

DPI Use Cases for Service Providers

July 2023

Introduction: DPI in Telecommunication



Deep Packet Inspection (DPI) is a technology that enables the network owner to analyse internet traffic, through the network, in real-time and to differentiate them according to their payload.

DPI is often used for understanding the performance or behaviour of subscribers, which applications they use, how often etc. This helps operators to focus on improving service for the important applications. For instance, video streaming services like Netflix, YouTube, etc. consume a lot of bandwidth. DPI can be used to limit this.

What is Deep Packet Inspection (DPI)



DPI facilitates analyzing and managing IP traffic and securing IP networks in real time by providing network visibility and real-time application awareness. Besides influencing bandwidth and traffic management decisions, DPI can provide insights into:





Deep Packet Inspection (DPI) is used extensively by both enterprises and internet service providers for the following applications.

- Policy Definition and Enforcement
- Buffer Overflow Attack Detection
- Data Leak Prevention (DLP)
- Targeted Advertising
- Quality of Service (QoS)
- Tiered Services Offer
- Copyright Enforcement
- Net Neutrality Prevention
- Lawful Interception
- OTT application monitoring
 (see our Video analytic approach)

How is Omnia Metadata output used?

- Find, Identify, Classify, Reroute, and Block Packets with particular data/code payloads.
- Allocate available resources to smoothen traffic flow
- Ameliorate network performance and throughput
- Impose online privacy through sender-receiver identification
- Enable advanced network management, user service, internet data mining, internet censorship, and eavesdropping
- Ensure throttled data transfer, preventing P2P (Peer-to-Peer) misuse

Why is this needed?

Use Case 1: Proactive Service Outage Alerts



An operator is often held accountable when a major service is unavailable. The support call center is faced with a massive influx of calls, causing a major problem which costs money and creates anger.



Cubro solution offers real-time information about the service availability, like YouTube, Netflix, all Microsoft services.

How does this help?

- The call center is aware of this situation and can answer accordingly and does not need to generate support tickets.
- Keep subscribers informed: Receive alerts via SMS/Messenger/Website/Mail for service outages and restoration.
- Optimize planning and streamline discussions through service outage monitoring.

Use Case 2: Misuse of Service



In many countries, there is an issue when subscribers act as a sub-service provider. Residents are typically provided with telephone service via a high-powered Wi-Fi hotspot. Subscriptions can also be shared within a building.



The Cubro solution is capable of detecting this through unusual traffic/sessions/applications.

How does this help?

To detect misuse of a private plan by companies

Use Case 3: Reselling of geolocation data



Objective

Depending on the regulations in the country, reselling of geolocation data by CSPs can be very profitable.





Geolocation intelligence to increase revenue

Cubro can enrich the Geolocation data with application information, even for blocking applications in specific sectors to prevent overloading the network.

Or the SP can sell anonymized geolocation data provided by the Cubro solution.

Use Case 4: Fraud Detection



Law enforcement might require to find SPAM servers and subscribers, Portscanner, Cryptomining, Tor Users/ Servers, SIM Box detection in case of unrecognized activity that might lead to a scam, identity theft or cybercrime.





The Cubro solution is capable of detecting this through unusual traffic/sessions/applications and subscribers.

How does this help?

- Detect unusual network and subscriber behaviour
- Detect fraud activities via signature based DPI

Use Case 5: Customer Retention



The rapid change and growing competition in communication service providers makes it tough to retain the existing customers.

Considering the fact that it is pricier to acquire new customers compared to retaining the existing ones, it is one of the main goals of CSPs.



Subscribers who frequently use bandwidth test tools are unhappy with the service. It is possible to solve this problem with a proactive call, keeping the customer in the plan.

How does this help?

- More in-depth understanding of user behaviour to proactively contact customers.
- Detailed information about applications used by customers (eg: Speedtest). Extensive speed testing reveals discontent among customers.

Use Case 6: Billing and Volume control



Billing and Billing control are crucial components for success as a Service Provider.

Volume measurements are important, but the volume measurement must be done in different aspects.



The Cubro solution can provide very precise "one second resolution" volume measurements.

- 1. Either aggregated per subscriber or segmented by application.
- 2. Either aggregated per cell or segmented by subscriber.
- 3. Especially useful for VMNO roaming and outbound traffic to different AS (Autonomous Systems).

Measurement Metrics based on Cubro Metadata





Subscriber & Roaming Subscriber Metrics

- Monitor real-time total bandwidth usage of each individual subscriber with one-second resolution.
- Calculate volume usage of each individual subscriber for different time frames such as Day/Week/Month/Year.
- Monitor real-time bandwidth usage per application of each individual subscriber with one-second resolution.
- Calculate volume usage per application of each individual subscriber for different time frames such as Day/Week/Month/Year.
- Detect unwanted or forbidden applications per individual subscriber.
- Identify irregular SIM card changes per subscriber, which may indicate possible fraud cases (for mobile networks only).
- Track the location of subscribers in real-time based on IMSI or IMEI to find stolen mobiles (for mobile networks only).
- Perform baselining to detect proactive misuse of the offered service such as reselling or SIM box activities.

Service Metrics



Service Metrics

- Receive an alarm in the event of a service outage across the entire network, such as Netflix, Office364, and AWS services.
- Receive an alarm in the event of a service outage at specific sites, such as Netflix, Office364, and AWS services.
- Receive an alarm in the event of a service outage for a specific user or user group.
- Receive information when the service is restored.
- Monitor service usage statistics per individual service.
- Monitor service usage statistics per service groups, such as Social Media and Video Streaming.
- Monitor traffic distribution to Autonomous Systems (AS).
- Receive an alarm for unwanted services and apps. If necessary, inline blocking can be applied to the entire network or specific network sectors.

Network Element Metrics





Network Element Metrics

- Monitor near real-time bandwidth usage per cell with one-second resolution.
- Detect congestion near real-time per cell using burst detection.
- Monitor service distribution per cell for network planning purposes.
- Use machine learning to establish baselines and identify abnormal cell behaviour.

From raw metadata \rightarrow metric \rightarrow KPI \rightarrow use case





KPI: performance per subscriber in total performance per subscriber in total and over time



KPI: performance per APP in total KPI: performance per APP over time

Counter: How many APP'S are used

This schema describes how much value our data has:

By combining different fields from the CDR and some simple calculator, it is possible to generate KPIs / Counter and Alarms out of the network.

In this case, it is the performance of the CELLs in the entire network.



Counter: amount of subscribers per CELL ID

Alarm: When a specific subscriber enters a specific CELL or CELL cluster /region)

KPI: change rate of subscribers per CELL (Cell jumping)

Deep Packet Inspection (DPI) is detecting traffic type by Signature; beyond port and protocol



This is the output from our DPI engine, we can find WhatsApp even when it is ciphered. We can find up to 4000 different applications.

