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Technical Specification

Universal Mobile Telecommunications System (UMTS); MBMS Synchronisation Protocol (SYNC) (3GPP TS 25.446 version 8.0.0 Release 8)

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Foreword

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Contents

Foreword

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

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Version x.y.z

where:

- x the first digit:
  - 1 presented to TSG for information;
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- 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 specifies the MBMS Synchronisation Protocol. For the release of this specification it is used on Iu towards UTRAN.

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 25.410: "UTRAN Iu interface: General Aspects and Principles".

[3] 3GPP TS 25.323: "Packet Data Convergence Protocol (PDCP) specification".

[4] 3GPP TS 25.346: "Introduction of the Multimedia Broadcast Multicast Service (MBMS) in the Radio Access Network (RAN); 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].

RAN Access interface: interface between the Core Network and the Radio Access Network.

RAN Access node: termination point of the RAN Access interface at the Radio Access Network.

MBMS RAB: denotes the Radio Access data bearer together with the RAN Access Interface data bearer for MBMS service user data transmission.

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].

SYNC MBMS synchronisation protocol

3.4 Specification notations

For the purposes of the present document, the following notations apply:

Procedure When referring to a procedure in the specification the Procedure Name is written with the first letters in each word in upper case characters followed by the word "procedure", e.g. Iu Rate Control procedure.

Frame When referring to a control or data frame in the specification, the CONTROL/DATA FRAME NAME is written with all letters in upper case characters followed by the words "control/data frame", e.g. TIME ALIGNMENT control frame.

IE When referring to an information element (IE) in the specification the *Information Element Name* is written with the first letters in each word in upper case characters and all letters in Italic font followed by the abbreviation "IE", e.g. *Frame Number* IE.

Value of an IE When referring to the value of an information element (IE) in the specification the "Value" is written as it is specified in subclause 5.6.3 enclosed by quotation marks, e.g. "0" or "255".

4 General

4.1 General aspects for the SYNC protocol for UTRAN

4.1.1 General aspects

The MBMS Synchronisation protocol (SYNC) is located in the User plane of the Radio Network layer over the Iu interface: the Iu UP protocol layer.

The SYNC protocol for UTRAN is used to convey user data associated to MBMS Radio Access Bearers.

One SYNC protocol instance is associated to one MBMS RAB and one MBMS RAB only. If several MBMS RABs are established towards one given UE, then these MBMS RABs make use of several SYNC protocol instances.

SYNC protocol instances exist at Iu access point as defined [2] i.e. at CN and UTRAN.

Whenever an MBMS RAB requires transfer of user data in the Iu UP, an Iu UP protocol instance exists at each Iu interface access points. These Iu UP protocol instances are established, relocated and released together with the associated MBMS RAB.

The following figure illustrates the logical placement of the SYNC protocol layer and the placement of the Data Streams sources outside of the Access Stratum.

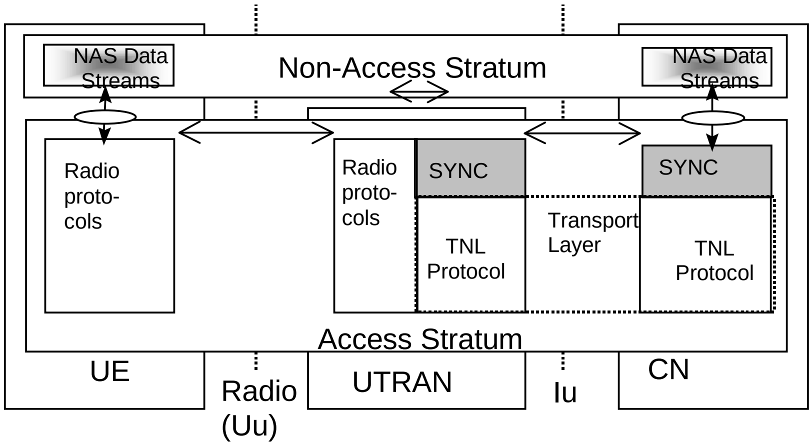

Figure 4.1.1-1: SYNC protocol layer occurrence in UTRAN overall architecture (User Plane View)

5 SYNC protocol version 1

5.1 General

5.1.1 Applicablity of SYNC protocol version 1

This version of the specification specifies the SYNC protocol for UTRAN. It is on top of TNL in Iu user plane, i.e. Iu userplane TNL transports SYNC protocol PDUs over the Iu interface.

