3GPP TSG-CT WG1 Meeting #119
Wroclaw (Poland), 26-30 August 2019

C1-194236

Further Considerations on CIoT Control Plane Data Transfer in 5GS

Nokia, Nokia Shanghai Bell, Broadcom

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Status after CT1#117

- 2 Proposals presented in CT1#116 and 117 meeting:
  - **Solution 1:**
    - C1-193190: Support for transmission of small data over NAS
    - Supporting Companies: Qualcomm Incorporated, Vodafone, Samsung R&D Institute UK, BlackBerry UK Ltd., InterDigital
  - **Solution 2:**
    - C1-193795/C1-193796: Control plane CIoT data transfer in 5GS for UE in connected mode and idle mode
    - Supporting Companies: Nokia, Nokia Shanghai Bell, Huawei, HiSilicon, Verizon, Ericsson, Intel, AT&T, China Mobile, Orange, MediaTek Inc., Sharp, CATT, InterDigital, Gemalto, NEC, Broadcom

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High Level Overview

- **Common aspects between 2 propoals:**
  - CONTROL PLANE SERVICE REQUEST (CPSR) message is used to send data/SMS from 5GMM-IDLE mode
  - Initial NAS message protection applies to the CPSR message

- **Main differences between 2 propoals:**
  - Solution 1 introduces new Data over NAS containers for data/SMS/N3data transfer. All the data transfer related information, including MM/SM information and the data are all directly hardcoded into new container without including header fields.
  - Solution 2 is based on reusing existing 5G generic payload container mechanism and SMS transfer. MM/SM information are provided as optional IE as per existing mechanism on a need basis.

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Overview of Solution 1 (C1-193190) – 1/2

- **Idle Mode data transfer:**
  - Different Data over NAS Container formats for different data types

Table 8.2.x.1.1: CONTROL PLANE SERVICE REQUEST message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	Extended protocol discriminator	Extended protocol discriminator 9.2	M	V	1
	Security header type	Security header type 9.3	M	V	1/2
	Spare half octet	Spare half octet 9.5	M	V	1/2
	Control plane service request message identity	Message type 9.7	M	V	1
	ngKSI	NAS key set identifier 9.11.3.32	M	V	1/2
	Control plane service type	Control plane service type 9.11.3.y	M	V	1/2
xx	Data over NAS	Data over NAS 9.11.3.x	O	TLV-E	5-n

8	7	6	5	4	3	2	1	
Data over NAS IEI								octet 1
Length of Data over NAS contents								octet 2 octet 3
0 Spare	DDX		PSSSI	UPRR	Data type			octet 4
PDU session identity								octet 5
Data over NAS contents								octet 6
								octet m
PSI-data (7)	PSI-data (6)	PSI-data (5)	PSI-data (4)	PSI-data (3)	PSI-data (2)	PSI-data (1)	PSI-data (0)	octet m+1*
PSI-data (15)	PSI-data (14)	PSI-data (13)	PSI-data (12)	PSI-data (11)	PSI-data (10)	PSI-data (9)	PSI-data (8)	octet m+2*
PSI-sync (7)	PSI-sync (6)	PSI-sync (5)	PSI-sync (4)	PSI-sync (3)	PSI-sync (2)	PSI-sync (1)	PSI-sync (0)	octet m+3*
PSI-sync (15)	PSI-sync (14)	PSI-sync (13)	PSI-sync (12)	PSI-sync (11)	PSI-sync (10)	PSI-sync (9)	PSI-sync (8)	octet m+4*

Figure 9.11.3.x.1: Data over NAS information element for Data type "5GSM data"

