

ICTビジネス戦略オンラインセミナー

「デジュール及びフォーラム標準に関する国際標準化活動調査」

将来の情報通信NWサービスへのAI/ML,MEC 技術の利活用に関する標準化動向の調査

(ITU-T FG-ML5G, ITU-T FG-NET2030, ETSI ISG-MEC)

2021/3/3

Hidenori Inouchi

The University of Tokyo

Agenda

- ITU FG-ML5G
- ITU FG-NET2030
- ETSI ISG MEC
- まとめ

ITU FG-ML5G

(Focus Group on ML for Future NWs including 5G)

ITU Focus Group on ML for Future NWs including 5G

- ・ 2017年11月ITU-T SG13会合にて設立
- ・ 2020/3/17-18第8回遠隔会合, 2020/6/2-3第9回遠隔会合,2020年7月で活動終了
- ・ 2020/12/16-18 ITU AI/ML in 5G Grand Challenge Finale開催でコミュニティ形成

The screenshot shows the ITU website page for the Focus Group on Machine Learning for Future Networks including 5G. The page features a navigation menu with categories like ITU, General Secretariat, Radiocommunication, Standardization, Development, ITU Telecom, Members' Zone, and Join ITU. The main content area includes a search bar, a breadcrumb trail (YOU ARE HERE > HOME > ITU-T > FOCUS GROUPS > ML5G), and a list of documents and specifications. A sidebar on the right contains sections for 'Meetings and Related Event', 'Past meetings and workshops', 'ACCESS THE FG-MLSG COLLABORATION SITE', and 'FG-MLSG MAILING LISTS'. The URL in the browser's address bar is https://www.itu.int/en/itu/telecom.

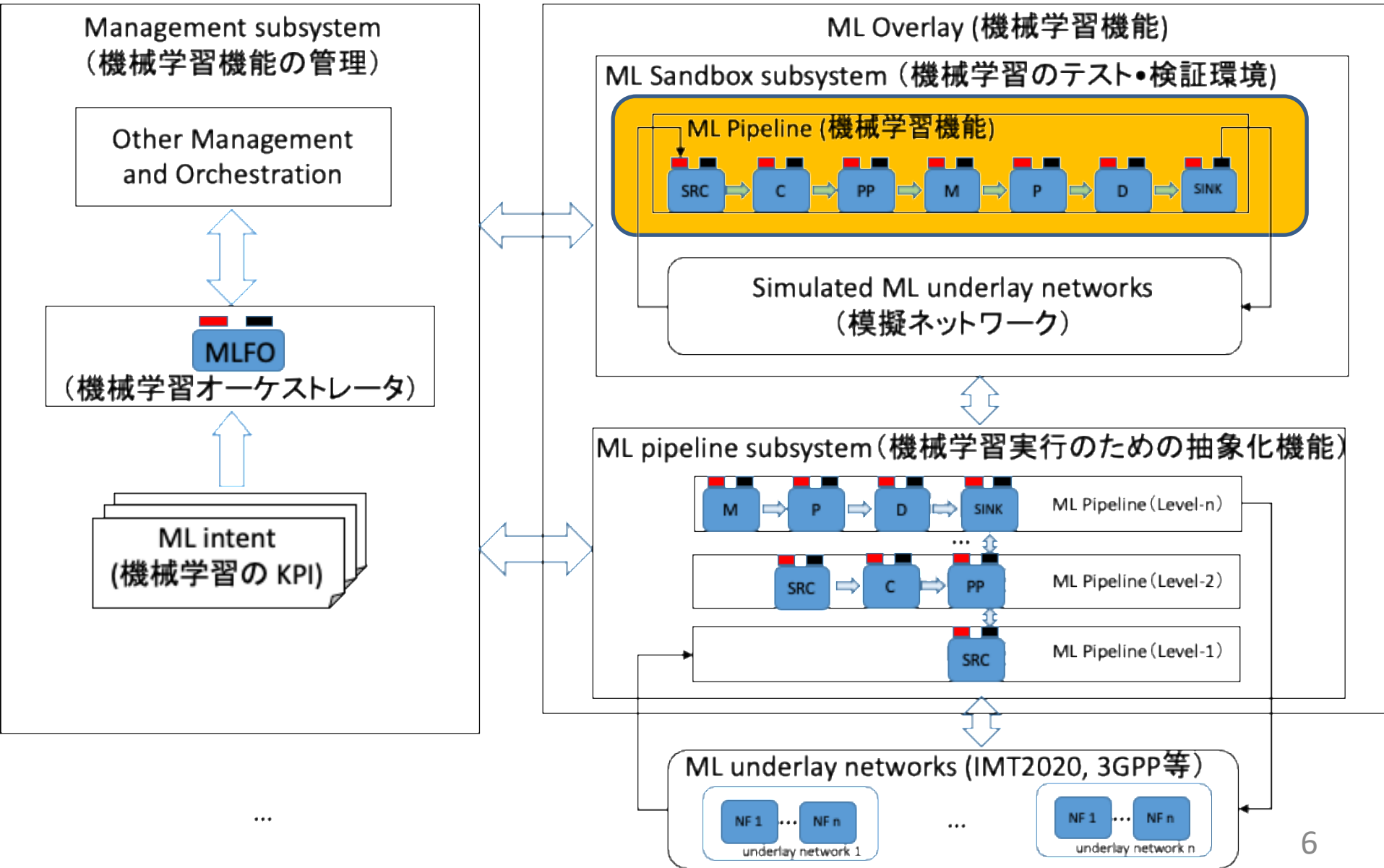
<https://www.itu.int/en/ITU-T/focusgroups/ml5g/Pages/default.aspx>

