Title*: Intelligent Traffic Profiling

from **Source***: China Mobile Research Institute
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input for **Committee***: ENI

Contribution **For***:		
	Decision	X
	Discussion	
	Information	

Submission date*: 2019-06-11

Meeting & Allocation:
Relevant WI(s), or deliverable(s):

Decision/action requested: Please approve

ABSTRACT: *This contribution proposes to start a PoC project on intelligent traffic profiling (iTP).*

1 PoC Project Details

1.1 PoC Project

PoC Number (assigned by ETSI):

PoC Project Name: Intelligent Traffic Profiling (iTP)

PoC Project Host: China Mobile Research Institute

Short Description: this PoC is meant to demonstrate the proposed intelligent traffic profiling mechanisms based on Artificial Intelligence/Machine Learning (AI/ML) algorithms. In particular, these proposed mechanisms are aimed to categorize network traffic into a number of application classes (e.g. videos, games, and VoIP), identify subactions in a specific application (e.g. picture, voice, and red packet in WeChat), and classify unknown applications. In consequence, results on traffic classification, traffic changing pattern or distribution will be provided to support network policy-making processes. Intelligent traffic profiling (iTP) plays a crucial role in network management (e.g. QoS, traffic engineering, etc.).

This PoC is purposed to demonstrate the use case [#2-8: AI enabled network traffic classification] discussed in GS ENI 001 [1], to verify the requirements identified in GS ENI 002 [2], and to report on suitability of ENI Reference Architecture described in GS ENI 005 [3] for this PoC.

1.2 PoC Team Members

Table 1.1

	Organization name	ISG ENI participant (yes/no)	Contact (Email)	PoC Point of Contact (see note 1)	Role (see note 2)	PoC Components
1	China Mobile Research Institute	Yes	Tao Sun (suntao@chinamobile.com) Weiyuan Li (liweiyuan@chinamobile.com)	X	Service Provider	-Storyline/ Implementation of the baseline architecture -Design of the traffic profiling algorithm -Implementation of the specific algorithms -Testbed logistic and setup
2	Huawei	Yes	Xinyu Hu (huxinyu@huawei.com) Xiaoyun Si (sixiaoyun@huawei.com) Yali Wang (wangyali@huawei.com) Shucheng Liu (liushucheng@huawei.com)		Manufacturer	-Design of the traffic profiling algorithm -Help with the architecture design, implementation of algorithm, testbed setup and discussion about intelligent solution
3	Intel	Yes	Tong Zhang (tong2.zhang@intel.com)		Manufacturer	-Help with hardware infrastructure setup and acceleration libraries -Help with testing and benchmarking -Provide hardware and software optimization to achieve real-time performance

4	Tsinghua University	Yes	Dan Li (tolidan@tsinghua.edu.cn)		University	-Design of the traffic profiling algorithm

NOTE 1: Identify the PoC Point of Contact with an X.
NOTE 2: The Role will be network operator/service provider, infrastructure provider, application provider or other as given in the Definitions of ETSI Classes of membership.

All the PoC Team members listed above declare that the information in this proposal is conformant to their plans at this date and commit to inform ETSI timely in case of changes in the PoC Team, scope or timeline.

1.3 PoC Project Scope

1.3.1 PoC Goals

This PoC will demonstrate the use case [#2-8: AI enabled network traffic classification]. In particular, the proposed mechanism is compliant with its initial context configuration, triggering conditions, operational flow, and post-conditions, as defined in GS ENI 001.

This PoC will demonstrate various requirements that are identified in GS ENI 002, including General requirements, Service orchestration and management, Data collection and analysis, Data learning, model training and iterative optimization, etc.

This PoC intends to test and validate functional blocks of ENI Reference Architecture that are identified in GS ENI 005 and report on the suitability of ENI Reference Architecture.

This PoC aims to verify the feasibility and the benefits of the use of AI/ML for network traffic classification, including the encrypted traffic, and demonstrate in a testbed environment that how ENI system can support intelligent traffic profiling and mechanism generalization. The detailed goals include:

- **PoC Project Goal #1: Traffic Categorization**. Demonstrate the use of ML algorithms to be able to categorize the network traffic into a number of application classes, e.g. video, games, VoIP and so on.
- **PoC Project Goal #2: Identification of Application Subactions**. Demonstrate the use of ML algorithms to be able to identify various subactions in a specific application, e.g. picture, voice, red packet, etc. in WeChat.

1.3.2 PoC Topics

PoC Topics identified in this clause need to be taken for the PoC Topic List identified by ISG ENI and publicly available. PoC Teams addressing these topics commit to submit the expected contributions in a timely manner.

