**3GPP TSG-WG SA2 Meeting #137E e-meeting  *S2-2001899***

**Elbonia, February 24 – 27, 2020 (revision of S2-200xxxx, merged with S2-2002281)**

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| *CR-Form-v12.0* |
| **CHANGE REQUEST** |
|  |
|  | **23.288** | **CR** | **0119** | **rev** |  | **Current version:** | **16.2.0** |  |
|  |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* |
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| ***Proposed change affects:*** | UICC apps |  | ME |  | Radio Access Network |  | Core Network | **X** |

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|  |
| ***Title:***  | Add the definition for Maximum number of results parameter into clause 6.1.3 |
|  |  |
| ***Source to WG:*** | China Mobile, Nokia, Nokia Shanghai Bell |
| ***Source to TSG:*** | SA2 |
|  |  |
| ***Work item code:*** | eNA |  | ***Date:*** | 2020-02-21 |
|  |  |  |  |  |
| ***Category:*** | **F** |  | ***Release:*** | Rel-16 |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)Rel-12 (Release 12)**Rel-13 (Release 13)Rel-14 (Release 14)Rel-15 (Release 15)Rel-16 (Release 16)* |
|  |  |
| ***Reason for change:*** | In TS 23.288, a new parameter i.e. Maximum number of results was introduced, however its definition is not clear.And the parameter also applies to the NF Load analytics, Network Performance analytics, User Data Congestion analytics and QoS Sustainability analytics. |
|  |  |
| ***Summary of change:*** | * Add the definition for Maximum number of results parameter into clause 6.1.3.
* Add the Maximum number of results parameter into the NF Load analytics, Network Performance analytics, User Data Congestion analytics and QoS Sustainability analytics.
* Some others editorial changes.
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|  |  |
| ***Consequences if not approved:*** | The definition of Maximum number of results parameter is not clear. NWDAF may provide more results than expected by the analytics consumer, hence overloading the analytics consumer. |
|  |  |
| ***Clauses affected:*** | 6.1.3, 6.4.1, 6.4.3, 6.5.3, 6.6.3, 6.7.3.1, 6.7.5.3, 6.8.3, 6.9.3 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **X** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** |  | **X** |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  | **X** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

\* \* \* \* First change \* \* \* \*

### 6.1.3 Contents of Analytics Exposure

The consumers of the Nnwdaf\_AnalyticsSubscription or Nnwdaf\_AnalyticsInfo service operations described in clause 7 may provide the following input parameters listed below.

- A list of Analytics ID(s): identifies the requested analytics.

- Analytics Filter Information: indicates the conditions to be fulfilled for reporting Analytics Information. This set of optional parameter types and values enables to select which type of analytics information is requested. Analytics Filter Information are defined in procedures.

- Target of Analytics Reporting: indicates the object(s) for which Analytics information is requested, entities such as specific UEs, a group of UE(s) or any UE (i.e. all UEs).

- (Only for Nnwdaf\_AnalyticsSubscription) A Notification Target Address (+ Notification Correlation ID) as defined in TS 23.502 [3] clause 4.15.1, allowing to correlate notifications received from NWDAF with this subscription.

- Analytics Reporting Information with the following parameters:

- (Only for Nnwdaf\_AnalyticsSubscription) Analytics Reporting Parameters as per Event Reporting parameters defined in Table 4.15.1-1, TS 23.502 [3];

- (Only for Nnwdaf\_AnalyticsSubscription) Reporting Thresholds, which indicate conditions on the level of each requested analytics that when reached shall be notified by the NWDAF;

- Analytics target period: time interval [start..end], either in the past (both start time and end time in the past) or in the future (both start time and end time in the future). An Analytics target period in the past is a request or subscription for statistics. An Analytics target period in the future is a request or subscription for predictions. The time interval is expressed with actual start time and actual end time (e.g. via UTC time). When the Analytics Reporting Parameters indicate a periodic reporting mode, the time interval can also be expressed as positive or negative offsets to the reporting time. By setting start time and end time to the same value, the consumer of the analytics can request analytics or subscribe to analytics for a specific time rather than for a time interval.