8	7	6	5	4	3	2	1	
Data over NAS IEI								octet 1
Length of Data over NAS contents								octet 2 octet 3
0 Spare	0 Spare	0 Spare	0 Spare	PSSSI	Data type			octet 4
PSI-data (7)	PSI-data (6)	PSI-data (5)	PSI-data (4)	PSI-data (3)	PSI-data (2)	PSI-data (1)	PSI-data (0)	octet 5
PSI-data (15)	PSI-data (14)	PSI-data (13)	PSI-data (12)	PSI-data (11)	PSI-data (10)	PSI-data (9)	PSI-data (8)	octet 6
PSI-sync (7)	PSI-sync (6)	PSI-sync (5)	PSI-sync (4)	PSI-sync (3)	PSI-sync (2)	PSI-sync (1)	PSI-sync (0)	octet 7*
PSI-sync (15)	PSI-sync (14)	PSI-sync (13)	PSI-sync (12)	PSI-sync (11)	PSI-sync (10)	PSI-sync (9)	PSI-sync (8)	octet 8*

Figure 9.11.3.x.3: Data over NAS information element for Data type "N3 data"

Data type (octet 4) *Bits*			
3	***2***	***1***	
0	*0*	*1*	*5GSM data*
0	*1*	*0*	*SMS*

8	7	6	5	4	3	2	1	
Data over NAS IEI								octet 1
Length of Data over NAS contents								octet 2 octet 3
0 Spare	0 Spare	0 Spare	0 Spare	PSSSI	Data type			octet 4
Data over NAS contents								octet 5
								octet m
PSI-sync (7)	PSI-sync (6)	PSI-sync (5)	PSI-sync (4)	PSI-sync (3)	PSI-sync (2)	PSI-sync (1)	PSI-sync (0)	octet m+1*
PSI-sync (15)	PSI-sync (14)	PSI-sync (13)	PSI-sync (12)	PSI-sync (11)	PSI-sync (10)	PSI-sync (9)	PSI-sync (8)	octet m+2*

Figure 9.11.3.x.2: Data over NAS information element for Data type "SMS"

Overview of Solution 1 (C1-193190) - 2/2

- **Connected Mode data transfer:**
  - Different Data over NAS Container formats for different data types

    =>overlap existing SMS delivery (SMS type is already supported by payload container (shown green arrow)

Table 8.2.10.1.1: UL NAS TRANSPORT message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	…				
	UL NAS TRANSPORT message identity	Message type 9.7	M	V	1
	Payload container type	Payload container type 9.11.3.40	M	V	1/2
	…				
	Payload container	Payload container 9.11.3.39	M	LV-E	3-65537
12	PDU session ID	PDU session identity 2 9.11.3.41	C	TV	2
59	Old PDU session ID	PDU session identity 2 9.11.3.41	O	TV	2
	…				

Table 8.2.11.1.1: DL NAS TRANSPORT message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	…				
	DL NAS TRANSPORT message identity	Message type 9.7	M	V	1
	Payload container type	Payload container type 9.11.3.40	M	V	1/2
	…				
	Payload container	Payload container 9.11.3.39	M	LV-E	3-65537
12	PDU session ID	PDU session identity 2 9.11.3.41	C	TV	2
58	5GMM cause	5GMM cause 9.11.3.2	O	TV	2
	…				

8	7	6	5	4	3	2	1	
Data over NAS IEI								octet 1
Length of Data over NAS contents								octet 2
								octet 3
0 Spare	DDX		PSSSI	UPRR	Data type			octet 4
PDU session identity								octet 5
Data over NAS contents								octet 6
								octet m
PSI-data (7)	PSI-data (6)	PSI-data (5)	PSI-data (4)	PSI-data (3)	PSI-data (2)	PSI-data (1)	PSI-data (0)	octet m+1*
PSI-data (15)	PSI-data (14)	PSI-data (13)	PSI-data (12)	PSI-data (11)	PSI-data (10)	PSI-data (9)	PSI-data (8)	octet m+2*
PSI-sync (7)	PSI-sync (6)	PSI-sync (5)	PSI-sync (4)	PSI-sync (3)	PSI-sync (2)	PSI-sync (1)	PSI-sync (0)	octet m+3*
PSI-sync (15)	PSI-sync (14)	PSI-sync (13)	PSI-sync (12)	PSI-sync (11)	PSI-sync (10)	PSI-sync (9)	PSI-sync (8)	octet m+4*

