#54*	*1.1.0*	*2.0.0*