Cubro DPI

DPI Applications

There are generally two different main applications for DPI

1. Analytics

A: In this application, the DPI engine can decode the full traffic and produce results in DB format for analytics purpose. This is only possible on CPU-based units like Omnia series. Since every packet has to be handled, it is a big effort in terms of CPU load and data output.

B: IPFIX with DPI enriched output. This is also a very common way of analyzing DPI data, but it is not very efficient and produces a lot of overhead. IPFIX on ISP level is very difficult because of the high amount of parallel sessions in the network. This often leads to issues on the installed probe like reaching memory limits.

2. Tagging/filtering/blocking

This application resonates with Cubro approach - remove an unwanted application type from the monitoring. **It is common to remove video streaming services.**

The same application is for blocking certain applications, or sending certain traffic to a special monitoring device. In this case, it is not needed to do a full decode because sampling gives a similar result but with much less effort.

DPI Signatures (Applications & Protocols)



We support up to 4000 signatures. These signatures are divided into two parts:

• 1400 see <u>DPI Services</u> - these are the top signatures which are maintained manually.

• The other signatures are maintained by deep learning and AI.

(The update cycle is between 7 and 10 Days)



More detailed Use Cases

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Bandwidth per Service per Subscriber



For a service provider, customer experience is a significant concern, and it directly correlates with bandwidth per application. This is precisely what Cubro can efficiently deliver.

Cubro provides per user/per application bandwidth information with a one-second resolution, ranging from 100 Gbit/sec up to multiple TB/sec.

Additionally, Cubro offers DPI data enrichment with Radius and Mobile data from other sources on request.

This is the XDR Probe output: MS ISDN, IMSI, IMEI, Cell ID, RAT, APN, USER IP, Application, Bandwidth in 1 sec resolution

Service Provider Use cases

- If the customer complaints, the Service Provider can demonstrate the bandwidth was adequate or inadequate due to a CELL issue, incorrect RAT (Radio Access Technology) or APN (Access Point Name). This simple method effectively resolves most customer complaints.
- With the same data, you can see the load on a specific CELL, and the application distribution.
- Customer movements can be monitored.
- Customer mobile phone type change.

Bandwidth per Service per Subscriber



LI Use cases:

• Profiling a person by his usage of application over time (base lining)

Master or Slave because we have a 100% price volume statistic up and down, it is possible to detect if the person is giving orders or receiving orders.

- Activity of individuals (baselining and ML)
- Changing SIM cards (IMEI MS ISDN correlation)
- Customer mobile phone type change.
- Movement of individuals via CELL ID and RAT changes
- With additional ML learning, it would be possible to identify people with relations
- Filtering on IMSI/MS ISDN for specific person to get full traffic captured.



Omnia QM Solution using Call Detail Records (CDRs) provides an efficient method of optimizing data and can potentially help CSPs to monitor data with less HW and SW resources.



One user WhatsApp traffic

Master or Slave because we have a 100% price volume statistic both up and down, it is possible to detect is the person giving orders or receiving orders.

This graph shows that this subscriber has only received messages because the outgoing traffic was in Bit and incoming traffic in kBit.

The outgoing was only management traffic (the acknowledgment).

This simple example shows how high-resolution bandwidth information can be.



Video analytic via Fingerprint







Each streaming application has a unique bandwidth fingerprint. This information can be used to detect good and bad service quality. Additionally, it can be leveraged to determine the frequency of customer channel switching and the number of streams being watched. Such insights are valuable for troubleshooting, or providing counterarguments against customer complaints.

These pictures show good performance, any other behaviour leads to bad quality.

Example of Packet Drop





Packet drop leads to this picture. -



This test is done with an impairment analyser to show what is the effect of 3% packet drop!



Time window based XDR (Cubro XDR)

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As described in the previous slides, there are several disadvantages to performing flow-based computation, mainly due to a lack of resources (CPU, memory, storage).

Aggregating metadata time window based solves most of these problems and allows a much higher computation throughput without losing any important metadata attributes.

The significant metadata cannot be extracted from single flows, as they mainly contain data from a technical perspective. The significant information is, for example, based on a device or user within the network. Which traffic is generated from a specific device, which services are used by a specific device and to what extent, how much traffic is generated by a user over time, which servers are involved, etc.



The time window-based approach focuses on this significant data.

The key is collecting Metadata for uploads, downloads, and internal traffic as well as DPI information from a device/user perspective over time. Extracting the essential information out of big data streams with the benefit of not wasting resources and storage for absolutely meaningless information (contained within single flows) is the important point. The time window-based approach allows many essential views of the data:

- **Service perspective:** For every Service the amount of traffic, how often it is used over time, how much traffic is uploaded or downloaded, etc.
- **Client/Device perspective:** For every Client (user) the usage of the network by upload and download, which services and locations are used, how often they are used over time.
- **Network perspective:** For every APN, eNodeB Cell, radio technology, how much traffic is uploaded or downloaded, what are the most frequent services, how many clients are connected, etc.



Time window based

VS



For each client, there is a bucket for each application, if needed, and we collect/count all packets for a certain time window (configurable). When the window is closed, an XDR is produced/enriched and sent out. The advantage is, the traffic is reduced on most far points to avoid constraints on the workflow along to the database. **Flow based**



For each 5 tuple connection, one flow is produced. A lot of these flows cannot be detected, for instance, Amazon related because the external domain cannot be resolved.

After producing the flow, it is forwarded to the Flow Cache. A Flow Cache can contain hundreds of thousands of entries, and in some cases, even millions of entries. This costs memory resources.

When the flows expire, they're exported off to the NetFlow Collector, which will constantly analyse and archive the flows for future reference.



Time window based

VS

Flow based

- We aren't concerned about sessions, (TCP handshake) perpetually open sessions are not an issue.
- Irregularly terminated/established sessions are also not an issue.
- The configurable time window offers the option to balance between performance constraints and granularity of the output.
- 0.1% 0.5% of the input traffic is the size of the resulting metadata stream (configurable).

- The flow-based solution cares about sessions, (TCP handshake) perpetually open sessions are an issue. Typically, a flow probe has a limitation in terms of number of flows (FPS) not bandwidth.
- Irregularly terminated/established sessions are also an issue because an irregularly terminated session stays open until the timeout and consumes unnecessary resources.

A session where the initial handshake is not seen for any reason will not be detected. For IoT especially, this could be an issue because such devices talk very rarely; it could be days until a session is detected again.

• 2% - 3% of the input traffic is the size of the resulting metadata stream.

For both solutions, there are pros and cons, but with the dramatic growth of traffic, a time window-based solution is much more efficient and saves Capex and Opex costs.



Hardware Appliance

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CPU & Switch Omnia models overview



Omnia120



CPU only Omnia models overview





Omnics (Cubro Smart NICs)



The implementation of high layer software on X86 server is becoming more and more complex. The performance of network service subsystem is a key factor to simplify application development and deployment.

