



Trust in Autonomous Networks

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Self-Introduction





Xiaojia SONG

- Affiliation: China Mobile
- Title: Researcher
- FG-AN work: co-chair of WG2, mainly focus on 'trust' topic
- Standard experience:
 - ITU-T SG13, SG16 delegate
 - ISO/IEC JTC1 delegate
 - Other SDO: IEEE SA, 3GPP, CCSA, etc
 - Domain: Autonomous Networks, Intelligent

Technologies in Network, AI, etc



Trust in Autonomous Networks (TiAN) General Information Introduction **Concepts and Basic Principles** Workflow Model of trusted AN **TiAN Evaluation and Quantization Future Plan**



General Information



- "Trust in Autonomous Networks" was dicussed and initiated as a draft Deliverable in FG-AN since February of 2021.
 - 1st stage of work (2021.02-2021.11): conpcepts, basic principles, workflow model for trusted AN and typical UCs.
 - ITU-T TR-trust-an-cpr (Q16/SG13): "Concepts and principles of trust for autonomous networks including IMT-2020 and beyond", since 2021-11.
 - 2nd stage of work (2021.11-2022.10): trustworthiness evaluation for AN, including metrics, sub-metric, evaluation methodology, general quantitative calculations, quantitative ways discussion.
 - New WI tranferring to Q16/SG13: some proposals are already handed over to SG13 to start further study and discussion as WI in Question16 of SG13.

Introduction



• Background:

Autonomous Network (AN)

For IMT-2020 and beyond, with the development of network systems and evolution of AI technology applications, operators are supposed to gradually handover their work and duties to network systems themselves which have self-X properties (the abilities to monitor, operate, recover, heal, protect, optimize, and reconfigure themselves).

Trust topic for AN

As decision-making behavior, trust is affected by past experience and associated predictions for the future. The study of trust in automated systems has been a topic of psychological study previously.

Necessities:

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- Should an operator trust the AN? How to make human operator trust AN, and willing to hand over the control authority of the network to the AN system?
- How much can human operators trust their AN?
- What are the most important factors for AN to earn human operator's trust?
- How to evaluate human operator's trust for AN?

Concepts



- **Trust**: the measurable belief and/or confidence which represents accumulated value from history and the expecting value for future. **[ITU-T Y.3052]**
- **Trusted AN:** the autonomous network which is trustworthy enough (i.e. working correctly as intended), so that the network can be partly or completely autonomous.
- **Trust in AN (TiAN):** a measurable and quantifiable degree of trustor's confidence to some AN to let it be governed by itself with minimal to no human intervention.
- **Trustor in AN**: the one who/which has the authority to authorize a network and/or the relevant entity to be governed by itself with minimal to no human intervention.
- Trustee in AN: a network and/or the relevant entity with autonomy capabilities which is to be authorized to govern itself with minimal to no human intervention.

Intent Authorization Order Trustor in AN Explanation Executive result Feedback

** Reference: ITU-T TR-trust-an-cpr in Q16/SG13.

Basic Principles



- Accountability: requires AN and its provider(s) or vendor(s) to explain, justify and take responsibility for any decisions and actions made by the AN, in the meantime, it is required to be auditable of AN itself throughout the whole life cycle.
- Equitability: requires AN and its provider(s) or vendor(s) to take deliberate steps in the AN life-cycle to avoid intended or unintended bias and unfairness which would inadvertently cause harm, damage or loss.
- **Explanability:** is the ability to describe how AN works, i.e., how AN making decisions and actions. Explanations will be produced regarding both the procedures followed by the AN (i.e., their inputs, methods, models, algorithms and outputs, etc.) and the specific decisions and actions that are made. These explanations are supposed to be accessible to people with varying degrees of expertise and capabilities including the public.
- **Robustness:** refers to the stability, resilience, adaptability, timely, performance, etc of AN system dealing with the changing ecosystem(s). AN will function robustly throughout its life cycle and potential risks are supposed to be continually assessed and managed.
- Safety: of AN is supposed to be tested, assessed and assured across the entire life cycle within an explicit and welldefined domain of usage. In addition, any AN will be designed to also safeguard the data, infrastructures, relevant hardwares and softwares which are impacted.
 ** Reference: ITU-T TR-trust-an-cpr in Q16/SG13.

Workflow model for trusted AN



** Reference: ITU-T TR-trust-an-cpr in Q16/SG13.

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Metrics and Sub-metrics for TiAN evaluation



Metric	Sub-metric		Metric	Sub-metric
Accuracy	Reproducibility		Resilience	Backup
	Precision			Fallback
	Timeliness			Reset
	Validity		Interpretability	Transparency
	Resource			Translatability
Stability	Interruption			Understandability
	Accident			Explanation accuracy
	Maturity			Explanation integrity
	Variability			Explanation integrity
Controllability	Predictability			Explanation reproducibility
	Supervision		Adaptability	Flexibility
	Taken-over			Adjustment

** Reference: ITU-T FG-AN Deliverable, "Trustworthiness evaluation for autonomous networks including IMT-2020 and beyond"

General evluation process and calculation of TiAN

General process of TiAN evaluation Trust in AN Evaluation Accumulate Metric Submetrics Trigger of Evaluation Trustor trust in AN consideration result evaluation Accumulate Sub-Metric metrics

TiAN calculating

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$$\begin{aligned} Value \ of \ Metric_{i} &= \sum_{j=0}^{m} [weight_{j} \times (value \ of \ submetric_{j})], \quad \sum_{j=0}^{m} weight_{j} = 1 \\ TiAN \ value &= \sum_{i=0}^{n} (weight_{i} \times metric_{i}), \quad \sum_{i=0}^{n} weight_{i} = 1 \end{aligned}$$

Quantitative ways for TiAN:

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- Binary
- Coarse-grained
- Fine-grained

** Reference: ITU-T FG-AN Deliverable, "Trustworthiness evaluation for autonomous networks including IMT-2020 and beyond"

Future Plan



- Futher studies of metrics and sub-metrics, especially the evaluation methods.
- Try to trigger TiAN evaluations in commercial environments.
- Futher studies and discussion of scenarios and use cases (UCs).
- Make TiAN evluation(s) more clearly in different scenarios and different UCs, and try to figure out the relevent sub-metrics and metrics in each scenarios or UCs, of course, including relevant TiAN evluation methods.
 - Go on with the standardization and relevant studies of trust topic, include but not limit to, AN, AI,

ML, etc.





THANKS!