As a specification convention, within this specification, the interface between the Core Network and the Radio Access Network is denoted as the 'RAN Access Interface', the termination point at the Radio Access Network is denoted as 'RAN Access Node', the termination point at the Core Network is denoted as 'Core Network' (CN). Further, 'MBMS RAB' denotes the Radio Access data bearer together with the RAN Access Interface data bearer for MBMS service user data transmission.

For the application of the SYNC protocol to UTRAN, the RAN Access Interface is the Iu interface, the RAN Access Node is the RNC.

5.1.1 Operation of the SYNC protocol

The SYNC protocol layer is present for data streams that originate in the CN and carry additional information within a specific userplane-frame.

The two strata communicate through a Service Access Point for Non Access Stratum (NAS) Data Streams transfer.

5.1.2 Interfaces of the SYNC protocol layer

As part of the Access Stratum responsibility, the SYNC protocol layer provides the services and functions that are necessary to handle non access stratum data streams for MBMS. The SYNC protocol layer is providing these services to the UP upper layers through a Dedicated Service Access Point used for Information Transfer.

The SYNC protocol layer is using services of the Transport layers in order to transfer user plane PDUs over the RAN Access interface.

5.2 SYNC protocol layer services

The following functions are needed to support the SYNC protocol:

- Transfer of user data along with synchronisation information;
- Transfer of synchronisation information without user data.

5.3 Services Expected from the UP Data Transport layer

The SYNC protocol layer expects the following services from the Transport Network Layer:

- Transfer of user data.
- no flow control

5.4 Elementary procedures

5.4.1 Transfer of User Data for MBMS procedure

5.4.1.1 Successful operation

The purpose of the Transfer of User Data procedure for MBMS is to transfer RAN Access Interface UP frames from the RAN Access interface UP protocol layers at CN to the RAN Access interface UP protocol layer at the RAN Access Node. One RAN Access interface UP instance is associated to a single MBMS RAB only.

The Transfer of User Data procedure is invoked whenever user data for that particular RAB needs to be sent across the Radio Access interface.

The NAS Data Streams specific functions make the padding of the payload (if needed) so that the Radio Access interface UP frame payload will be an integer number of octets. Then the NAS Data Streams specific functions perform, if needed, CRC calculation of the Iu frame payload and passes the Radio Access interface UP frame payload down to the Frame Handler function.

The Frame Handler function within the CN retrieves the packet counter and octet counter value from its internal memory, formats the frame header and frame payload into the appropriate PDU Type and sends the Radio Access interface UP frame PDU to the lower layers for transfer across the Radio Access interface. If the user data is provided with compressed IP header, the Radio Access interface UP frame contains PDCP information and the uncompressed IP header.

The Frame Handler function within the CN is also responsible for appropriate setting of the Time Stamp value in order to allow all RAN Access nodes to submit the MBMS user data in a synchronised manner.

Upon reception of a user data frame, the RAN Access interface UP protocol layer within the RAN Access node checks the consistency of the RAN Access interface UP frame as follows:

- The Frame Handler function checks the consistency of the frame header and the consistency of the packet counter value.
- Then the RAN Access node utilises the time stamp information to schedule the user data on the radio interface on the next TTI.