ITU FG-ML5Gの成果文書

文書分類	進捗状況 (担当WG)
ユースケース	Yシリーズ補助文書Y.55 (Machine learning in future networks including IMT-2020: use cases)として完成[2]. (WG1)
アーキテクチャフレームワーク	Y.3172 (Architectural framework for machine learning in future networks including IMT-2020)として勧告化済み[3]. (WG3)
将来網の知的レベル評価フレームワーク	Y.3173 (Framework for evaluating intelligence levels of future networks including IMT-2020)として勧告化済み[4]. (WG3)
データ処理フレームワーク	Y.3174 (Framework for data handling to enable machine learning in future networks including IMT-2020)として勧告化済み[5]. (WG2)
IMT-2020ネットワーク向けのQoS保証のための機能アーキテクチャ	Y.3175 (Functional architecture of machine learning-based quality of service assurance for the IMT-2020 network)として発行予定[6]. (WG3)
機械学習機能オーケストレータ (MLFO)の要求条件, アーキテクチャ, 設計	入力文書ML5G-0-038 (Requirements, architecture and design for machine learning function orchestrator)はFG-ML5Gで合意済. 今後, ITU-T Q20/13で勧告化予定. (WG3)
機械学習Sandboxの要求条件, アーキテクチャ	入力文書ML5G-0-035 (Machine Learning Sandbox for future networks including IMT-2020: requirement and architecture framework)はFG-ML5Gで合意済. 今後, ITU-T Q20/13で勧告化予定. (WG3)
機械学習済みモデル活用の要求条件, アーキテクチャ	入力文書ML5G-0-036 (Serving framework for ML models in future networks including IMT-2020)はFG-ML5Gで合意済. 今後, ITU-T Q20/13で勧告化予定. (WG3)
機械学習市場	Y.3176 (ML marketplace integration in future networks including IMT-2020)として発行予定[7]. (WG3)