Cubro i-NIC helps application software to offload network related processing from server CPU to a dedicated SoC, so that the application system can be accelerated with too much modification on existing software.

- 4 x 10/25 Gbit SFP+
- 2 x 100 Gbit QSFP
- 24 core ARM CPU
- 64 GB Memory
- 16 lane PCI connection (v4)
- Works also as a stand alone



4 x 10/ 25 Gbit/s Interface

2 x 100 Gbit/s Interface



Terabit metadata extraction application

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How we connect the solution to the network





4G and 5G Interface which we can use

S2b	GTPv2-C/GTPv1-U	ePDG - PDN-GW
S3	GTPv2-C	MME - SGSN
S4	GTPv2-C/GTPv1-U	S-GW - SGSN
S5	GTPv2-C/GTPv1-U	S-GW - PDN-GW
S6a	Diameter	MME - HSS
S6d	Diameter	SGSN - HSS
S8	GTPv2-C/GTPv1-U	S-GW - PDN-GW (Roaming)
S10	GTPv2-C	MME - MME
S11	GTPv2-C	MME - S-GW
S12	GTPv1-U	S-GW - UTRAN
S13	Diameter	MME - EIR
SGi	IP	PDN-GW - PDN
N1	N2-AP/SCTP	gNB - AMF
N2	N2-AP/SCTP	gNB - AMF
N3	GTPv1-U	gNB - UPF
N4U	GTPv1-U	SMF - UPF
N6	GTPv1-U	UPF - Data Network
N9	GTPv1-U	UPF - UPF

Smart NIC in Server





Super Server internal function





1–2 Tbps User Plane monitoring in an MNO (real picture)





only 19 U 836 mm

System Schema for 1-1.2 TB of user traffic







Function of the Data Lake





41

Advantages of a Data Lake compared to a DB





All reports and results are preprocessed, which ensures rapid execution.

However, this approach demands higher storage and CPU resources compared to a database (DB) approach.

Cluster Data Network



The passive DPI solution for sampled traffic 1:4



500 Gbit Raw Input traffic from taps or spannports raw traffic input 0 0 0 \circ \circ \circ \circ Total Counter from the live link 66 66 session aware loadbalanced output recalculate to the full bandwidth loadballenced and sampled traffic to 25 % (125 Gbit) IELEE DPI output per live link 1999

For some applications, sampling can help to reduce the cost. This is such an example for routing and peering Analytics, 1 : 4 sampling ratio will work perfect for such application.







3U small site solution up to 180 Gbit



- Load balancer
- Filter
- Signaling Probe

- Up to three Smart NICs for DPI analytics
- Performance up to 150 to 180 Gbit/s

User plane / Signaling correlation is done in the server CPU.



Supervision Solution

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Managing and Monitoring Cubro DPI solution



Managing and monitoring such a complex system is a significant issue. With its numerous components, the owner requires comprehensive information spanning the entire chain. The drawing shows the chain and all data collection points. But we are not solely collecting information (counters), we are building KPIs.

For instance, comparing input traffic on the NPB to the output in CDR or input traffic on all ports of the NPB versus output all ports. These KPIs can be configured by the customer themselves.

Graphical User Plane Output - Overflowing with data





Kafka Message output to data lake





Signaling Control plane Input





Control Plane CDR output





Only a specific CDR; in this case, N11







Technical Figures

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Performance figures (single use case estimations, can differ by traffic type and other external factors)

Product	IPFIX	IPFIX/DPI	Aggregated Cubro XDR with DPI (user plane)	Capture
Omnia120	20 Gbps on CPU 1	40 Gbps only one CPU 2	40 – 60 Gbps (on CPU 2)	Up to 6 TB / 8 - 10 Gbps performance
Omnia200	60 Gbps	60 Gbps	Up to 85 Gbps depending on the traffic situation	Up to 16 TB / 10 - 15 Gbps performance
Omnia400	60 Gbps (per CPU)	60 Gbps (per CPU)	160 Gbps (85 per CPU)	Up to 16 TB 10 - 15 Gbps performance
Omnic	40 Gbps	40 Gbps	Up to 85 Gbps depending on the traffic situation	No capture on NIC, but endless on the server via PCI
Omnic NG (road map Q1/23)	NA	NA	120+ Gbps depending on the traffic situation	No capture on NIC, but endless on the server via PCI

Raw packet storage calculation



Bandwidth in Gbit/s	1	3	6	12	24	Retention time in hours	1024 TB = 1 PB Petabyte		
0,1	0,08	0,25	0,5	1	2		Such a 42 Rack can		
0,5	0,25	0,75	1,5	3	6		support 3600 TB = 3,54		
1	0,46	1,375	2,75	5,5	11		PB		
5	2,25	6,75	13,5	27	54		432 x 8 TB HDD		
10	4,50	13,5	27	54	108		2x 50A 208 3-Phase		
50	22,50	67,5	135	270	540		Metered PDU		
100	45,00	135	270	540	1.080	in TB storage	Cost 600 - 890K Euro		
							depending on CPU PAM		

depending on CPU RAM and HDD type

Bandwidth in Gbit/s	1	5	10	30	60	90	Retention time in days
0,1				33	65	98	
0,5		27	54	162	162 324 468		
1		54	108	324	648	972	
5	54	270	540	1.620	3.240	4.860	
10	108	540	1.080	3.240	6.480	9.720	
50	540	2.700	5.400	16.200	32.400	48.600	
100	1.080	5.400	10.800	32.400	64.800	97.200	in TB storage





The huge difference in Volume to store - 2,5 PB to 29 PB

Estimated IPFIX Metadata retention time

Bandwidth in Gbit/s	1	5	10	30	60	90	Retention time in days
0,1	0,060			0,990		2,940	
0,5		0,810	1,620	4,860	9,720	14,040	
1	0,330	1,62	3,240	9,720	19,440		
5	1,62	8,10	16,20	48,60 97,	97,20	20 145,80	
10	3,24	16,20	32,40	97,20	194,40	291,60	
50	16,20	81	162		972		
100	32,40	162	324	972	1.944	2.916	
500	162	810	1.620	4.860	9.720	14.580	
1000	324	1.620	3.240	9.720	19.440	29.160	in TB storage

Estimated Cubro Metadata retention time

Bandwidth in Gbit/s	1	5	10	30	60	90	Retention time in days
0,1	0,00	0,014	0,029	0,086	0,173	0,259	
0,5	0,01	0,072	0,144	0,432	0,864		
1	0,03	0,14	0,29	0,86		2,59	
5	0,29	1,44	2,88	8,64		25,92	
10	0,72	3,60	7,20	21,60	43,20	64,80	
50	1,44	7,20	14,40	43,20	86,40	129,60	
100	2,88	14,40	28,80	86,40	172,80	259,20	
500	14,40	72	144	432	864	1.296	
1000	28,80	144		864	1.728	2.592	in TB storage