Figure 9.11.3.x.1: Data over NAS information element for Data type "5GSM data"

8	7	6	5	4	3	2	1	
Data over NAS IEI								octet 1
Length of Data over NAS contents								octet 2
								octet 3
0 Spare	0 Spare	0 Spare	0 Spare	PSSSI	Data type			octet 4
Data over NAS contents								octet 5
								octet m
PSI-sync (7)	PSI-sync (6)	PSI-sync (5)	PSI-sync (4)	PSI-sync (3)	PSI-sync (2)	PSI-sync (1)	PSI-sync (0)	octet m+1*
PSI-sync (15)	PSI-sync (14)	PSI-sync (13)	PSI-sync (12)	PSI-sync (11)	PSI-sync (10)	PSI-sync (9)	PSI-sync (8)	octet m+2*

Figure 9.11.3.x.2: Data over NAS information element for Data type "SMS"

8	7	6	5	4	3	2	1	
Data over NAS IEI								octet 1
Length of Data over NAS contents								octet 2
								octet 3
0 Spare	0 Spare	0 Spare	0 Spare	PSSSI	Data type			octet 4
PSI-data (7)	PSI-data (6)	PSI-data (5)	PSI-data (4)	PSI-data (3)	PSI-data (2)	PSI-data (1)	PSI-data (0)	octet 5
PSI-data (15)	PSI-data (14)	PSI-data (13)	PSI-data (12)	PSI-data (11)	PSI-data (10)	PSI-data (9)	PSI-data (8)	octet 6
PSI-sync (7)	PSI-sync (6)	PSI-sync (5)	PSI-sync (4)	PSI-sync (3)	PSI-sync (2)	PSI-sync (1)	PSI-sync (0)	octet 7*
PSI-sync (15)	PSI-sync (14)	PSI-sync (13)	PSI-sync (12)	PSI-sync (11)	PSI-sync (10)	PSI-sync (9)	PSI-sync (8)	octet 8*

Figure 9.11.3.x.3: Data over NAS information element for Data type "N3 data"

Data type (octet 4)

Bits			
3	*2*	*1*	
0	*0*	*1*	*5GSM data*
0	*1*	*0*	*SMS*

Payload container type value (octet 1)

Bits				
4	3	2	1	
0	0	0	1	N1 SM information
0	0	1	0	SMS
0	0	1	1	LTE Positioning Protocol (LPP) message container
0	1	0	0	SOR transparent container
0	1	0	1	UE policy container
0	1	1	0	UE parameters update transparent container
1	0	0	1	Control plane data
1	1	1	1	Multiple payloads

All other values are reserved.

NOTE: The value "Multiple payloads" is only used when the Payload container contents in figure 9.11.3.39.1 contains multiple payloads as shown in figure 9.11.3.39.2.

Evaluation of Solution 1

- **Summary of Issues (See C1-193331):**
  - 5G system is led by some key principles to enable versatile and modular design and to facilitate reuse through well defined interfaces. Same principles should be followed when existing features are extended or when new features are introduced, such as 5G CIoT.
  - For 5GS**, generic NAS transport mechanism has already been specified** in 24.501 for UEs in connected mode to transport different types of payloads between the UE and the AMF based on payload type. There is no need to invent another mechanism only for transport with CONTROL PLANE SERVICE REQUEST message.
  - Placing value contents of optional IEs directly in this new "Data over NAS container" without IE header **introduces tight coupling among all informations** considering that these information are optional to begin with.
  - **SMS payload container type is already supported and related handling already specified**. Introducing another layer of "Data over NAS container" for SMS transfer is totally unnecessary and complicates/contradicts existing design.
  - MM/SM layer violation: "Data over NAS container" introduces another layer of "mini" signalling protocol that **mixes MM and SM layer information which forces the mandatory handling on the AMF side** in order to determine how to handle the data forwarding.