- Preferred level of accuracy of the analytics (e.g. Low/High).

- (Only for Nnwdaf\_AnalyticsInfo\_Request) Time when analytics information is needed (if applicable). If the time is reached the consumer does not need to wait for the analytics information any longer, yet the NWDAF may send an error response to the consumer.

- Maximum number of results to limit the number of analytics per Nnwdaf\_AnalyticsSubscription\_Notify or Nnwdaf\_AnalyticsInfo\_Request response.

NOTE: The feasibility of the parameter "Time when analytics are needed" will be checked by stage 3.

The NWDAF provides to the consumer of the Nnwdaf\_AnalyticsSubscription or Nnwdaf\_AnalyticsInfo service operations described in clause 7, the output information listed below:

- (Only for Nnwdaf\_AnalyticsSubscription) The Notification Correlation Information.

- For each Analytics ID the analytics information in the requested Analytics target period.

- In addition, the following additional information:

- Timestamp of analytics generation, which allows consumers to decide until when the received information shall be used. For instance, an NF can deem a received notification from NWDAF for a given feedback as invalid based on this timestamp;

- Validity period, which defines the time period for which the analytics information is valid.

- Probability assertion: level of certainty, confidence in statistics/prediction.

\* \* \* \* Next change (2) \* \* \* \*

### 6.4.1 General

This clause specifies how NWDAF can provide Observed Service Experience (i.e. average observed Service MoS) analytics, in the form of statistics or predictions, to a service consumer.

The Observed Service Experience analytics may provide one or both of the following:

- Service Experience for a Network Slice: Service Experience for UEs (for a UE or a group of or any UE) for a given Application or a set of Applications or any Application (i.e. all Applications) in a Network Slice;

- Service Experience for an Application: Service Experience (i.e. for a UE or a group of UEs or any UE) in an Application.

Therefore, Observed Service experience may be provided individually per UE or group of UEs, or globally, averaged per Application or averaged across a set of Applications on a Network Slice.

The service consumer may be an NF (e.g. PCF), or the OAM.

The consumer of these analytics shall indicate in the request or subscription:

- Analytics Id set to "Service Experience";

- The Target of Analytics Reporting: one or more SUPI(s) or Internal Group Identifier(s), or "any UE";

- Analytics Filter Information as defined in Table 6.4.1-1 and, optionally, maximum number of results;

Table 6.4.1-1: Analytics Filter Information related to the observed service experience

|  |  |
| --- | --- |
| Information | Description |
| Application ID (1..n)(NOTE 1) | The identification of the application(s) for which the analytics information is subscribed or requested. |
| S-NSSAI(NOTE 2) | Identifies the Network Slice for which analytics information is subscribed or requested. |
| Area of Interest | Identifies the Area (i.e. set of TAIs), as defined in TS 23.501 [2] where the analytics information is subscribed or requested. |
| Media/application bandwidth | Identifies the Media/application bandwidth requirement of the application. |
| DNN | DNN to access the application. |
| DNAI | Identifier of a user plane access to one or more DN(s) where applications are deployed as defined in TS 23.501 [2] |
| NOTE 1: If no Application ID is provided, the Analytics Filter information applies to any application (i.e. all applications) in the Network Slice.NOTE 2: The S-NSSAI is mandatory if the NWDAF Service Consumer subscribes or requests the Service Experience in a Network Slice. |

- An Analytics target period that indicates the time window for which the statistics or predictions are requested;

- In a subscription, the Notification Correlation Id and the Notification Target Address.

The NWDAF shall notify the result of the analytics to the consumer as specified in clause 6.4.3.

NWDAF collects the network data from AF (directly or via NEF) and from other 5GC NF(s) in order to calculate and provides statistics and predictions on the observed service experience to a consumer NF or to OAM.

\* \* \* \* Next change (3) \* \* \* \*

### 6.4.3 Output Analytics

The NWDAF services as defined in the clause 7.2 and 7.3 are used to expose the analytics.

- Service Experience statistics information is defined in Table 6.4.3-1.