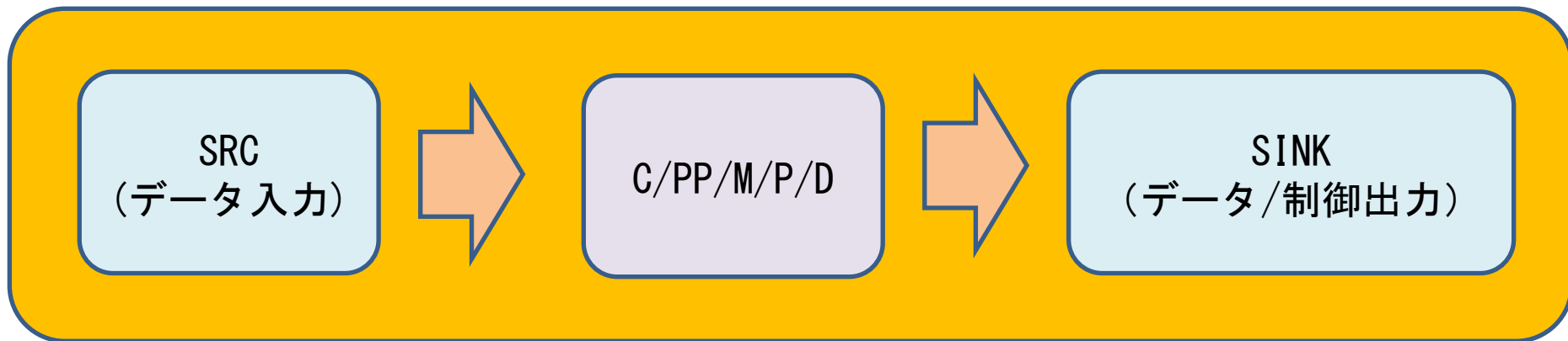
Y.3172

• AI/ML適用ネットワークのアーキテクチャフレームワーク文書



ML Pipeline

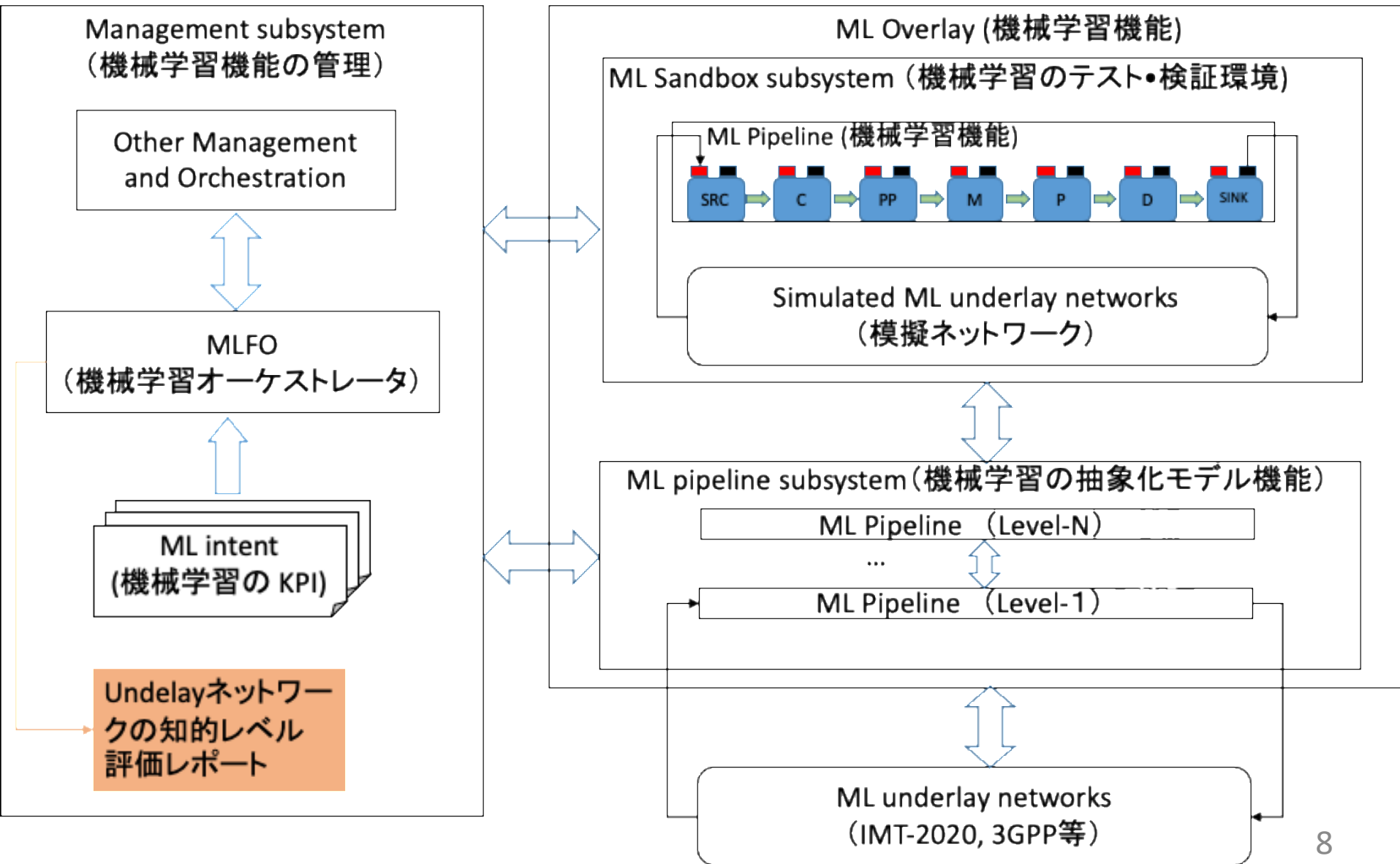
- ITU-T文書でよく使われる用語であるが、一般には馴染みは薄い
- 機械学習プログラムでは、以下のパイプライン処理を順番に行っているのが普通なので特殊なアーキテクチャフレームワークではない



C: Collector	機械学習モデル生成のためのデータ収集
PP: Preprocessor	データの前処理
M: Model	機械学習モデル
P: Policy	データ/制御出力を得るための制御ポリシー
D: Distributor	データ（推定, 予測, RCA）や制御出力の配布