- Implementation Complexity: with "Data over NAS container" approach, new handling logic needs to be introduced. The handling **deviates from existing generic payload container mechanism**, also **SMS transfer for UEs in idle vs connected mode would use different mechanism** would complicates both UE and network side implementation.
- **Performance inefficiency:** with "Data over NAS container" approach, **the network has to always parse through the fields in the container to derive necessary handling even if optional Information is not present,** e.g. to explicit check the DDX field in octet 4 for every packet even if RAI is not sent. Considering that for CIoT, there are millions of cheap devices, forcing the network to parse millions of packets just to found out something not there is extremely inefficient.
- Flexibility and Extensibility: the “protocol in protocol” approach is **not future proof and any extension would require explicit change of the Data over NAS IE definition** on both the UE and the network side.
- **Messaging inefficiency**: For IoT device in PSM/eDRX mode, once the UE wakes up for service, there could be multiple data or SMS packets to be transported UL or DL. The "Data over NAS container" approach provides **no possibility to bundle these packets.** In comparison, existing payload container mechanism allows data, SMS and other payload packets to be sent bundled via “multiple payload”, therefore reducing the number of messages needed for transport the data packets, making the overall transport very efficient.

Evaluation of Solution 1

Additional Considerations

- Based on these considerations, it is **not beneficial** to introduce new container layer for user data or SMS transfer because all good design principles have been sacrificed with much complexity and handling inefficiency only to save a few octets message header size
- The analysis of message overhead in C1-193188 is not accurate and other factors were missed to be considered. For example:
  - The frequency for sending optional information such as PDU session status need to be considered.
    - Optional information does not need to be transported in every message
    - The typical number of PDU sessions for IoT devices is small. Considering that Control plane data transfer is meant to be used for infrequent small data transfer for simple monitoring/metering devices, the typical PDU sessions for these devices would not exceed 2 PDU sessions (in fact, one network connection would be sufficient in most cases). As such, the PDU session ID status IE for synchronization is not expected to be needed
  - The formula used to calculate message overhead in C1-193188 is not correct

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Further considerations

- NAS message header size
- Message overhead
- Energy consumption evaluation
- Main factors that impact battery Life
- Impact of message size to battery life during control plane data transfer
- Transport Block Size
- Impact of Transport Block Size to battery life
- Rel-15 enhancement to battery life
- Rel-16 enhancement to battery life
- Conclusion

Further considerations

NAS message header size (1/2)

Type of IEs	Solution 1 NAS header size (octets)	Solution 2 NAS header size (octets)
Mandatory IEs	4 (see mandatory header in CPSR)	4 (see mandatory header in CPSR)
		NAS message container IE: 3 (IEI is 1, and length field is 2)
	"Octet 4 of Data over NAS IE": 1	Payload container type IE: 1
	Data over NAS IE: 3 (IEI is 1, and length field is 2)	Payload container IE: 3 (IEI is 1, and length field is 2)
	PDU session identity: 1	PDU session identity IE: 2
Total # of octets (for typical usage)	9	13
Optional IEs	Release assistance indication (part of Octet 4)	Release assistance indication IE: 1
	PDU session status IE: 2	PDU session status IE: 4

Container used for ciphering

4 octets difference

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Further considerations

NAS message header size (2/2)

- Observation:
  - For mandatory information needed for CP data transfer, the message header size difference is only 4 octets (12-9=4 octets):
    - 3 Octets from using the “NAS message container” for ciphering (as done for all NAS messages for 5G)
    - 1 Octet from the PDU session IE header (IEI)

- What is the impact of 4 octets to the message overhead and device battery life?

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Further considerations

Message overhead

- When analyzing message overhead, the formula used to is not correct, even for the worst case:

  The formula in C1-193188 to calculate message overhead is:

  % overhead = 1 – (payload / overhead)

  But in fact the denominator should be (payload + ∑ overhead), also the overhead should include protocol headers from all protocol layers (NAS/RRC/PDCP/MAC…, not just 1 protocol layer:

  % overhead = 1 – (payload / (payload + ∑ (all protocol layer overhead))).