Cubro aggregated XDR volume calculation



UP Input	CDR/sec	CDR/H	Volume JSON/H Mbyte	Volume Binary/H Mbyte	Volume JSON/H Gbyte	Volume Binary/H Gbyte
25 Mbit	1,70	6.200	25	3		
100 Mbit	6,80	24.800	100	12		
250 Mbit	17	62.000	250	30		
500 Mbit	34	124.000	500	60		
1 Gbit	68	248.000	1.000	120		0,12
10 Gbit	680	2.480.000	10.000	1.200	10	
25 Gbit	1.700	6.200.000	25.000	3.000	25	3
50 Gbit	3.400	12.400.000	50.000	6.000	50	6
100 Gbit	6.800	24.800.000	100.000	12.000	100	12
500 Gbit	34.000	124.000.000	500.000	60.000	500	60
1 Tbit	68.000	248.000.000	1.000.000	120.000	1.000	120

User plane Data (This data is based on the real output from a European Mobile SP)



The output options

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Cubro Metadata Broker

The Cubro Metadata Broker is a server based application available on Intel or ARM which receives the UDP streams from the DPI producers and performs several actions to generate an output stream which fulfills the customers requests.

- Data Enrichment from other sources
- Data Aggregation
- Time Aggregation
- Output Formation

The preferred output format is Google Protocol Buffers because it is a very efficient format. (see next page)

This format is supported by a modern programming language and is a very efficient way to serialize and deserialize data.



Protocol Buffers as Output





Google developed Protocol Buffers for use in their internal services. It is a binary encoding format that allows you to specify a *schema* for your data using a specification language.

Protocol Buffers offers several compelling advantages over JSON or YAML for sending data over the wire between internal services. While not a wholesale replacement for JSON, especially for services which are directly consumed by a web browser, Protocol Buffers offers very real advantages not only in the ways outlined above, but also typically, in terms of speed of encoding and decoding, size of the data on the wire, and more.

Confluent just updated their Kafka streaming platform with additional support for serializing data with Protocol buffers (or protobuf) and JSON Schema serialization. This makes integration much less difficult.



Proto Buffer Cubro XDR output schema and Jason

message PortData {



syntax = "proto3";

package com.messages.merlin;

```
option java package =
"com.merlin.lib.pp.common.api.tw.protobuf";
option java multiple files = true;
option java outer classname = "Merlin";
option optimize for = SPEED;
message TimeWindow {
 int64 timestamp = 1;
 int64 bps = 2;
 int64 incomingPkts = 3;
  int64 outgoingPkts = 4;
  int64 internalPkts = 5;
  int64 incomingBytes = 6;
  int64 outgoingBytes = 7;
 int64 internalBytes = 8;
  int32 connections = 9;
  repeated ServiceData services = 10;
  repeated ClientData clients = 11;
  repeated IpData servers = 12;
  repeated TypeBytesData 13 = 13;
  repeated TypeBytesData 14 = 14;
  repeated PortData ports = 15;
  repeated DnsData domains = 16;
message ServiceData {
 ServiceEntry service = 1;
 int64 incomingPkts = 2;
 int64 outgoingPkts = 3;
 int64 internalPkts = 4;
  int64 incomingBytes = 5;
  int64 outgoingBytes = 6;
 int64 internalBytes = 7;
  repeated IpData clients = 8;
  repeated IpData servers = 9;
message ClientData {
 IpData ip = 1;
```

repeated ServiceEntry services = 2;

repeated IpData servers = 3;

```
TypeBytesData port = 1;
  repeated IpData clients = 2;
/* represents a generic entry for an IP, bytes (volume), and geo location
message IpData {
  IpEntry ip = 1;
   int64 incomingPkts = 2;
   int64 outgoingPkts = 3;
   int64 internalPkts = 4.
   int64 incomingBytes = 5;
   int64 outgoingBytes = 6;
   int64 internalBytes = 7;
   GeoData geo = 8;
   oneof oneof mac {
    bytes mac = 9;
message ServiceEntry {
 string name = 1;
  oneof oneof hash {
   int64 hash = 2;
/* represents a generic entry for IPv4 or IPv6 Address */
message IpEntry {
 oneof oneof ip
    int32 ip4 = 1;
    bytes ip6 = 2;
message GeoData {
 float lon = 1:
  float lat = 2;
/* represents a generic entry for some type and bytes mapping */
message TypeBytesData {
  int32 type = 1;
   int64 incomingPkts = 2;
   int64 outgoingPkts = 3;
   int64 internalPkts = 4;
   int64 incomingBytes = 5;
   int64 outgoingBytes = 6;
   int64 internalBytes = 7;
message DnsData {
 string name = 1;
  repeated IpData clients = 2;
  repeated IpData servers = 3;
```

Datei Bearbeiten Format Ansicht Hilfe "timestamp" : 1633943082054, "bps" : 260684210400, "incomingPkts" : 157254, "outgoingPkts" : 166146. "internalPkts" : 780, "totalPkts" : 324180, "totalExternalPkts" : 323400, "incomingBytes" : 166408776, "outgoingBytes" : 159251095. "internalBytes" : 125748, "totalBytes" : 325785619, "totalExternalBytes" : 325659871, "connections" : 0. "services" : [{ "name" : "unknown", "hash" : -2307423566270376311, "incomingPkts" : 235, "outgoingPkts" : 531, "internalPkts" : 48, "totalPkts" : 814, "totalExternalPkts" : 766, "incomingBytes" : 35263, "outgoingBytes" : 33871, "internalBytes" : 3424, "totalBytes" : 72558, "totalExternalBytes" : 69134, "clients" : [{ "ip" : "192.168.0.1" "mac" : "aclf6b1b1a5f", "lation" : null. "ip4" : -1062731775, "ip6" : null, "lon" : null, "lat" : null, "deviceHash" : 3714172930, "incomingPkts" : 0. "outgoingPkts" : 0, "internalPkts" : 24. "totalPkts" : 24. "totalExternalPkts" : 0, "incomingBytes" : 0, "outgoingBytes" : 0, "internalBytes" : 1712, "totalBytes" : 1712, "totalExternalBytes" : 0 }, {
 "ip" : "192.168.0.65" "mac" : "a4ae111e7b00", "latlon" : null, "ip4" : -1062731711, "ip6" : null, "lon" : null, "lat" : null, "deviceHash" : 2130148618, "incomingPkts" : 1. "outgoingPkts" : 2, "internalPkts" : 0, "totalPkts" : 3, "totalExternalPkts" : 3. "incomingBytes" : 66. "outgoingBytes" : 120, "internalBytes" : 0, "totalBytes" : 186, "totalExternalBytes" : 186 }, {
 "ip" : "192.168.0.40",
 "ip" : "192.168.0.40", "mac" : "cc483aa09ad7" "lation" : null, "in4" : -1062731736. "ip6" : null, "lon" : null,