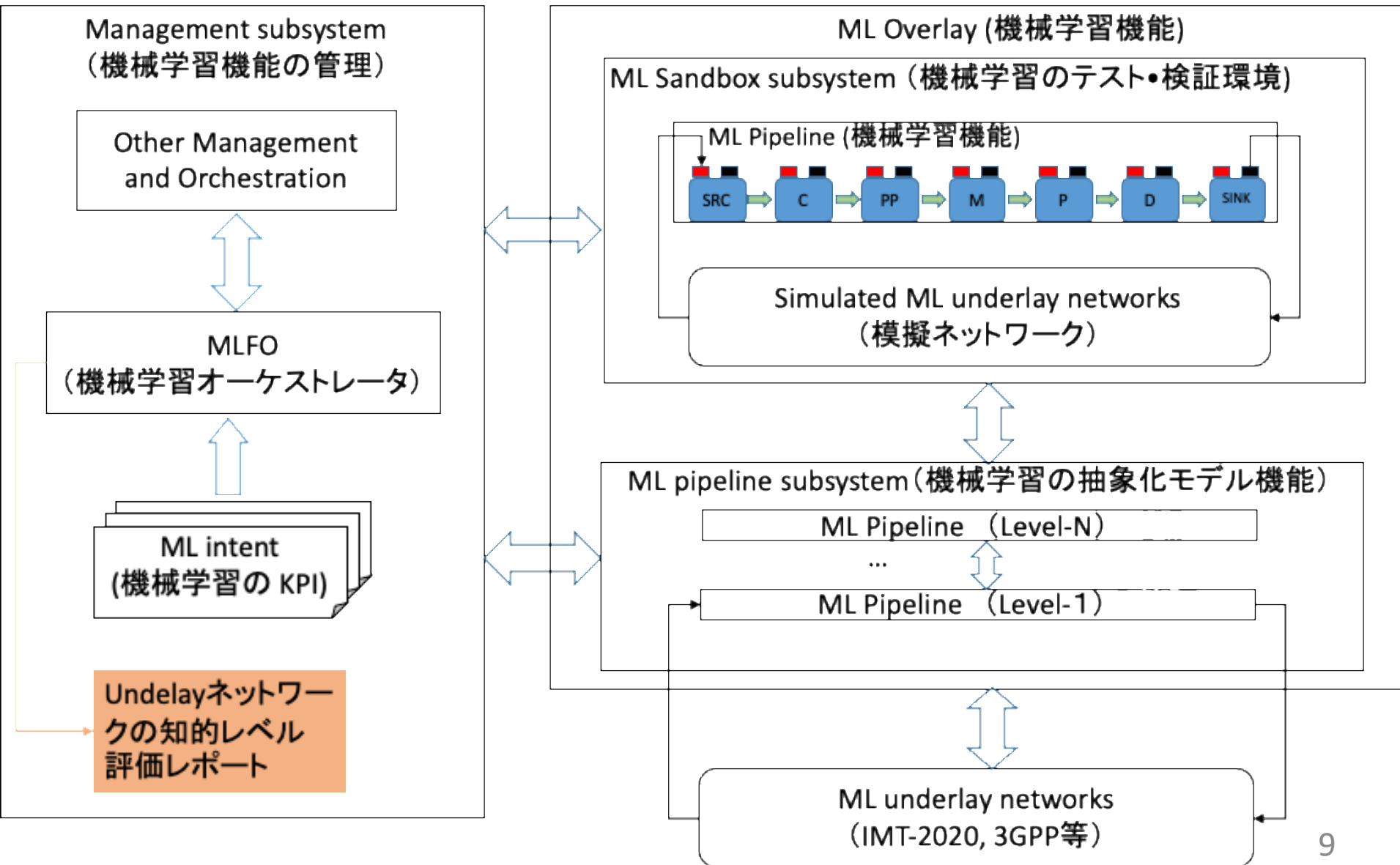
Y.3173

• AI/ML適用ネットワークのインテリジェンスレベル評価フレームワーク文書



Y.3174

• AI/ML適用ネットワークのMLデータハンドリングフレームワーク文書



ITU AI/ML in 5G Challenge

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SUSTAINABLE DEVELOPMENT GOALS

What would you like to search for?

ITU General Secretariat Radiocommunication Standardization Development ITU Telecom Members' Zone Join ITU

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ITU AI/ML in 5G Challenge

YOU ARE HERE HOME > ITU-T > ARTIFICIAL INTELLIGENCE > CHALLENGE > ITU AI/ML GLOBAL CHALLENGE IN 5G

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ITUEvents

ITU AI/ML in 5G Challenge
Applying machine learning in communication networks
ai5gchallenge@itu.int

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Important Dates

- ▶ May/June, 2020: Global Round starts
- ▶ 15 Oct. : Final submission for Global Round
- ▶ 20 Nov. : Announcement of Global Round winners
- ▶ 15-17 December: Final Conference (program)
- ▶ December: ITU AI/ML in 5G Challenge winners Announcement Event
- ▶ Grand Finale in the news!
- ▶ Access our new website

PARTNERSHIPS

ORGANIZED BY

Artificial Intelligence (AI) will be the dominant technology of the future and will impact every corner of society. In