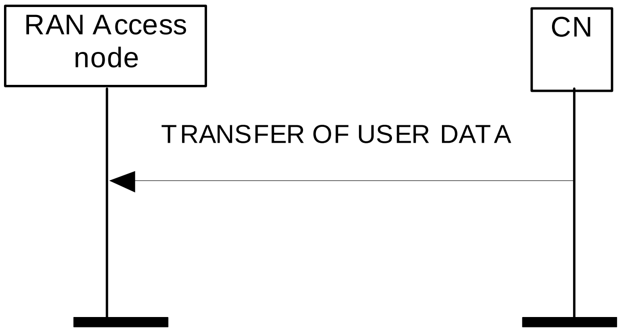

Figure 5.4.1.1-1. Successful Transfers of User Data.

5.4.1.2 Unsuccessful operation

If the RAN Access interface UP frame carrying the user data is incorrectly formatted or cannot be correctly treated by the receiving RAN Access interface UP protocol layer, or if a frame loss is detected due a gap in the sequence of the received frame numbers, the RAN Access node shall cease to provide user data to the radio interface protocol entities and wait until the next synchronisation period.

5.4.2 Transfer of Synchronisation Information for MBMS procedure (without user data)

5.4.2.1 Successful operation

The purpose of the Transfer of Synchronisation Information for MBMS procedure is to transfer synchronisation information from the CN to the RAN Access node at the end of each synchronization sequence (see [4]) to improve the RAN Access node resynchronization in case of packet loss.

The Frame Handler function within the CN retrieves the synchronisation time stamp from its internal clock and the total packet counter and total octet counter from its internal memory, formats the frame header and frame payload into the appropriate PDU Type and sends the RAN Access interface UP frame PDU to the lower layers for transfer across the RAN Access interface.

Upon reception of a user data frame, the RAN Access interface UP protocol layer checks the consistency of the RAN Access interface UP frame as follows:

- The Frame Handler function checks the consistency of the frame header and the consistency of the synchronisation time stamp, total packet counter and total octet counter.

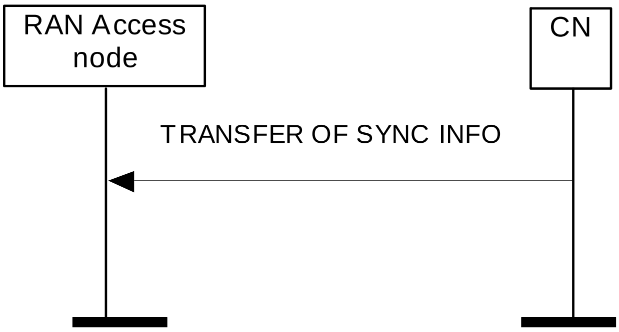

Figure 5.4.2.1-1. Successful Transfers of Synchronisation Information.

5.4.2.2 Unsuccessful operation

If the RAN Access interface UP frame carrying the user data is incorrectly formatted or cannot be correctly treated by the receiving RAN Access interface UP protocol layer, the RAN Access interface UP protocol layer shall either discard the frame or pass it to the upper layers with a frame classification indicating a corrupted frame.

5.5 Elements for the SYNC protocol

5.5.1 General

In the present document the structure of frames will be specified by using figures similar to Figure 5.5.1-1.

Bits								Number of Octets		
7	6	5	4	3	2	1	0			
Field 1				Field 2				1	Octet 1	Header part
Field 3						Field 4		2	Octet 2	
Field 4 continue				Spare					Octet 3	
Field 6								2	Octet 4	Payload part
Field 6 continue				Padding					Octet 5	
Spare extension								0-m		

Figure 5.5.1-1. Example frame format.

Unless otherwise indicated, fields which consist of multiple bits within an octet will have the more significant bit located at the higher bit position (indicated above frame in Figure 5.5.1-1). In addition, if a field spans several octets, more significant bits will be located in lower numbered octets (right of frame in Figure 5.5.1-1).

On the Iu interface, the frame will be transmitted starting from the lowest numbered octet. Within each octet, the bits are sent according decreasing bit position (bit position 7 first).

Spare bits should be set to "0" by the sender and should not be checked by the receiver.