61

IPFIX output from Custos



),	Time	Source	Destination	Protocol	Length 1	Info							
	4 4.997546	10.30.0.10	10.30.1.61	CFLOW	252	IPFIX	flow (210	bytes)	Obs-Domain-ID=	1	[Data:258]	
	5 9.997553	10.30.0.10	10.30.1.61	CFLOW	442	IPFIX	flow ((400	bytes)	Obs-Domain-ID=	1	[Data:258]	
	6 14.999700	10.30.0.10	10.30.1.61	CFLOW	537	IPFIX	flow (495	bytes)	Obs-Domain-ID=	1	[Data:258]	
	7 14.999704	10.30.0.10	10.30.1.61	CFLOW	118	IPFIX	flow (76	bytes)	Obs-Domain-ID=	1	[Data-Template:256]	
	8 19.997696	10.30.0.10	10.30.1.61	CFLOW	134	IPFIX	flow ((92	bytes)	Obs-Domain-ID=	1	[Data-Template:257]	
	9 19.997698	10.30.0.10	10.30.1.61	CFLOW	134	IPFIX	flow (92	bytes)	Obs-Domain-ID=	1	[Data-Template:258]	
	10 25.002232	10.30.0.10	10.30.1.61	CFLOW	252	IPFIX	flow (210	bytes)	Obs-Domain-ID=	1	[Data:258]	
	11 29.971536	10.30.0.10	10.30.1.61	CFLOW	1411	IPFIX	flow ((1369	bytes)	Obs-Domain-ID=	1	[Data:257]	
	12 35.000297	10.30.0.10	10.30.1.61	CFLOW	133	IPFIX	flow (91	bytes)	Obs-Domain-ID=	1	[Data:257]	
	13 35.000310	10.30.0.10	10.30.1.61	CFLOW	822	IPFIX	flow (780	bytes)	Obs-Domain-ID=	1	[Data:258]	
	14 35.000313	10.30.0.10	10.30.1.61	CFLOW	118	IPFIX	flow (76	bytes)	Obs-Domain-ID=	1	[Data-Template:256]	
	15 40.003088	10.30.0.10	10.30.1.61	CFLOW	134	IPFIX	flow (92	bytes)	Obs-Domain-ID=	1	[Data-Template:257]	
	16 40.003091	10.30.0.10	10.30.1.61	CFLOW	134	IPFIX	flow (92	bytes)	Obs-Domain-ID=	1	[Data-Template:258]	
	17 41.276563	10.30.20.75	10.30.255.255	NBNS	92 1	Name o	query !	B WP	AD<00>				
	18 42.026401	10.30.20.75	10.30.255.255	NBNS	92 1	Vame o	query I	NB WP	AD<00>				
	10 40 375750	10 30 30 75	10 30 355 355	NITING	02.1								
Ir	iternet Protocol	Version 4, Src: 1	0.30.0.10, Dst: 10.30.1.0	51									
Us	er Datagram Prot	cocol, Src Port: 4	739, Dst Port: 9995										
C	sco NetFlow/IPFI	DX											

Version: 10 Length: 1369

Timestamp: Sep 18, 2020 10:57:14.000000000 Mitteleuropäische Sommerzeit ExportTime: 1600419434

FlowSequence: 224072 (expected 223958)

Observation Domain Id: 1

 Set 1 [id=257] (19 flows) FlowSet Id: (Data) (257)

FlowSet Length: 1353 [Template Frame: 2]

Flow 1

InputInt: 3 OutputInt: 2 Packets: 10

> [Duration: 0.117622944 seconds (nanoseconds)] Source Mac Address: Dell_Be:75:8b (a4:4c:68:8e:75:8b) Destination Mac Address: SuperMic_lb:la:5f (ac:1f:6b:1b:la:5f) Ethernet Type: 8 SrcAddr: 192.168.3.36 DstAddr: 99.86.245.33 Protocol: TCP (6) Octes: 929 SrcPort: 59828 (59828) DstPort: 443 (443) > TCP Flags: ex080b, ACK, PSH, SYN, FIN

Enterprise Private entry: (cubro) Type 1: Value (hex bytes): f3 06

1436 pexip	Pexip	Messaging	Meeting and interoperability media glattrom
1437 phantasy star online 2	Phantasy Star Online 2	Gaming	Online role-playing game published by Sega
1438 phantom fex	Phantom EEX	Gaming	Card, casino and gambling games
1439 phantom vpn	Phantom VPN	Remoting	Multi-protocol Virtual Private Network
1440 philips	Philips	Remoting	Consumer and business electronics
1441 philips hue	Philips Hue	Remoting	Wrelessly controlled LED lamps
1442 photomath	Photomath	Education	Mathematical camera calculator
1443 photorank	Photorank	Advertising	Measuring user photo-sharing activity
1444 piccollage	PicCollage	Photo	Photo, sticker and text collages
1445 picsart	PicsArt	Photo	Image editing, collage and drawing service
1446 picturethis	PictureThis	Education	Online plant encyclopedia
1447 pinger	Pipper	Messaging	Texting and calling service
1448 pinger call	Pinger Call	Messaging	Voice and video calling
1449 pinterest	Picterest	Social	Discover and save photos
1450 pivotal tracker	Pivotal Tracker	Productivity	Project planning software
1451 pixalate	Pixalate	Advertising	Advertising fraud intelligence and marketing compliance platform
1452 pixelberry	Pixelberry Studios	Gaming	Video game traffic by Pixelberry
1453 pil	PJL	Networking	Printer job management service
1454 plarium	Pladum	Gaming	Video game traffic by Plarium
1455 playdemic	Playdemic	Gaming	Video game traffic by Playdemic
1456 playerupknowns battleground	s PlayerLinknown's Battlegrounds	Gaming	Battle royale video game
1457 playfab	PlayFab	Gaming	Backepd game platform as a service
1458 playgendary	Playgendary	Gaming	Video game traffic by Playgendary
1459 playhayen	PlayHaven	Advertising	Mobile gaming monetization platform
1460 playrix	Playtix	Gaming	Video game traffic by Playtix
1461 playtika	Playtika	Gaming	Casino style video games
1462 plentyoffish	Pleotyoffish	Social	Online dating service
1463 plex	Plex	Video	Audio and video media player services
1464 plexypp	PlexVPN	Remoting	Multi-protocol Virtual Private Network
1465 plume	Plume	Productivity	Plume WIFI services
1466 plustransfer	PlusTransfer	File Transfer	Large file transfer for email
1467 plutoty	PlutoTV	Video	American internet television service
1468 prop	PNBP	Networking	Peer-to-peer name resolution service
1469 pocket	Pocket	News	Article reading list management service
1470 pocketcamp	Animal Crossing: Pocket Camp	Gaming	Social simulation video game
1471 pocket controller	Pocket Controller	Remoting	Remote control help desk software
1472 pokec	Pokec	Social	Online social network
1473 pokemon cafe mix	Pokemon Cafe Mix	Gaming	Puzzle video game
1474 pokeman go	Pokemon GO	Gaming	Augmented reality video game
1475 pokemon home	Pokemon Home	Gaming	Cloud service for Pokemon gaming
1476 pokemon lets go	Pokemon Let's Go	Gaming	Adventure Role-Playing video game
1477 pokemonmasters	Pokemon Masters	Gaming	Pokemon strategy and battling game
1478 pokemon_sword_shield	Pokemon Sword and Shield	Gaming	Role-playing video game
1479 polyup	Polyup	Education	3D playground for learning math
1480 pop3	POP3	Messaging	Standard email protocol
1481 pops lots	POP! Slots	Gaming	Casino gambling video game
1482 postmark	Roshmark	Shopping	Social commerce marketplace