  Typical small data size is 5-20 Octets and typical protocol layer overhead used by RAN study are the following.

  - 65 octets upper layer protocol header
  - 15 octets SNDCP/LLC/RLC/MAC/CRC overhead

  For 5 octets, overhead=1 – (5/(5+65+15))=94.12%

  If header is increased by 4 octets: overhead = 1-(5/(5+69+15))=94.38%, the increased overhead is only 0.26%

Data size (octets)	Overhead with protocol header =65+15 =80 (octets)	Overhead with 4 additional octets in header =80+4=84 (octets)	Overhead Difference	Overhead with protocol header =45 +15 =60 (octets)	Overhead with 4 additional octets in header =60+4=64 (octets)	Overhead Difference
5	94.12%	94.38%	0.26%	92.31%	92.75%	0.44%
20	80%	80.77%	0.77%	75%	76.19%	1.19%

Energy Consumption Evaluation

Main factors

- TS 45.820 provides energy consumption evaluation for various MTC technologies.
- For NB-IoT, it is stated that:
  - *The achievable battery life for a MS using the NB-CIoT solution for Cellular IoT has been estimated as a function of reporting frequency and coupling loss.*

Table 7.3.6.4-4: Battery life estimates with integrated PA

	Battery life (years)		
Packet size, reporting interval	Coupling loss = 144 dB	Coupling loss = 154 dB	Coupling loss = 164 dB
50 bytes, 2 hours	22.4	11.0	2.5
200 bytes, 2 hours	18.2	5.9	1.5
50 bytes, 1 day	36.0	31.6	17.5
200 bytes, 1 day	34.9	26.2	12.8

- battery life is mostly affected when there are frequent data transmissions under extreme coverage,

e.g. it is not expected that 50 bytes vs 54 bytes would cause much battery usage difference.

150 bytes increase would cause no battery issue under normative coverage

150 bytes increase would cause no battery issue for infrequent transmission

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Energy Consumption Evaluation

Impact Due to Retransmission

- TS 45.820 provides energy consumption evaluation for various MTC technologies.
- Note that impact due to retransmission is already included in the evaluation:

> *The impact of re-transmissions of the uplink reports is included in the energy consumption analysis by taking account of the simulated BLER for the initial transmission of the uplink report for each scenario …. This means that the energy consumption analysis takes account of the average number of retransmissions of the uplink report.*

Table 7.3.6.4-4: Battery life estimates with integrated PA

	Battery life (years)		
Packet size, reporting interval	Coupling loss = 144 dB	Coupling loss = 154 dB	Coupling loss = 164 dB
50 bytes, 2 hours	22.4	11.0	2.5
200 bytes, 2 hours	18.2	5.9	1.5
50 bytes, 1 day	36.0	31.6	17.5
200 bytes, 1 day	34.9	26.2	12.8

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Main factors that impact battery Life

Observations

- As can be observed from the analysis:
  - **Coverage level and reporting intervals/frequency are the main factors** that have significant impact to battery life. **Packet size** has some impact to battery life, but is **not a relatively significant factor**
  - In general, no battery concern under normative coverage:
    - Under normal coverage, packet size increase does not cause much degradation to battery life;
    - Even 150 bytes increase causes no battery issue under normative coverage;
  - In general, no battery concern for infrequent transmission.
    - Under normal coverage, packet size increase does not cause much degradation to battery life;
    - Even 150 bytes increase causes no battery issue for infrequent transmission;
  - Battery life is mostly affected when there are **frequent** data transmission under **extreme coverage**
  - **Even for a device with 164 dB coupling loss, a 10-year battery life can be reached if the UE transmits 200-byte data less frequently (e.g. change to transmit from once every 2 hours to once per day).**

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Control Plane CIoT Small Data Transfer

Impact of message size to battery life

- Control plane data transfer is designed for devices with **infrequent small data transmission** requirements, like alarm, metering type of devices.
- Based on energy consumption evaluation analysis, for infrequent small data transmission, it is not expected that 4 octets increase would result in any significant battery usage difference.