The header part of the frame is always an integer number of octets. The payload part is octet rounded (by adding 'Padding' when needed).

The receiver should be able to remove an additional spare extension field that may be present at the end of a frame. See description of Spare extension field.

5.5.2 Frame format for the SYNC protocol

5.5.2.1 Transfer of Synchronisation Information without payload (SYNC PDU Type 0)

This Frame Format is defined to transfer synchronisation information over the RAN Access Interface UP without user data payload.

The following shows the SYNC frame structure for PDU TYPE 0 data frame of the RAN Access Interface UP protocol at the SAP towards the transport layers (TNL-SAP).

Bits								Number of Octets	
7	6	5	4	3	2	1	0		
PDU Type (=0)				spare				1	Frame Control Part
Time Stamp								2	
Packet Number								2	
Elapsed Octet Counter								4	
Total Number Of Packet								3	
Total Number Of Octet								5	
Header CRC						Padding		2	Frame Check Sum Part

Figure 5.5.2.1-1. SYNC PDU Type 0 Format.

The SYNC PDU TYPE 0 data frame is made of two parts:

1) SYNC Frame Control part (fixed size);

2) SYNC Frame Check Sum part (fixed size);

5.5.2.2 Transfer of User Data for MBMS with uncompressed header (SYNC PDU Type 1)

This Frame Format is defined to transfer user data over the RAN Access Interface UP for user data with uncompressed header.

The following shows the SYNC frame structure for PDU TYPE 1 data frame of the RAN Access Interface UP protocol at the SAP towards the transport layers (TNL-SAP).

<table>
<tr><td colspan="8">Bits</td><td rowspan="2">Number of Octets</td><td rowspan="2"></td></tr>
<tr><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td colspan="4">PDU Type (=1)</td><td colspan="4">spare</td><td>1</td><td rowspan="4">Frame Control Part</td></tr>
<tr><td colspan="8">Time Stamp</td><td>2</td></tr>
<tr><td colspan="8">Packet Number</td><td>2</td></tr>
<tr><td colspan="8">Elapsed Octet Counter</td><td>4</td></tr>
<tr><td colspan="6">Header CRC</td><td colspan="2">Payload CRC</td><td rowspan="2">2</td><td rowspan="2">Frame Check Sum Part</td></tr>
<tr><td colspan="8">Payload CRC</td></tr>
<tr><td colspan="8">Payload Fields</td><td rowspan="2">1–n</td><td rowspan="3">Frame Payload part</td></tr>
<tr><td colspan="4">Payload Fields</td><td colspan="4">Padding</td></tr>
<tr><td colspan="8">Spare extension</td><td>0-4</td></tr>
</table>

Figure 5.5.2.2-1. SYNC PDU Type 1 Format.

The SYNC PDU TYPE 1 data frame is made of three parts:

1) SYNC Frame Control part (fixed size);
2) SYNC Frame Check Sum part (fixed size);
3) SYNC Frame Payload part (SDU sizes rounded up to octets [Note: this does not consider the usage of spare extension field]).

5.5.2.3 Transfer of User Data for MBMS with compressed header (SYNC PDU Type 2)

This Frame Format is defined to transfer user data over the RAN Access Interface UP for user data with compressed header.

The following shows the SYNC frame structure for PDU TYPE 2 data frame of the RAN Access Interface UP protocol at the SAP towards the transport layers (TNL-SAP).