- Service Experience predictions information is defined in Table 6.4.3-2.

Table 6.4.3-1: Service Experience statistics

|  |  |
| --- | --- |
| Information | Description |
| S-NSSAI | Identifies the Network Slice for which analytics information is provided. |
| ServiceExperience (1..max) | List of observed service experience information for each Application. |
| > Application ID | Identification of the application. |
| > Service Experience Type | Type of Service Experience analytics, e.g. on voice, video, other. |
| > Service Experience | Service Experience over the Analytics target period (average, variance). |
| > SUPI list (1..max) | List of SUPI(s) for each application, applicable only to detailed Service Experience. |
| > Ratio | Estimated percentage of UEs with similar service experience (in the group, or among all UEs). |
| > Spatial validity | Area where the estimated Service Experience applies.If Area of Interest information was provided in the request or subscription, spatial validity may be a subset of the requested Area of Interest. |
| > Validity period | Validity period as defined in clause 6.1.3. |
| Slice service experience | Service experience across applications on a Network Slice over the Analytics target period (average, variance). |

Table 6.4.3-2: Service Experience predictions

|  |  |
| --- | --- |
| Information | Description |
| S-NSSAI | Identifies the Network Slice for which analytics information is provided. |
| ServiceExperience (1..max) | List of predicted service experience information for each Application. |
| > Application ID | Identification of the application. |
| > Service Experience Type | Type of Service Experience analytics, e.g. on voice, video, other. |
| > Service Experience | Service Experience over the Analytics target period (average, variance). |
| > SUPI list (1..max) | List of SUPI(s) for each application, applicable only to detailed Service Experience. |
| > Ratio | Estimated percentage of UEs with similar service experience (in the group, or among all UEs). |
| > Spatial validity | Area, where the estimated Service Experience applies.If Area of Interest information was provided in the request or subscription, spatial validity may be a subset of the requested Areas of Interest. |
| > Validity period | Validity period as defined in clause 6.1.3. |
| > Probability assertion | Confidence of this prediction. |
| Slice service experience | Service experience across applications on a Network Slice over the Analytics target period (average, variance). |

The number of Service Experiences and SUPIs is limited by the maximum number of results provided as input parameter.

\* \* \* \* Next change (4)\* \* \* \*

### 6.5.3 Output analytics

The NWDAF services as defined in the clause 7.2 and 7.3 are used to expose the analytics. NF load statistics information are defined in Table 6.5.3-1. NF load predictions information are defined in Table 6.5.3-2.

Table 6.5.3-1: NF load statistics

|  |  |
| --- | --- |
| Information | Description |
| List of resource status (1..max) | List of observed load information for each NF instance along with the corresponding NF id / NF Set ID (as applicable) |
| > NF type | Type of the NF instance |
| > NF instance ID | Identification of the NF instance |
| > NF status | The availability status of the NF on the Analytics target period, expressed as a percentage of time per status value (registered, suspended, undiscoverable) |
| > NF resource usage | The average usage of assigned resources (CPU, memory, disk) |
| > NF load | The average load of the NF instance over the Analytics target period  |
| > NF peak load (optional) | The maximum load of the NF instance over the Analytics target period |

Table 6.5.3-2: NF load predictions

|  |  |
| --- | --- |
| Information | Description |
| List of resource status (1..max) | List of predicted load information for each NF instance along with the corresponding NF id / NF Set ID (as applicable) |
| > NF type | Type of the NF instance |
| > NF instance ID | Identification of the NF instance |
| > NF status | The availability status of the NF on the Analytics target period, expressed as a percentage of time per status value (registered, suspended, undiscoverable) |
| > NF resource usage | The average usage of assigned resources (CPU, memory, disk)  |
| > NF load | The average load of the NF instance over the Analytics target period  |
| > NF peak load (optional) | The maximum load of the NF instance over the Analytics target period |
| > Confidence | Confidence of this prediction |

NOTE: The variations on per-instance NF load and resource usage could be influenced by the number of running NF instances in addition to the load itself.