<https://www.itu.int/en/ITU-T/AI/challenge/2020/Pages/default.aspx>

ITU AI/ML in 5G Challengeとは？

デジュール標準と実用化のギャップを埋めるITUでは初の試み

The screenshot shows a Zoom meeting interface. The main content is a presentation slide titled "ITU AI/ML in 5G Grand Challenge Finale" with the subtitle "Applying machine learning in communication networks". The slide's main heading is "Value Creation of ITU Challenge". Below this, it states "The ITU AI/ML in 5G Challenge will:" followed by four bullet points: "❖ Create a **community** in the field of AI/ML", "❖ Innovate and solve network problems with AI/ML" (highlighted with an orange box), "❖ Apply ITU's AI/ML architecture framework in IMT-2020", and "❖ Uncover problems, identify standards gaps, point to solutions". The ITU logo is in the bottom right corner of the slide. The video player shows a timestamp of 01:01:35 / 04:20:32. To the right, the "Audio Transcript" panel is open, showing a search bar and several transcript entries. The entry at 01:01:34 is highlighted in blue and reads: "For the communication industry in this challenge." Other entries include: "01:01:19 Now, what was the idea behind the challenge. One of the idea was vocation. We want to create a community that can have value that can produce an impact in the field of AI and machine learning.", "01:01:39 One of the objective was to solve network related problems using AI, as well as applying the architecture of the ICU, because they", and "01:01:49 The concept of the challenge was after the clothes or when we are about to close the focus book machine for 15 and this focus group produced several specs." A "Resume Transcript Auto-Scroll" button is at the bottom of the transcript panel.

https://itu.zoom.us/rec/play/671aiGNrYXmnK3HDmplODTXtwv7g6phCrmc25Tw46aca7YABr4MZyvmAAb1gW8R2SvaaBp1MBEL8Oyvg.wfTm1PJMpGhdMW8T?continueMode=true&_xzm_rtaid=NaqO3YNkR7-PUNSQAwsHzw.1612187617445.ba54ec117afbb992d7807779726991e3&_xzm_rhtaid=309 (01:01:35)から引用

The Grand Challenge Finale

AI/MLのネットワーク適用事例教材としても有用（無償公開）

【Day 1- Tuesday, 15 December 2020 (Time zone - CET)Video Recording】

https://itu.zoom.us/rec/play/E4SIuF67HnK6ze0tJQa5oG7yC_TC87Dx9b3ELLLNqaPgkRq9-1oVsQY9JuzuFVL22MFRF3IFdPIWA5z1.sJGh0Yjf6-JsvYu5?autoplay=true&startTime=1608116113000

【Day 2 - Wednesday, 16 December 2020 (Time zone - CET)Video Recording】

https://itu.zoom.us/rec/play/z8zfLZnwfCt4PJ88ahpSWdl4Y6_fQg-GrTjfmKGPoaXh_8ibhsdWqyrFhynWB51IRmGahxCw9gtweTX.ba_P2FTto3DSCqS3f?autoplay=true&startTime=1608029982000

【Day 3- Thursday, 17 December 2020 (Time zone - CET)Video Recording】

https://itu.zoom.us/rec/play/671aiGNrYXmnK3HDmpI0DTXtwv7g6phCrmc25Tw46aca7YABr4MZyvmAAb1gW8R2SvaaBp1MBEL80yvg.wfTm1PJmPGhdMW8T?continueMode=true&_x_zm_rtaid=Naq03YNkR7-PUNSQAwsHzw.1612187617445.ba54ec117afbb992d7807779726991e3&_x_zm_rtaid=309

FG-ML5Gの参考文献

- [1] <https://www.itu.int/en/ITU-Y/focusgroups/ml5g>
- [2] <https://www.itu.int/rec/T-REC-Y.Supp55-201910-1/en>
- [3] <https://www.itu.int/rec/T-REC-Y.3172/en>
- [4] <https://www.itu.int/rec/T-REC-Y.3173-202002-1>
- [5] <https://www.itu.int/rec/T-REC-Y.3174-202002-1/en>
- [6] <https://www.itu.int/rec/T-REC-Y.3175-202004-P>
- [7] <https://www.itu.int/rec/T-REC-Y.3176-202009-P>
- [8] 桐葉 佳明, “ITU FG-ML5G会合”, TTC Report 2018, October Vol. 33/No. 3, pp63-67, 2018/10
- [9] 桐葉 佳明, 岡本 康史, “ITU FG-ML5G Meeting -Focus Group on Machine Learning for Future Networks including 5G-”, ITUジャーナルVol48/No. 11, 2018/11
- [10] Ved P. Kafle, 千田 昇一, “ITU FG-ML5G会議報告”, ITUジャーナルVol49/No. 9, 2018/11
- [11] 村上 誠, Ved P. Kafle, “ITU-T Focus Group on Machine Learning for Future Networks including 5G 第7回会合”, ITUジャーナルVol50/No. 2, 2020/2
- [12] ITU AI/ML 5G Challenge, <https://www.itu.int/en/ITU-T/AI/challenge/2020/Pages/default.aspx>
- [13] ITU AI/ML in 5G Challenge Global Round in Japan, <https://www.ieice.org/~rising/jpn/AI-5G/>
- [14] 中尾彰宏, 井内秀則, “情報通信ネットワークサービスへのAI/ML利活用に関する標準化動向”, 電子情報通信学会論文誌和文論文誌B (Vol.J104-B, No.3), pp. 123-128, 2021/31

ITU FG-NET2030

(Focus Group on Technologies for Network 2030)

ITU Focus Group on Technologies for Network 2030

- 2018年7月ITU-T SG13会合にて設立
- 2020/6/15-19 第7回遠隔会合 (5月東大開催予定), 2020年7月で活動終了
- IMT-2020/5Gの先にある2030年代以降のネットワークに焦点