<table>
<tr><td colspan="8">Bits</td><td rowspan="2">Number of Octets</td><td></td></tr>
<tr><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td><td></td></tr>
<tr><td colspan="4">PDU Type (=2)</td><td colspan="3">spare</td><td>IPv6 indic</td><td>1</td><td rowspan="6">Frame Control Part</td></tr>
<tr><td colspan="8">Time Stamp</td><td>2</td></tr>
<tr><td colspan="8">Packet Number</td><td>2</td></tr>
<tr><td colspan="8">Elapsed Octet Counter</td><td>4</td></tr>
<tr><td colspan="8">PDCP Information</td><td>1</td></tr>
<tr><td colspan="8">Uncompressed Payload IP header</td><td>20(40)</td></tr>
<tr><td colspan="6">Header CRC</td><td colspan="2">Payload CRC</td><td rowspan="2">2</td><td rowspan="2">Frame Check Sum Part</td></tr>
<tr><td colspan="8">Payload CRC</td></tr>
<tr><td colspan="8">Payload Fields</td><td rowspan="2">1–n</td><td rowspan="3">Frame Payload part</td></tr>
<tr><td colspan="4">Payload Fields</td><td colspan="4">Padding</td></tr>
<tr><td colspan="8">Spare extension</td><td>0-4</td></tr>
</table>

Figure 5.5.2.3-1. SYNC PDU Type 2 Format.

The SYNC PDU TYPE 2 data frame is made of three parts:

1) SYNC Frame Control part (fixed size);

2) SYNC Frame Check Sum part (fixed size);

3) SYNC Frame Payload part (SDU sizes rounded up to octets [Note: this does not consider the usage of spare extension field]).

5.5.3 Coding of information elements in frames

5.5.3.1 PDU Type

Description: The PDU type indicates the structure of the SYNC frame. The field takes the value of the PDU Type it identifies: i.e. "0" for PDU Type 0. The PDU type is in bit 4 to bit 7 in the first octet of the frame.

Value range: {0=synchronisation frame without payload, 1=user data with synchronisation frame for uncompressed headers, 2=user data with synchronisation frame for compressed headers, 3-15=reserved for future PDU type} extensions}

Field length: 4 bits

5.5.3.2 Timestamp

Description: Absolute time value for the starting time of certain transmission period in the air interface within the synchronisation period.

Value range: {0...60000-1} Unit: multiples of 10ms.

Note: The value range allows for a synchronisation period of 600s.

Field length: 2 octets

5.5.3.3 Packet Number

Description: This parameter indicates the number of SYNC PDUs within the synchronization sequence. It helps the RAN Access node to notice the loss of SYNC PDUs. Additionally it is used to reorder the PDUs in the RAN Access node. The Packet number is reset at the end of every synchronisation period.

Value range: {0..2^{16}-1}.

Field length: 2 octets.

5.5.3.4 Elapsed Octet Counter

Description: This parameter indicate the number of elapsed cumulative octets cumulatively within one synchronisation period. It helps the RAN Access node to know how many packets were not received in case of packet loss. This counter is reset at the end of every synchronisation period.

Value range: {0..2^{32}-1}.

Field length: 4 octets.

5.5.3.5 Total Number Of Packet

Description: This parameter indicates cumulatively the number of the packets for the MBMS service for an hour.

Value range: {0..2^{24}-1}.

Field length: 3 octets.

5.5.3.6 Total Number Of Octet

Description: This parameter indicates cumulatively the number of the octets for the MBMS service for an hour.

Value range: {0..2^{40}-1}.

Field length: 5 octets.

5.5.3.7 PDCP Information

Description: This parameter contains PDCP Information as specified in [3].

Value range: as specified in [3].

Field length: 1 octet.

5.5.3.8 IPv6 Indicator

Description: This parameter indicates whether the Uncompressed Payload IP header is of IPv6 type.

Value range: {0=IPv4, 1=IPv6}.

Field length: 1 bit.

5.5.3.9 Uncompressed Payload IP header

Description: This parameter provides the uncompressed IP header of the payload.

Value range: {any value}

Field length: 20 bytes if IPv6 Indicator=0, 40 bytes if IPv6 Indicator=1.

5.5.3.10 Header CRC

Description: This field contains the CRC of all fields in Frame Control Part. The CRC is a 6-bit checksum based on the generator polynom $G(D) = D^6+D^5+D^3+D^2+D^1+1$, see subclause 5.6.2. With this CRC all error bursts shorter than 7 bits are detected, as well as all odd number of bits faulty (and two-bit faults) when the protected area is shorter than 24 bits, (max 3 octets).