The predictions are provided with a Validity Period, as defined in clause 6.1.3.

The number of resource status is limited by the maximum number of results provided as input parameter.

\* \* \* \* Next change (5)\* \* \* \*

### 6.6.3 Output Analytics

The NWDAF shall be able to provide both statistics and predictions on Network Performance.

Network performance statistics are defined in Table 6.6.3-1.

Table 6.6.3-1: Network performance statistics

|  |  |
| --- | --- |
| Information | Description |
| List of network performance information (1..max) | Observed statistics during the Analytics target period |
| > Area subset | TA or Cell ID within the requested area of interest |
| > gNB status information | Ratio of gNBs that have been up and running during the entire Analytics target period in the area subset |
| > gNB resource usage | Average usage of assigned resources (CPU, memory, disk) |
| > Number of UEs | Number of UEs observed in the area subset |
| > Communication performance | Ratio of successful setup of PDU Sessions |
| > Mobility performance | Ratio of successful handover |

Network performance predictions are defined in Table 6.6.3-2.

Table 6.6.3-2: Network performance predictions

|  |  |
| --- | --- |
| Information | Description |
| List of network performance information (1..max) | Predicted analytics during the Analytics target period |
| > Area subset | TA or Cell ID within the requested area |
| > gNB status information | Ratio of gNBs that will be up and running during the entire Analytics target period in the area subset |
| > gNB resource usage | Usage of assigned resources (CPU, memory, disk) (average, peak) |
| > Number of UEs | Number of UEs predicted in the area subset |
| > Communication performance | Ratio of successful setup of PDU Sessions |
| > Mobility performance | Ratio of successful handover |
| > Confidence | Confidence of this prediction |

NOTE 1: The predictions are provided with a Validity Period, as defined in clause 6.1.3.

NOTE 2: The analytics on number of UEs are related to the information retrieved from the AMFs.

The number of network performance information entries is limited by the maximum number of results provided as input parameter.

The NWDAF provides Network Performance Analytics to a consumer that includes the load in the area of interest and the number of UEs located in the area of interest or both at the time requested by the consumer in the Analytics target period:

- Analytics ID set to "Network Performance".

- Notification Target Address including the address of the consumer.

- Notification Correlation Id, for the consumer to correlate notifications from NWDAF if subscription applies.

- Analytics specific parameters including the load in the Area of Interest and the number of UEs in the Area of Interest, at the time indicated in the Analytics target period**.**

\* \* \* \* Next change (6) \* \* \* \*

#### 6.7.3.1 General

In order to support some optimized operations, e.g. customized mobility management, traffic routing handling, or QoS improvement, in 5GS, an NWDAF may perform data analytics on UE communication pattern and user plane traffic, and provide the analytics results (i.e. UE communication statistics or prediction) to NFs in the 5GC.

An NWDAF supporting UE Communication Analytics collects per-application communication description from AFs. If consumer NF provides an Application ID, the NWDAF only considers the data from AF, SMF and UPF that corresponds to this application ID.

The consumer of these analytics may indicate in the request:

- The Target of Analytics Reporting which is a single UE or a group of UEs.

- Analytics Filter Information including S-NSSAI, DNN and optional maximum number of results.

- An Analytics target period indicates the time period over which the statistics or predictions are requested.

- Preferred level of accuracy of the analytics (low/high).

\* \* \* \* Next change (7) \* \* \* \*

#### 6.7.5.3 Output Analytics

The NWDAF services as defined in the clauses 7.2 and 7.3 are invoked to notify consumer NFs. A new Analytics ID named "Abnormal behaviour" is defined.

Corresponding to the Analytics ID, the analytics result provided by the NWDAF is defined in Table 6.7.5.3-1 and Table 6.7.5.3-2. When the level of an exception trespasses above or below the threshold, the NWDAF shall notify the consumer of the exception with an appropriate exception ID if the exception has an identity within the list of exception IDs indicated by the consumer or matches the expected analytics type indicated by the consumer. The NWDAF shall provide the Exception Level and determine which of the other information elements to provide, depending on the observed exception.