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Focus Group on Technologies for Network 2030

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Automatic Translation: English عربي 中文 Español Français Русский

Focus Group on AI for autonomous and assisted driving

Focus Group on Quantum Information Technology for Networks

Focus Group on Environmental Efficiency for Artificial Intelligence and other Emerging Technologies

Focus Group on Artificial Intelligence for Health

Focus Group on Vehicular

FG NET-2030

"Network 2030: A pointer to the new horizon for the future digital society and networks in the year 2030 and thereafter." – Dr Richard Li, FG NET-2030 chairman

The ITU-T Focus Group Technologies for Network 2030 (FG NET-2030) was established by ITU-T Study Group 13 at its meeting in Geneva, 16-27 July 2018.

The Focus Group, intends to study the capabilities of networks for the year 2030 and beyond, when it is expected to support novel forward-looking scenarios, such as holographic type communications, extremely fast response in critical situations and high-precision communication demands of emerging market verticals. The study aims to answer specific questions on what kinds of network architecture and the enabling

Meetings and Related Event Focus Group News Focus Group Videos

Workshop and 7th meeting of FG NET-2030:
20-22 May 2020, Tokyo, Japan

Hosted by **University of Tokyo**
Address: 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-0033
Meeting Venue:
Daiwa Ubiquitous Computing Research Building

ITU FG-NET2030の現況

• Richard Li (Huawei) 議長

2030年以降のネットワークにおける「ユースケースと要求条件」, 「サービスとテクノロジー」, 「アーキテクチャとインフラ」の標準化に関する報告書の作成

	SG1 Use Cases & Requirements	SG2 Network Services & Technology	SG3 Architecture & Infrastructure
チェア	Mostafa ESSA (Vodafoneエジプト)	Richard Li (ファーウェイ)	David Dai (CICT) Mehmet Toy (ベライゾン)
検討内容	•抽象的な要求条件(帯域、正確な時刻、セキュリティ、AI支援、メーネットワーク、その他の多次元からの要求条件のスコアリングのために二つのユースケースを更新	•成果文書による現状(4G/5G)と2030年のネットワーク技術のギャップ分析に注力	•インターネットプロトコル、ルーティング、セキュリティ、QoS、レジリエンシー、信頼性、ネットワーク管理などの幅広いトピックスについての提案を募集中
主成果	• <i>“Representative use cases and key network requirements for Network 2030”</i> をSG13に送付してSupplement文書として完成予定	•Ms Kiran Makhijani, Futurewei, USAをGAP分析文書のエディタ/ラポータとしてとしてGAP分析文書成果をまとめる予定	•ワークショップでのデモに注力 <i>“Description of Demonstrations for Network 2030 on Sixth ITU Workshop on Network 2030 and Demo Day”</i>

NET2030アーキテクチャフレームワーク

配布不可

NET2030議論のコンテキストと傾向 (UCL)

配布不可

ネットワークサービス観点での NET2030議論のコンテキストと傾向（UCL）

配布不可

ETSI ISG MEC ***(Multi-access Edge Computing)***

MEC: Multi-access Edge Computing

MEC Decode: MEC Deployment and Ecosystem Development

ETSI ISG MEC

- 2014年10月SDN & OpenFlow World Congress (Dusseldorf) にて設立
- 2020/6/2-5の第22回遠隔会合,2020/9/22-25の第23回遠隔会合,2020/12/8-11の第24回遠隔会合に出席

The screenshot shows the ETSI website for Multi-access Edge Computing (MEC). The browser address bar shows [etsi.org](https://www.etsi.org). The page title is "ETSI - Multi-access Edge Computing - Standards for MEC". The navigation menu includes: STANDARDS, TECHNOLOGIES (selected), MEMBERSHIP, COMMITTEES, EVENTS, ABOUT US, IPR, MORE. The main heading is "Multi-access Edge Computing (MEC)". Below the heading, there are tabs for "MEC" and "MEC PoC". The "Introduction" section is visible, with the following text: "Multi-access Edge Computing (MEC) offers application developers and content providers cloud-computing capabilities and an IT service environment at the edge of the network. This environment is characterized by ultra-low latency and high bandwidth as well as real-time access to radio network information that can be leveraged by applications." The "Related Committees" section lists "MEC". The "Related News" section lists two articles: "ETSI Multi-access Edge Computing builds on NFV and network slicing" and "ETSI publishes a white paper on Network Transformation - Building on key technologies for 5G".

<https://www.etsi.org/technologies/multi-access-edge-computing>

先進MNO向けのETSIプロジェクト

ISGの参加者規模と貢献文書数は比例しない:

- MEC (Multi-access Edge Computing) 20名規模
- NFV (Network Functions Virtualization) 200名規模

MEC標準化ターゲットの変化:

- セルラーからエッジクラウドへ
- APIを提供するためにMECアーキテクチャ再構築
(サードPartyにMEC機能をAPIとして提供)
- VMからコンテナへ
- 4Gのみならず5GのAPI提供へ

ETSI MECで実現するサービス

- エンドユーザのメリット：周囲状況の自動確認、クラウドコネクタビリティ等
- MECサービスプロバイダのメリット：エンドユーザのQoS/QoE/SLAモニター



Existential questions of applications “on the edge”

How do I reach my cloud service?