Field length: 6 bits.

5.5.3.11 Payload CRC

Description: This field contains the CRC of all the fields (including Padding and possible Spare extension) of the Frame Payload Part. The CRC is a 10 bit checksum based on the generator polynom $G(D) = D^{10}+ D^9+D^5+D^4+D^1+1$, see subclause 5.6.2. With this CRC all error bursts shorter than 11 bits are detected, as well as all odd number of bits faulty (and two-bit faults) when the protected area is shorter than 500 bits (max 62 octets).

Field length: 10 bits.

5.5.3.12 Padding

Description: This field is an additional field used to make the frame payload part an integer number of octets when needed. Padding is set to "0" by the sender and is not interpreted by the receiver.

Value range: {0–127}.

Field length: 0–7 bits.

5.5.3.13 Spare

Description: The spare field is set to "0" by the sender and should not be interpreted by the receiver.

Value range: $(0–2^n-1)$.

Field Length: n bits.

5.5.3.14 Spare extension

Description: The spare extension field shall not be sent. The receiver should be capable of receiving a spare extension. The spare extension should not be interpreted by the receiver. This since in later versions of the present document additional new fields might be added in place of the spare extension. The spare extension can be an integer number of octets carrying new fields or additional information; the maximum length of the spare extension field (m) depends on the PDU type.

Value range: $0–2^{m*8}-1$.

Field Length: 0–m octets. For PDU Types in the set {0,1}, m=4. For PDU Types in the set {14}, m=32.

5.5.3.15 Payload fields

Description: This field contains the payload of the MBMS user data.

Value range: {any value}.

Field length: Sum of the lengths of the included Subflow SDUs.

5.5.4 Timers

not applicable

5.6 Handling of unknown, unforeseen and erroneous protocol data

5.6.1 General

void

5.6.2 CRC Calculation

The parity bits are generated by one of the following cyclic generator polynomials:

$g_{CRC6}(D) = D^6 + D^5 + D^3 + D^2 + D^1 + 1$;

$g_{CRC10}(D) = D^{10} + D^9 + D^5 + D^4 + D^1 + 1$.

Denote the bits to be protected of a frame by $a_1, a_2, a_3, \ldots, a_{A_i}$ (a_1 being the bit with the highest bit position in the first octet), and the parity bits by $p_1, p_2, p_3, \ldots, p_{L_i}$. A_i is the length of the protected data and L_i is 6 or 10 depending on the CRC length.

The encoding is performed in a systematic form, which means that in GF(2), the polynomial

$$a_1 D^{A_i+5} + a_2 D^{A_i+4} + \ldots + a_{A_i} D^6 + p_1 D^5 + p_2 D^4 + \ldots + p_5 D^1 + p_6$$

yields a remainder equal to 0 when divided by $g_{CRC6}(D)$ and the polynomial

$$a_1 D^{A_i+9} + a_2 D^{A_i+8} + \ldots + a_{A_i} D^{10} + p_1 D^9 + p_2 D^8 + \ldots + p_9 D^1 + p_{10}$$

yields a remainder equal to 0 when divided by $g_{CRC10}(D)$. If $A_i = 0$, $p_1 = p_2 = p_3 = \cdots = p_{L_i} = 0$.

5.6.3 Relation between input and output of the Cyclic Redundancy Check

The protected bits are left unchanged in the frame. The parity bits for the Header CRC are put in the Header CRC field with p_1 being the highest bit position of the first octet of the Header CRC field. The parity bits for the Payload CRC are put in the Payload CRC field with p_1 being the highest bit position of the first octet of the Payload CRC field.

Annex A (informative): Change history

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
12/2008	42	RP-080831			Presented to TSG-RAN for approaval		1.0.0
12/2008	42	RP-080831			approved at TSG-RAN#42 and placed under change control	1.0.0	8.0.0

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