Table 1.2

PoC Topic Description	Related WI	Expected Contribution(s)	Target Date
Network Operations -> AI enabled network traffic classification	ENI-005, (GS ENI 005 Architecture) -Early draft ENI-007 GS ENI 002 Requirements) -Early draft ENI-008 (GS ENI 001 Use Cases) -Early draft	1. Framework for intelligent traffic profiling. 2. Functional blocks for this PoC. 3. The feasibility of network traffic classification using AI/ML algorithms. 4. Report on the suitability of ENI Reference Architecture for this PoC.	01/07/2020

1.4 PoC Project Stages/Milestones

Table 1.4

PoC Milestone	Stages/Milestone description	Target Date	Additional Info
P.S	PoC Project Submission	07/2019	
P.TP.1	PoC User Story finalization	08/2019	Finalization of the high-level description of the two scenarios described In Section 2.
P.TP.1	PoC Test Plan 1	09/2019	Initial algorithm testbed up and running.
P.D1	PoC Demo 1 for PoC Project Goal #1	>12/2019	Webinar demo at an ENI plenary meeting.
P.D2	PoC Demo 2 for PoC Project Goal #2	>04/2020	Webinar demo at an ENI plenary meeting.
P.C1	PoC Expected Contribution 1	TBD	Contributions to ENI requirements.
P.C2	PoC Expected Contribution 2	TBD	Contributions to ENI reference architecture.
P.R	PoC Report	06/2020	PoC-Project-End Feedback
P.E	PoC Project End	07/2020	presented to ISG ENI for information

1.5 Additional Details

The dates for the demos are tentative and will be confirmed. More demos may be provided, if the PoC team finds the right venue.

2 PoC Technical Details

2.1 PoC Overview

With the rapid growth of network traffic, traffic profiling, including traffic identification and analysis, is becoming increasingly important. Based on accurate traffic identification and analysis results, network operators can build traffic profiles and perform essential network management. Indeed, traffic profiling is required in many fields, such as network security, traffic engineering, Quality of Service (QoS), etc.

Recently, there are various traffic identification methodologies, e.g. port-based, deep packet inspection (DPI)-based, statistics-based techniques, etc. As more and more applications use random or non-standard ports and a large amount of Internet traffic is encapsulated in encrypted ways, port-based and DPI-based techniques are ineffective. As a result, a statistic-based technique using AI/ML algorithms becomes the main trend of encrypted traffic classification. AI/ML algorithms can benefit to automatic feature extraction, automatic update of feature library, generalization, etc. Thanks to iTP, service providers can continue to ensure service quality, manage resource utilization, optimize traffic, while protecting user privacy, reducing the cost of labour and remaining largely unaffected by encryption.

This PoC is proposed to demonstrate the feasibility of statistic-based traffic profiling using AI/ML algorithms. As shown in Fig.1, this PoC consists of two scenarios.

- The first scenario demonstrates that the AI/ML-based technique enables network traffic to be categorized into classes of application types, e.g. videos, VoIP, games, etc.
- The second scenario shows that traffic flows generated by a specific application can be classified into classes of subactions types, e.g. picture, voice, and red packet in WeChat, etc.

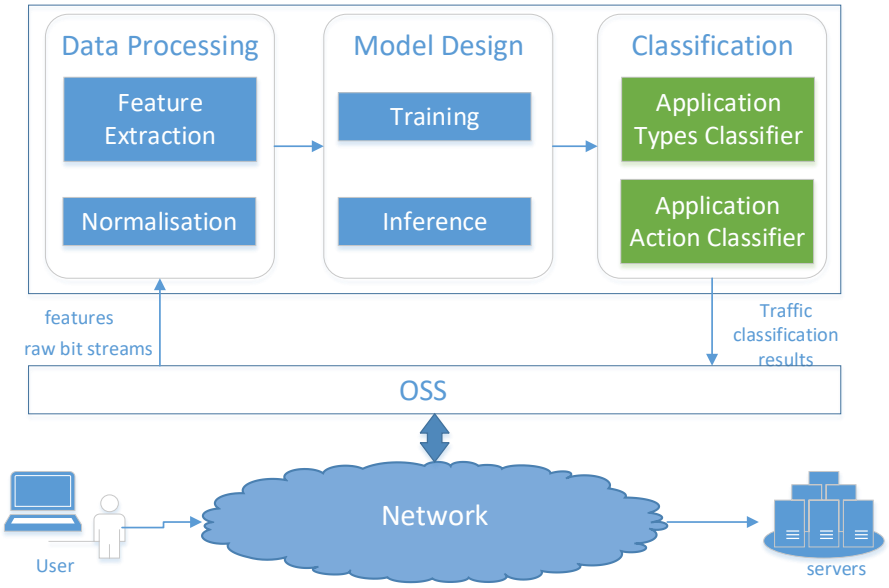

Figure 1: Scenarios of this PoC

2.2 PoC Architecture

The diagram below shows the framework of the PoC mapping to the ENI reference architecture.