Abnormal behaviour statistics information is defined in Table 6.7.5.3-1.

Table 6.7.5.3-1: Abnormal behaviour statistics

|  |  |
| --- | --- |
| Information | Description |
| Exceptions (1..max) | List of observed exceptions |
|  > Exception ID | The risk detected by NWDAF |
|  > Exception Level | Measured level, compared to the threshold |
|  > Exception trend | Measured trend (up/down/unknown/stable) |
|  > UE characteristics | Internal Group Identifier, TAC |
|  > SUPI list (1..max) | SUPI(s) of the UE(s) affected with the Exception |
|  > Ratio | Estimated percentage of UEs affected by the Exception within the Target of Analytics Reporting |
|  > Amount | Estimated number of UEs affected by the Exception (applicable when the Target of Analytics Reporting = "any UE") |
|  > Additional measurement | Specific information for each risk |

Abnormal behaviour predictions information is defined in Table 6.7.5.3-2.

Table 6.7.5.3-2: Abnormal behaviour predictions

|  |  |
| --- | --- |
| Information | Description |
| Exceptions (1..max) | List of predicted exceptions |
|  > Exception ID | The risk detected by NWDAF |
|  > Exception Level | Measured level, compared to the threshold |
|  > Exception trend | Measured trend (up/down/unknown/stable) |
|  > UE characteristics | Internal Group Identifier, TAC |
|  > SUPI list (1..max) | SUPI(s) of the UE(s) affected with the Exception |
|  > Ratio | Estimated percentage of UEs affected by the Exception within the Target of Analytics Reporting |
|  > Amount | Estimated number of UEs affected by the Exception (applicable when the Target of Analytics Reporting = "any UE") |
|  > Additional measurement | Specific information for each risk |
|  > Confidence | Confidence of this prediction |

The UE characteristics may provide a set of features common to all UEs affected with the exception.

The number of exceptions and the length of the SUPI list shall be lower than the parameter maximum number of results provided as input parameter.

If PCF subscribes notifications on "Abnormal behaviour", the NWDAF shall send the PCF notifications about the risk, which may trigger the PCF to update the AM/SM policies.

The NWDAF also sends the notification directly to the AMF or SMF, if the AMF or SMF subscribes the notification, so that the AMF or SMF may, based on operator local policies defined on a per S-NSSAI or per (DNN,S-NSSAI), take actions for risk solving. The following Table 6.7.5.3-2 gives examples of additional measurement, AM/SM policies and corresponding actions for solving each risk.

Table 6.7.5.3-3: Examples of policies and actions for risk solving

|  |  |  |  |
| --- | --- | --- | --- |
| Exception ID and description | Additional measurement | AM/SM policy | Actions of NFs |
| Unexpected UE location | Unexpected UE location (TA or cells which the UE stays) | Add the area of current UE location into mobility restriction | PCF may extend the Service Area Restrictions. AMF may extend the mobility restriction |
| Unexpected long-live/large rate flows | Unexpected flow template (IP address 5 tuple) | Decrease the MBR for the related QoS flow | SMF updates the QoS rule. PCF, if dynamic PCC applies for corresponding DNN, S-NSSAI, updates PCC Rules that triggers SMF updates the QoS rule. |
| Unexpected wakeup | Time of unexpected wake-up | Apply MM back-off timer to the UE | AMF applies MM back-off timer to the UE |
| Suspicion of DDoS attack | Victim's address (target IP address list) | Release the PDU session and Apply SM back-off timer | PCF may request SMF to release the PDU session.SMF may release the PDU session and applies SM back-off timer |
| Wrong destination address | Wrong destination address (target IP address list) | Update the packet filter of the related QoS flow to block the wrong SDF | PCF updates the packet filter in the PCC Rules that triggers the SMF to update the related QoS flow and configures the UPF |
| Ping-pong UE | Numbers, frequency, time and location, assumptions about the possible circumstances | NWDAF notifies the AMF or AF (Service Provider) | AMF may adjust the UE (e.g. a stationary UE) registration area. |
| Too frequent Service Access/Abnormal traffic volume | Volume, frequency, time, assumptions about the possible circumstances | NWDAF notifies AF (Service Provider) |  |
| Unexpected radio link failures | Numbers, frequency, time and location, assumptions about the possible circumstances | Not applicable | If the unexpected radio link failures are per UE location bases, the AMF may allow the use of CE (Coverage Enhancement) in the affected location. Also, the Operator may improve the coverage conditions in the affected location.If the unexpected radio link failures are per UE bases, then the AMF and/or the AF may allow the use of CE for the affected UE. |
| Ping-ponging across neighbouring cells | Numbers, frequency, time and location information, assumption about the possible circumstances of the ping-ponging | Not applicable | If the amount of ping-ponging across neighbouring cells is above the thresholds set by the service provider, the service provider may adjust and improve the antenna tilts of the neighbouring cells or the overlapping coverage conditions in the affected location. If the ping-ponging are per UE, then the AMF and/or the AF may allow the use of Coverage Enhancement for the affected UE. |