How do I get discovered by my users?

Where am I?

What is around me?

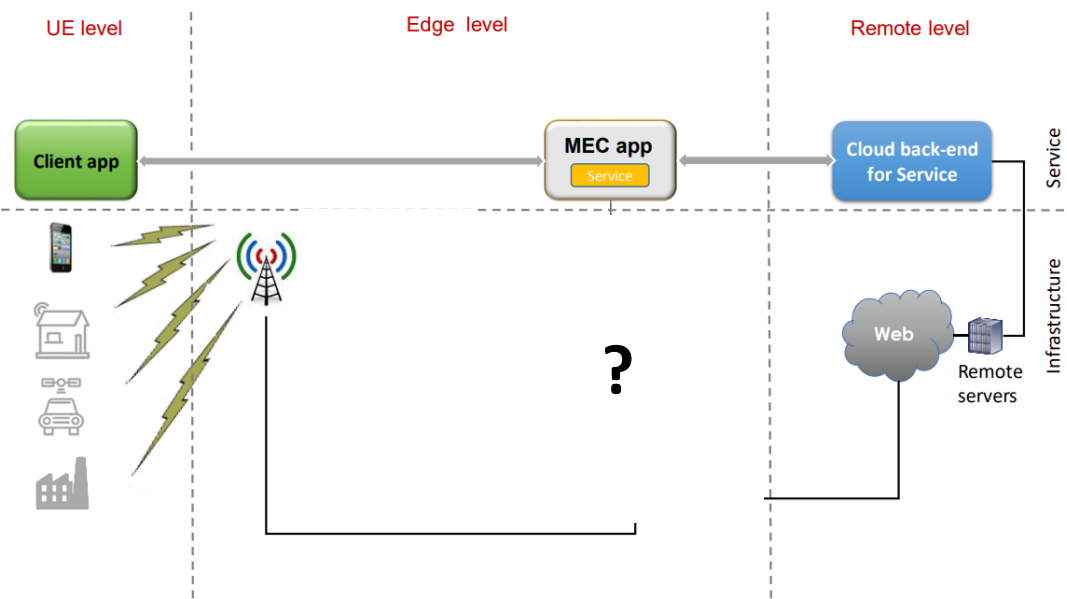


Figure 2: New application development paradigm introduced by MEC.

How am I connected to the users?

What is my QoS?

How many users am I serving? And where are they?

How can I be sure I am running when and where they need me?

What if my users move?

Img Source: https://www.etsi.org/images/files/ETSIWhitePapers/etsi_wp20ed2_MEC_SoftwareDevelopment.pdf

MEC WGの主要ワークアイテム

Work Item	Title (Multi-access Edge Computing (MEC) は省略)
GS MEC 001	<i>Terminology</i>
GS MEC 002	Phase 2: Use Cases and Requirements
GS MEC 003	Framework and Reference Architecture
GS MEC 005	<i>Proof of Concept Framework</i>
GS MEC 009	<i>General principles for Mobile Edge Service APIs</i>
GS MEC 010	<i>Mobile Edge Management; Part 1: System, host and platform management</i>
GS MEC 011	<i>Mobile Edge Platform Application Enablement</i>
GS MEC 012	Radio Network Information API
GS MEC 013	Location API
GS MEC 014	UE Identity API
GS MEC 015	Bandwidth Management API
GS MEC 016	UE application interface
GS MEC 021	Application Mobility Service API
GS MEC 028	WLAN Information API
GS MEC 030	V2X Information Service API
GR MEC 031	MEC 5G Integration *** NSAは MEC 031の検討範囲外***
GS MEC 033	IoT API
GS MEC 035	Inter-MEC systems and MEC-Cloud systems coordination (KDDIが主導中)