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Transport Block Size (TBS)

Defined in TS 36.213

	eMTC		NB-IoT	
	Cat-M1	Cat-M2	Cat-NB1	Cat-NB2
DL TBS	1000	4008	860	2536
UL TBS	1000 (Rel-13), 2984 (Rel-14)	2984 (1.4 MHz), 6968 (5MHz)	1000	2536

- Once TBS is selected, the value is fixed
- If the total size of transmission does not reach TBS size, then padding would be added to make the total transmission TBS size before transmission

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Control Plane CIoT Small Data Transfer

Impact of Transport Block Size to battery life

- Impact of TBS to battery life:
  - Use NB-IoT as an example, UL TBS is 1000 bits, which means 125 octets.
  - Based on the battery life calculation from RAN1 analysis:

    - 20 octets application report,
    - 65 octets upper layer protocol header,
    - 15 octets SNDCP/LLC/RLC/MAC/CRC overhead

    Total 100 octets of data will need to be transmitted using TBS size of 125 octets.

    If the upper layer protocol header increased from 65 octets to 69 octets, then the total size of 104 octets is still within the same transport block size, so it is not expected to cause battery usage to change.

- There is typically a gap of 10-20 bytes between TBS sizes.
- It is unlikely that 4 octets header difference could result in change in TBS size.
- If the selected TBS size does not change, then there is no change in battery life.

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Battery life

Power Consumption Enhancement in Rel-15

- Further enhancement in Rel-15 to reduce UE power consumption

RAN Rel -15 WID (LTE eMTC4):

Improved power consumption:

- Power consumption reduction for physical channels [RAN1 lead, RAN2, RAN4]
  - Study and, if found beneficial for idle mode paging and/or connected mode DRX, specify physical signal/channel that can be efficiently decoded or detected prior to decoding the physical downlink control/data channel.
  - Study and, if found beneficial for connected mode, specify physical signal/channel/DCI for HARQ-ACK feedback in DL for data transmission in UL.
- Relaxed monitoring for cell reselection [RAN2 lead, RAN4]
  - Enable relaxed UE monitoring for cell (re)selection e.g. by (re)configuration.

Battery life

Power Consumption Enhancement in Rel-16

- Further enhancement in Rel-16 on UE power consumption

RAN Rel -16 WID (LTE eMTC5):

- **Improved DL transmission efficiency and/or UE power consumption:**
  - Specify support for mobile-terminated (MT) early data transmission (EDT) [RAN2, RAN3]
  - Specify quality report in MSG3 at least for EDT [RAN1, RAN2, RAN4]
  - Specify aperiodic quality report in connected mode using same quality definition as in Msg3 [RAN1, RAN2, RAN4]
  - Specify MPDCCH performance improvement by using CRS at least for connected mode [RAN1, RAN2, RAN4]
  - Specify support for UE-group wake-up signal (WUS) [RAN1, RAN2, RAN4]

- **Improved UL transmission efficiency and/or UE power consumption:**
  - Specify support for transmission in preconfigured resources in idle and/or connected mode based on SC-FDMA waveform for UEs with a valid timing advance [RAN1, RAN2, RAN4]
    - » Both shared resources and dedicated resources can be discussed
    - » Note: This is limited to orthogonal (multi) access schemes

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Overall Consideration

Impact of message size to battery life

- Control plane data transfer is designed for devices with **infrequent small data transmission** requirements, like alarm, metering type of devices.
- Typical small data payload size is around 5-20 octets. Max TBS size for NBIoT uplink is 125 octets.
- As long as the increase of packet size does not exceed the selected TBS size, the impact to battery life is not expected

Conclusion: For packet with small data payload, it is not expected that 4 octets message header size increase could cause change to TBS size or impact to device battery life.