Signaling Probe output



NAS 5GMM

		1.0	1.10	5 E .	1.5	
-	0			20 N1	IN2 50	AMM (DR/5401)
	100000000000000000000000000000000000000	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Typ	Lengt	Defa	
Overview	Field name	Name		h	ults	Meaning/Remarks
	'CDR header' IAL	CDR header		44		All CDR header structure
	and in	Abde N2 ID	1000	16	0	
Senaline	amf_oort	AME part number	unt	1 2	0	
channel	enh in	eNR signaling plan	uinti	16	0	
	anb port	gNB port number	unt	2	0	
	amf ue nzao id	AMF UE NGAP ID	uinti	8	0	R15.6 has been modified to 40bit
	ran ue ngap id	RAN UE NGAP ID	unt	4	0	
NGAP	amf_region_id	AMF Region ID	uinti	1	0	3GPP 24.501-9.11.3.4, fill in the AMF area identifier of 5G-GU or 5G-STMSI
	amf set id	AMF Set ID	uint	1 1	0	
	amf pointer	AMF Pointer	uinti	1	0	
4 4		1400	uint			
	mee	MUC	16	-	-4	
	mnc	MNC	16	2	-1	
	tac	TAC	unti	4	0	3 octets
User location						the current location type of the UE at the end of the process:
	location_type	Location type	unt	1	0	1: NR (nrLocation)
	Service Service	Property and a second second				2: E-UTRAN (EUTRICCEDON)
		2008/201				the Cell ID/E-LITRAN Cell ID where the LIE is located at the en-
	a	Cell ID	unt	8	0	of the process
5	impi	SUPI	strin	15	NULL	IMSI or NAI (not currently supported)
	imei	PEI	strin	16	NULL	IMD or IMDSV
User ID	msisdn	GPSI	strin	24	NULL	mobile phone number
	Se tesi	SG-TMSI	unt	4	0	The registration request uses tisi to register, the service
	- 0		-	-	-	request uses tmsi to register
2 0	total_time	Total online time	4	8	0	Nanosecond (ns)
	delay_time	Response time	intó	8	0	Nanosecond (ns)
			•	-	-	Oud1: Resistanting
						Ox5b: Identity Request
						0x56: Authentication Request
	outer through	Descare hone				Ox5d: Security Mode Command
	cos" other	contrast office	unte			0x45: ue-De-registration
Action overv						0x47: net-De-registration
						Ox4c: Service Request
					-	2000 24 501 9 11 2 7 rection id request tune require request
	msg_type	Subtype	uinti	1	-1	Type
	cdr result	Process status	uinti	1	0	Process results: 1: success: 2: failure: 3: timeout:
	direction	Originating directi	uinti	1	0	1: UE initiated 2: Network initiated
	cause	Sgmm cause	unti	1	-1	
	access_type	Access network ty	uinti	1	-1	1: 3GPP access 2: Non-3GPP access 3: 3GPP access and
						1: 5G-AKA, no EAP message, 5G AV
	authen_type	Authentication typ	unti	1	-1	2: EAP-AKA', EAP Method Type = 50
	2010/02/02/02					3: EAP-TLS, EAP Method Type = 13
						Refer to section 24.501 9.11.3.34 type of ciphering algorithm:
						0: 5G encryption algorithm 5G-EA0
						1: 50 encryption algorithm 128-50-EA1
datalle	rinher also	NAS encountron al	LICOL			3: 50 encryption algorithm 128-50-642
Or Carls	column and a	iners enter (proteiner)		1.	· · ·	4 : 5G encryption algorithm 5G-EA4
						5: 50 encryption algorithm 5G-EA5
						6: 5G encryption algorithm 5G-EA6
			-	-	_	7: 5G encryption algorithm 5G-EA7
	new amf_region_id	new AMF Region I	uinti	1	-1	3GPP 24.501-9.11.3.4, fill in the AMF area identifier of 5G-GU
	and and let id	And the second second			-	or 5G-5-TMSI
	new_amn_set_id	new And Set ID	unt	1	-1	
	new Se trad	Dev SG-TMS	ulo*	4	0	After registration, accept can be redistributed to travi
		A COMPANY OF A COM			- 10	THE PARTY OF THE P