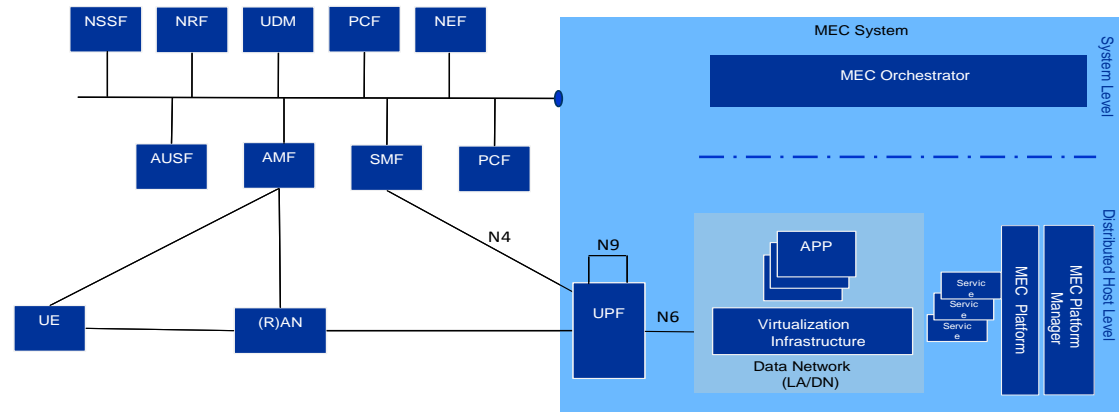
GR MEC 031

- 5Gシステムが提供するMEC機能をエッジコンピューティングEnablerとして活用
- C-PlaneのAF APIを通じて5GCとMECが連携する
- 5GCのみならず、RANとMECも適切に連携する



MEC Phase 2 – Study Item MEC in 5G (MEC 031)

- ✓ The ETSI white paper MEC in 5G networks sets the scene for this study item
- ✓ ISG MEC investigates the opportunities offered to MEC by the 5G system and its edge computing enablers
- ✓ The scope includes the following
 1. C-plane interactions with 5GC,
 2. Functional split between MEC and 5GC wrt. API framework,
 3. Organization of MEC as an AF,
 4. Pertinent interactions of MEC with (R)AN



5GCがAF (Application Function) APIをサポートすることで、初めてMECアプリケーションが動作することに留意する (例: ローカル5Gなどのカスタマイズ可能システム)

- OTT CloudとTelcoのEdgeCloud (MEC)との間で、シームレスなApp Federationに必要なとされる要求条件について日本先導で議論中
- V2Xサービス等の経済化実現が期待される
- 他の標準化組織との棲み分けが必要

MEC White Papers

- 標準は必要に応じて使うツールであってソリューションにあらず
- API標準はシステムの相互互換性を保証する
- 広くユースケースをカバーするが、全部をカバーするわけではない



MEC White Papers: A view of a whole picture

Standards are necessarily tools, not solutions

- ✔ Enable interoperability
- ✔ Support a broad range of use cases and system architecture
- ✔ Address only a specific part of the whole picture

MEC White Papers: how we help industry see the whole picture

- ✔ Harmonizing Standards for Edge Computing: a synergized architecture leveraging ETSI MEC and 3GPP
<https://www.etsi.org/newsroom/news/1806-2020-07-new-etsi-white-paper-harmonizing-standards-for-edge-computing-a-synergized-architecture-leveraging-etsi-3gpp-specifications>
 - ✔ MEC in an Enterprise Setting
https://www.etsi.org/images/files/ETSIWhitePapers/etsi_wp30_MEC_Enterprise_FINAL.pdf
 - ✔ MEC in 5G Networks: http://www.etsi.org/images/files/ETSIWhitePapers/etsi_wp28_mec_in_5G_FINAL.pdf
 - ✔ MEC deployment in 4G and towards 5G:
http://www.etsi.org/images/files/ETSIWhitePapers/etsi_wp24_MEC_deployment_in_4G_5G_FINAL.pdf
 - ✔ CRAN and MEC: A Perfect Pairing:
http://www.etsi.org/images/files/ETSIWhitePapers/etsi_wp23_MEC_and_CRAN_ed1_FINAL.pdf
 - ✔ Developing SW for MEC (2nd Ed.)
https://www.etsi.org/images/files/ETSIWhitePapers/etsi_wp20ed2_MEC_SoftwareDevelopment.pdf
 - ✔ and many more to come!
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まとめ

まとめ

- ITU-T FG-ML5Gの国際標準化活動が、実世界の課題を解決するITUの5G AI/MLコンテストに繋がったことは画期的。**中国が先行しているものの、我が国もキャッチアップできる位置につけており、来年のコンテストも大いに期待する**
- ETSI MECのAPIを使った**ローカル5GアプリケーションがMECエコシステムの主流となる可能性**がある。ETSIがSandBoxやコンフォーマンステストプログラム、APIを公開するなどデジュール標準化組織のあり方が変化している
- ITU FG-NET2030は**FG-AN(Autonomous Networks)に引き継がれ AI/ML研究が加速する動き**を見せており、我が国も積極参加する必要がある

◆ 機械学習(AI/ML)のネットワーク領域(5G and beyond)適用の動向

- ✓ 多様な最適化を実現するネットワークのスマート化
- ✓ サービス設計からNW運用までカバーする広インテリジェント化
- ✓ **ネットワークデータから価値を創造するML/AI基盤**

◆ 技術課題・検討課題の方向性

- ✓ データ収集手法に関するノウハウ蓄積と共有フレームワークの確立
- ✓ AI/ML実装・利活用によるNWアーキテクチャと運用の変革詳細化
- ✓ 5GチャレンジによるAI/ML効果と実現方式の検証
- ✓ **ドメイン知識(Knowledge Plane)との融合によるシステム全体の高度化**
- ✓ **クラウド~MECに跨るアプリケーションコンテキストの共有仕様策定**