\* \* \* \* Next change (8)\* \* \* \*

### 6.8.3 Output analytics

The NWDAF outputs the user data congestion analytics for transfer over the user plane, for transfer over the control plane, or for both. The output may consist of statistics, predictions, or both. The detailed information provided by the NWDAF is defined in Table 6.8.3-1 for statistics and in Table 6.8.3-2 for predictions.

Table 6.8.3-1: User Data Congestion statistics

|  |  |
| --- | --- |
| Information | Description |
| Area of Interest | A list of TAIs or Cell IDs |
| List of user data congestion Analytics (1..max) |  |
|  >Type | User Plane or Control Plane |
|  >Applicable Time Window | The time period that the analytics applies to |
|  >Network Status Indication | Congestion Level |

Table 6.8.3-2: User Data Congestion predictions

|  |  |
| --- | --- |
| Information | Description |
| Area of Interest | A list of TAIs or Cell IDs |
| List of user data congestion Analytics (1..max) |  |
|  >Type | User Plane or Control Plane |
|  >Applicable Time Window | The time period that the analytics applies to |
|  >Network Status Indication | Congestion Level |
|  > Confidence information | Confidence of this prediction |

The number of user data congestion analytics entries is limited by the maximum number of results provided as input parameter.

\* \* \* \* Next change (9)\* \* \* \*

### 6.9.3 Output analytics

The NWDAF outputs the QoS Sustainability analytics. Depending on the Analytics target period, the output consists of statistics or predictions. The detailed information provided by the NWDAF is defined in Table 6.9.3-1 for statistics and Table 6.9.3-2 for predictions.

Table 6.9.3-1: "QoS Sustainability" statistics

|  |  |
| --- | --- |
| Information | Description |
| List of QoS sustainability Analytics (1..max) |  |
| >Applicable Area | A list of TAIs or Cell IDs within the Location information that the analytics applies to. |
| >Applicable Time Period | The time period within the Analytics target period that the analytics applies to. |
| >Crossed Reporting Threshold(s) | The Reporting Threshold(s) that are met or exceeded by the statistics value or the expected value of the QoS KPI. |

Table 6.9.3-2: "QoS Sustainability" predictions

|  |  |
| --- | --- |
| Information | Description |
| List of QoS sustainability Analytics (1..max) |  |
| >Applicable Area | A list of TAIs or Cell IDs within the Location information that the analytics applies to. |
| >Applicable Time Period | The time period within the Analytics target period that the analytics applies to. |
| >Crossed Reporting Threshold(s) | The Reporting Threshold(s) that are met or exceeded by the statistics value or the expected value of the QoS KPI. |
| >Confidence | Confidence of the analytics. |

NOTE 1: The meaning of Confidence is based on the SLA, i.e. the consumer has to understand the meaning of the different values of Confidence.

NOTE 2: The Analytics can contain multiple sets of the above information in case the location information reflected a list of waypoints.

The number of QoS sustainability analytics entries is limited by the maximum number of results provided as input parameter.

\* \* \* \* End of changes \* \* \* \*