NAS 5GSM

- A -		U	U.			N
		ZC_NIN2_5	GMM	CDR	[5401]	
Overview	Field name	Name	Typ	Len	Defa	Meaning/Remarks
	1000 hander 11	(78 hander storeture		gen	uits	AT COR handles cloutbox
	And in the second second	AARE NO ID	1000	1.6	0	
Senaine	amf port	AMF port number	usine 1	2	0	
channel	enb io	aNB signaling plane IP	week?	15	0	
	anb port	aNB port number	uint	2	0	
	amf us ngap id	AMF UE NGAP ID	uinté		0	R15.6 has been modified to 40bit
	ran ue ngap id	RAN UE NGAP ID	ulet	-4	0	
NGAP channel	amf_region_id	AMF Region ID	uinté	1	0	3GPP 24:501-9.11.3.4, fill in the AMF area identifier of 5G-GUTI or 5G-5-TMSI
	amf_set_id	AMF Set ID	uint1	1	0	
	amf pointer	AME Pointer	uinti	1	0	
	mcc	MCC	uint 16	2	-1	
	mnc	MNC	uint	2	4	
	1.00	21.0	10			A second s
User locatio	location_type	Location type	unte	1	0	I doctes the current location type of the UE at the end of the process: 12 NR (inflocation) 22 E-UTRAN (extracocation) 32 E-UTRAN (extracocation)
	ø	Cell ID	the NR Cell ID/E-UTRAN Cell ID where the UE is located at the			
	land	da ede	-			end of the process
	inte	107	1000	16	MORT I	INEL OF THE
	meiada	689	and and	10	PR-01	mehia shasa sumhar
Liser (D)	Se traci	5G-TMD	uler1	4	0	the set of
	don	DNN	strin	3.2	NULL	Access network name
	pdu address vé	POLI Address vě	ulet?	4	0	
	pdu address v6	PDU Address v6	uints	16	0	
	upf ipvi	uplink bearer channel	uint?	4	0	
	upt lipv6		uinti	16	0	
	upf_teid		uint1	-4	0	
	gnb_ipv4	downlink bearer channel	uiet?	4	0	
	gnb_ipv6		uinti	16	0	
OTB-U chang	gnb_teld	The second s	uint	-4	0	
	add_upf_igw4	uplink additional bearer	uset!	4	0	
	add_upf_ipv6		unti	16	0	
	add_upf_teid		Used	4	0	
	and and inte	downink approval bearer	Termine and		0	
	and sub taid			10	0	
		a la gra a secondo	inté			and the second se
	total_time	Total online time	d Inte	8	0	Nanosecond (ns)
	delay_time	Response time	4	1	0	Nanosecond (ns)
	cdr_type	Process type	uinti	1	0	DxL1: POU Session Establishment DxC9: POU Session Modification
Action overv	mig_type	Subtype	uinti	1	а	(M), Volume 1, Adverse
	cdr_result	Process status	unts	1	0	Process results: 1: success; 2: failure; 3: timeout;
	direction	Longinating direction	uints	-	0	3: UR INDIAGED 2: Network Initiated
_	Canada Canad	agen save eg. descrives	area		-	Refer to section 9.11.3.41 of 3GPP 24.501, fill in the effective
	pon_recopy_rg	POU session to	units		0	value 1-15 in decimal format
	ter mode	the num section to	ALC: NO	-	0	1: 557 mode 1 7: 557 mode 2 1: 557 mode 3
	select use mode	Gelerted SSC mode	Laine a		0	1:55C mode 1 2:55C mode 2 3:55C mode 1
details	select_pdu_session_t	PDU session type	uintă	1	0	2: IP44 2: IP46 2: IP466 3: ID4066 3: ID4076 3: ID407676 3: ID407676 3: ID407676 3: ID407676 3: ID407676 3: ID407676 3: ID40767676 3: ID40767676 3: ID4076767676 3: ID4076767676767676767676767676767676767676
	a masai sat	S-NSSAI SST network slice selection auxiliary information	wints	1	0	1-EMBR 2-URILC 3:Mio
	s resai ad	5-NSSAI SD network slice selection auxiliary information		4	0	
			-	_	-	

N2 Handover

	A		c	D	ε	F	0
		2			- 20	N1N2	SGMM_CDR(5401)
2	Overview	Field name	Name	Typ	Leng th	Defa ults	Meaning/Remarks
3		'CDR header'	CDR header structure		44		All COR header structure
4.		and ip	AME N2 IP	uinti	16	0	
5.	Signaling	amf_port	AMF port numb	Unit:	2	0	
6	channel	gnb_ip	gNB signaling pl	uinti	10	0	
7		gnb_port	gNB port numbe		2	0	
		amf ue ngap id	AMF UE NGAP I	uinti	8	0	R15.6 has been modified to 40bit
9		ran ue ngap id	RAN UE NGAP ID	ulet:	4	0	
10	NGAP channel	amf_region_id	AMF Region ID	uinti	1	0	3GPP 24.501-9.11.3.4, fill in the AMF area identifier of 5G-GUTI or 5G-5-TMSI
11		amf set id	AMF Set ID	ulet)	1	0	
12		amf pointer	AMF Pointer	uinti	1	0	
13		mcc	MCC	uint 16	2	-4	
14		mec	MNC	uint 16	2	-1	
15		tac.	TAC	unet	4	0	3 octets
16	User location	location_type	Location type	uinti	1	0	the current location type of the UE at the end of the process: 1: NR (oriocation) 2: E-UTRAN (extraLocation) 3: NSIWF (inglaLocation)
17		d	Cell ID	uinti	8	0	At the end of the process, the NR Cell ID/E-UTRAN Cell ID where the UE is located
18	1	imsi	SUPI	strie	25	NULL	IMSLOT NAI
19	The In	imel	PEI	strin	16	NULL	IMEI or IMEISV
20	Cite in	msisdn	GPSI	strin	24	NULL	mobile phone number
23		5g_tmsi	5G-TMSI	uint	4	0	Global temporary identification
22		total_time	Total online time	intő 4	8	0	Nanosecond (ns)
23		delay_time	Response time	ints 4	8	0	Nanosecond (ns)
24		cdr_type	Process type	wints	1	0	Ov01 Move out 0x02 Move in
25	Action overs	msg_type/handov	Subtype	uinti	1	-4	Migration type eg.intra 5g
26		cdr_result	Process status	uinti	1	0	Process results: 1: success; 2: failure; 3: timeout;
27		direction .	Originating direc	uinti	1	0	1: UE initiated 2: Network initiated
28		target_tac	Peer TAC	pint 1	2	0	
29		target_ci	Peer Cell ID	uint6	8	0	At the end of the process, the NR Cell ID/E-UTRAN Cell ID where the UE is located
30	details	target_location_ty	Opposite locatio	uinti	1	0	the current location type of the UE at the end of the process: 3: NR (vricotation) 2: E-UTRAN (eutralocation) 3: NSTWF (rogalocation)
21		ran node id len	RAN NODE ID Ie	uint	1	0	The bit length of the RAN Node ID.
32		ran_node_id	RAN NODE ID	int1	2	0	RAN Node ID, or the target RAN Node ID when switching out
33		ng_cause	Reason for requi	wints	1	-1	
34		ng cause type	cause type	uint	1	-1	
35							