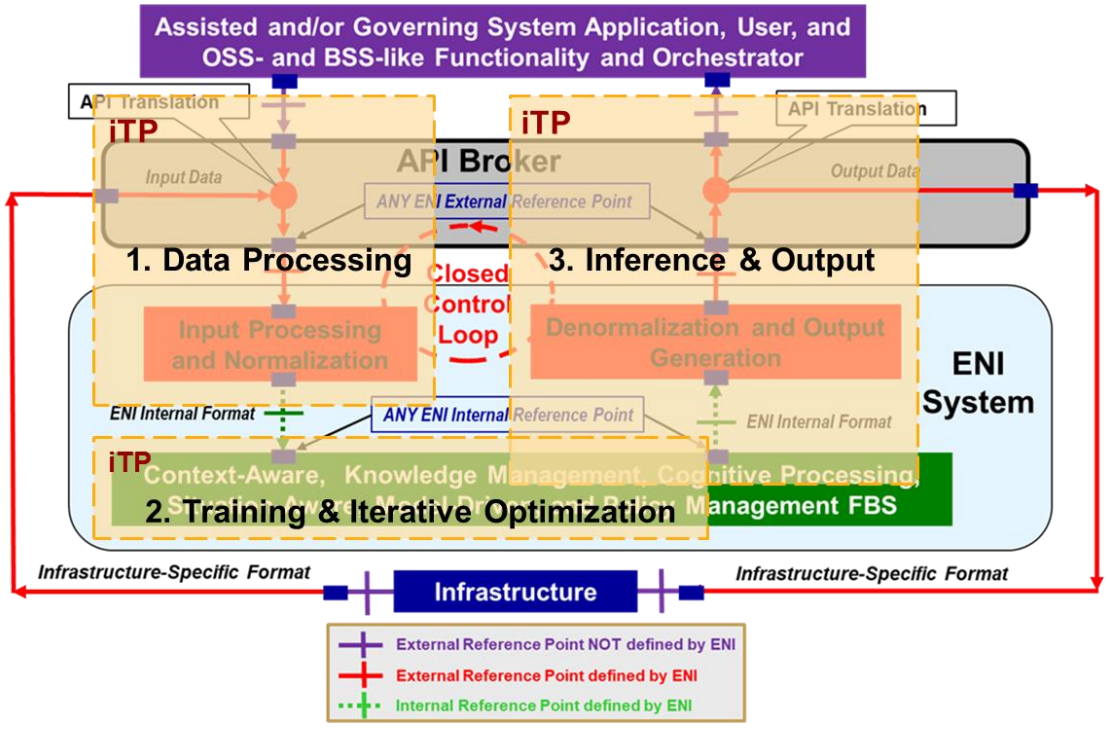

Figure 2: PoC architecture mapped to ENI reference.

In order to achieve these two scenarios, the framework of iTP consists of three stages:

1. The first stage is Data Processing, which maps to Data Ingestion and Data Normalisation functional blocks (FBs) of the ENI system. In this stage, the raw bit streams and features (e.g. port, packet length, inter-packet arrival time, session time, etc.) are collected from network infrastructure controlled by Operations Support System (OSS). Eventually, these data are transformed into a common format using statistic feature extraction algorithms and normalisation algorithms so as to be further processed by other FBs.

2. The second stage is Model Training and Iterative Optimization, which maps to Cognition Framework, Knowledge Management and Context-Aware Management FBs of the ENI system. In this stage, training datasets are fed into machine learning algorithms (e.g. Random Forests, Convolution Neural Network, and Recurrent Neural Network) to generate an iTP model. Meanwhile, adjustment of the model's hyperparameters to obtain the optimal accuracy and re-training of the model are performed periodically to adapt to unknown traffic.
3. The third stage is Inference and Output, which maps to Knowledge Management, Denormalisation and Output Generation FBs of the ENI system. In this stage, pre-processed data and the well-trained modules are implemented to categorize traffic into various classes of application types and subactions in a specified application. Finally, classification results sever as the guideline for OSS.

Based on the above stages, iTP provides a solution which can be applied to unknown traffic profiling tasks, including how to extract features, how to design models, etc.

2.3 PoC Success Criteria

All goals are met when the described functionality is proved to be available.

References

[1] RGS/ENI-008 (GS ENI 001), "Experiential Networked Intelligence (ENI); ENI use cases", v2.0.8 (early draft), Sec 5.3.8.
[2] RGS/ENI-007 (GS ENI 002), "Experiential Networked Intelligence (ENI); ENI requirements", v2.0.4 (early draft).
[3] DGS/ENI-005 (GS ENI 005), "Experiential Networked Intelligence (ENI); System Architecture", v0.0.22 (early draft).