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Overview of Solution 2 (C1-193795/C1-193796)

- Idle mode and Connected Mode data transfer:
  - Both based on reusing the same generic payload container mechanism
  - Existing SMS transfer mechanism reused

Table 8.2.10.1.1: UL NAS TRANSPORT message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	…				
	UL NAS TRANSPORT message identity	Message type 9.7	M	V	1
	Payload container type	Payload container type 9.11.3.40	M	V	1/2
	…				
	Payload container	Payload container 9.11.3.39	M	LV-E	3-65537
12	PDU session ID	PDU session identity 2 9.11.3.41	C	TV	2
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	…				

Table 8.2.11.1.1: DL NAS TRANSPORT message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	…				
	DL NAS TRANSPORT message identity	Message type 9.7	M	V	1
	Payload container type	Payload container type 9.11.3.40	M	V	1/2
	…				
	Payload container	Payload container 9.11.3.39	M	LV-E	3-65537
12	PDU session ID	PDU session identity 2 9.11.3.41	C	TV	2
58	5GMM cause	5GMM cause 9.11.3.2	O	TV	2
	…				

8	7	6	5	4	3	2	1	
Payload container IEI								octet 1
Length of payload container contents								octet 2
								octet 3
Payload container contents								octet 4
								octet n

Figure 9.11.3.39.1: Payload container information element

Payload container type value (octet 1) bits				
4	3	2	1	
0	0	0	1	N1 SM information
0	0	1	0	SMS
0	0	1	1	LTE Positioning Protocol (LPP) message container
0	1	0	0	SOR transparent container
0	1	0	1	UE policy container
0	1	1	0	UE parameters update transparent container
0	1	1	1	~~xxxx~~ User data container
1	1	1	1	Multiple payloads
All other values are reserved.				
NOTE: The value "Multiple payloads" is only used when the Payload container contents in figure 9.11.3.39.1 contains multiple payloads as shown in figure 9.11.3.39.2.				

Table 8.2.x.1.1: CONTROL PLANE SERVICE REQUEST message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	Extended protocol discriminator	Extended protocol discriminator 9.2	M	V	1
	Security header type	Security header type 9.3	M	V	1/2
	Spare half octet	Spare half octet 9.5	M	V	1/2
	Control plane service request message identity	Message type 9.7	M	V	1
	Control plane service type	Control plane service type 9.9.3.47	M	V	1/2
	ngKSI	NAS key set identifier 9.11.3.32	M	V	1/2
8-	Payload container type	Payload container type 9.11.3.40	O	TV	1
7B	Payload container	Payload container 9.11.3.39	O	TLV-E	4-65538
12	PDU session ID	PDU session identity 3 9.11.3.41A	C	TV	2
50	PDU session status	PDU session status 9.11.3.44	O	TLV	4-34
F-	Release assistance indication	Release assistance indication 9.11.3.y	O	TV	1
40	Uplink data status	Uplink data status 9.11.3.57	O	TLV	4-34
71	NAS message container	NAS message container 9.11.3.33	O	TLV-E	4-n

Benefits of Solution 2

- Overall **benefits** for payload container based approach (See C1-193170):
  - **Facilitate reuse**:
    - for 5GS, Generic NAS transport mechanism has already been specified in 24.501 for UEs in connected mode to transport different types of payloads between the UE and the AMF based on payload type.
    - SMS payload container type is already supported and related handling already specified.
  - **Flexibility & modular design**: all information are optional. Any combination of scenarios can be supported.
  - **Ease of Implementation**: both data and SMS are transported via same existing payload container mechanism and same interface. This would simplify both network and UE implementation.
  - **Extensibility**: the mechanism is extensible and future proof. Generic NAS transport mechanism can be easily extended to accommodate more types, additional information can be transported as needed as optional IEs.
  - **Efficiency**: For IoT device in PSM/eDRX mode, once the UE wakes up for service, there could be multiple data packets to be transported UL or DL. With payload container based approach, these packets can be sent bundled via the existing payload container via “multiple payload”, therefore reducing the number of messages needed for transport the data packets. Furthermore, besides data packets, SM information and SMS can also be bundled in the same message, making the overall transport very efficient.

Conclusion

- It is proposed to standardize Solution 2 for supporting 5G CIoT control plane small data transfer.

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