Signaling Probe output



N11 Signaling

-				-		ATT COMPLETE	
	field come	Rese	Pres.	Leng	Defa	Meaning/Nemarks	
	Trans in the local			. 85	ults	annong ressers	
-	1028 header' (AL	CDR header structure	_	-64	-	All CDR header structure	
						2: North POUSesson Createshi/Context	
						3: Normf POUSession ReleaseSMContext	
						4: Nord_PDUSession_SMContextStatusNotify	
						5: Nort POUSession_Context	
						6: Namf_Communication_N1MessageNotify	
4	offer Type	Process Type	weeks .	1.	4	7: Namf_Communication_N1MessageSubscribe	
						B. Namf_Communication_N1MessageUrSubscribe	
						10 Martin Communication, NUMPring and an anti-	
						13: Nami Communication Elistusianment	
						12: Naml Communication AMPStatusChangefultscribe	
						13: Namf_Communication_AMFStatusDhangeUnSubscribe	
			_	_		14: Naml_Communication_AMFStatusChangeNotify	
						Fill in the value of RequestType or RequestIndication in the North_POUSession request	
						messaga.	
1.1				1.5		When it represents RequestType, the meaning is as follows:	
	repype_411	Smouthbe	4115		1.4	LI INTUAL_REQUEST	
						A DODING POV SEDON	
		0				A EVENAL ENERGING AND ADDRESS	
		100000000000000000000000000000000000000		-	-	Boreas muchs	
•	cdr_result	Process status	wints	- 1	-4	L'success 2 falure 3 other	
				-	-	1/POST	
						2.907	
7	http_req_type	Type of the first HTTP Request m	until .	1	-4	3: 687	
						4: #67CH	
				-	_	5: DELETE	
	http status code	http status code	yett	1	-1	O: status Zos 1: status Ixo/4os/Sox -1: no status response	
						1. REL_DUE_TO_HO	
						2. EPS_FALLBACK	
						A RELIDIATION	
						S SHELLOWERSTON	
						A REL DUE TO REACTIVATION	
	consent cause	Reason for consent	-	1.	1.4	2 NO AN ANT RESPONDED	
	address County	reason in reprin		1.1		A REL DUE TO SUCE NOT ANNUARIE	
						9. NEL DUE TO DUPLICATE SESSION ID	
						10. POU_SESSION_STATUS_MISMATCH	
						11. HO_FAILURE	
						12. INSUFFICIENT_UP_RESOURCES	
				-	_	LE. POU_SESSION_HANDED_OVER	
	failure_cause	Reapon for failure	1000	1.	-1		
	and to alter	AME IP address	-	10	0		
	and to addr	SMP IP address	4008	18	0		
	and port	AMY port number	wei16	1	0		
- 2	Per 201	SW# Dort number	100010	14			
	bas passor a	PEO Selecon ID	1000		1.1	1.15 Yeed verse o in hot amighted	
						In initial second	
	request_type	Request type	urd.	1		To existing PDU session	
					-4	It initial emergency request	
						4: existing emergency POU session	
					L.'	Sc modification request if not, fill in the blank	
				_		PDU Session Type in the request message, value:	
				L		L 1914	
12	of and the	Mary Lensing Turns	1.000	1.00	1.4	2: 1946	
	here assessed the	and register that		1.1	1.4	3: (Pv8x6	
						4: Unstructured	
				-		S: Ethernet if not, fill in the blank	
3	13_42/2015	IP address on the UPF side of the	and -	16	0		
2	n3_601_004	IP address on the UPF side of the	1004132	4	0		
-	rd upf teld	TEO on the UPF side of the N3 in	404132	4	0		
4	ng an ipv8	IP address on the AN side of the	write a	10	0		
4	AL_AD_IDH	ter appress on the AN side of the	wires2	1.4	0		
а.	to an held	rang on the AN side of the N3 in	April 1	4	0	Decision of decision of the standard as	
				E		one verse or senser of in the signaling to	
24	1,7958,385	Snotal off	wett	1	-4	1.1.Mar	
				1		540x7 refer to 29.871 5.4.4 2 and 23.501 5.15.2 2 for the value	
25	a year of	tonial of	weeting.	4	-1	Southant chrome reservations the time Differentiation whose of in chromine	
26	644	Parts network name	aning.	1 12	ALC: N	Chaine Stat of SCRE TS 12 (50)	
- 22	and and	their address of the and same	100013	12	mak	Canada and a server of damage	
-	union lines	the address of the and star	and a second second	1.14	1 a		
24	ACCESS TODA	Access default's hole	Contra Co	1.	14	Annual address have as force to blight ensure to have blight ensure of and, bit to F	
	and a state of the	and a state of the	-		1.4	the current location tune of the LE at the end of the porcess	
		5. S.				It ME Instancement	
-20	location_type	Location type	wints	1	-4	2: E-L/TRAN (eutral ocation)	
		1000000000		1.1		3: M37WF (n3gaLocation)	
21	mos	MCC	une16	2	-4		

GTP

				1.	1.81		•
	Field Name	Name -	Type	1.00	Collect Value	Maning Netse	Scanarie and Source
	1004 Peacer	coll header		44		CDR header structure	and the second second second
	uner in	structure	1018	14		user it compaties with low	derived how Create RCP Context Berginna managers
4	Mar in	STUTIE IF	and a	14	2	shurle #	studie 7 of the 7 layer of \$77 of the request message
1	der_ir	Department of	Pieta .	10		Delthration if	destination in of the integer of string the request message
*	MMULE	SSSN control-plane transmitting if	uist	18		SUN control-plane transmitting #	 to create #DF, derived from 979 body of request message, for update and delate #DF, derived from if layer (anv_(a), del_(b) and 100% if of itrade (art/seaming)
7	401,1,0	DDDV uper-plane transmitting 2	une	18		SSDruse-glane transmitting #	 for create PDP, derived from STP looky of request message. for update and delete PDP judged by the initiator. If the initiator is 550%, the user-plane
		6654		1		acon control giante	If it request manage super, how we use parts if of requires manage super 1 for create 404, denied from STV body of requires manage or dett, is if there a no requires manage.
	Burch	taunitirg #	2013	-		and spin a	 for update and delete KOR, derived from iP layer (sour_jo), derr_jo) and SSSN iP of Prote INFORMATING 1. For create KPA, derived from SPI body of response message
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15		mobile network 0209	uincia	2	0.000	81 OL	(initiated by SGDN), "Supplete FOF comment response. (initiated by SGDN)," and "reside FOF control response"
19		p1043544	- United	÷	-	masage type	Versige type if off, keep in Out, 1079,28040, 16: Oneshfort, Onterchequest 18: Update/Ontortechequest
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14	later	initiation direction	una	÷	1	2. Writebol by the user 2. Writebol by the retruction	Subtracted before PDF message, compare the start μ with spin-C(μ , gam, C(μ , fither large μ , matches with spin μ , μ , the interval in the spin μ method with gpin μ , μ , the interval μ method with gpin μ , μ , the interval μ method with gpin μ , μ method μ method μ . The method μ . The method μ .
18	tear_down	tear down id	uire .	1	-	8: tear down net requested	in the STR of "belies PCP op-text" In the STR field is any valid to believe ADP, 10 in the default value for other signaling types
18	w.	location area	-	1	-	incartan area code	Derived from the ut of 01% of "Owner for context request", "update FOP context request (Initiated by 6000), ", "update FOP context response Contexed by 6000," and "derived context by 6000,", "
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÷	94	router area code	una	1	0.00	router area code	Rected from the Nal of 579 of "Create FOP context request", "update FOP context request", "Sign context request" and "chards the request".
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We have operations in all time zones. Reach us at: <u>support@cubro.com</u>