SCF FAPI Reference Implementation in OAI

- Opportunities for the Broader Community -

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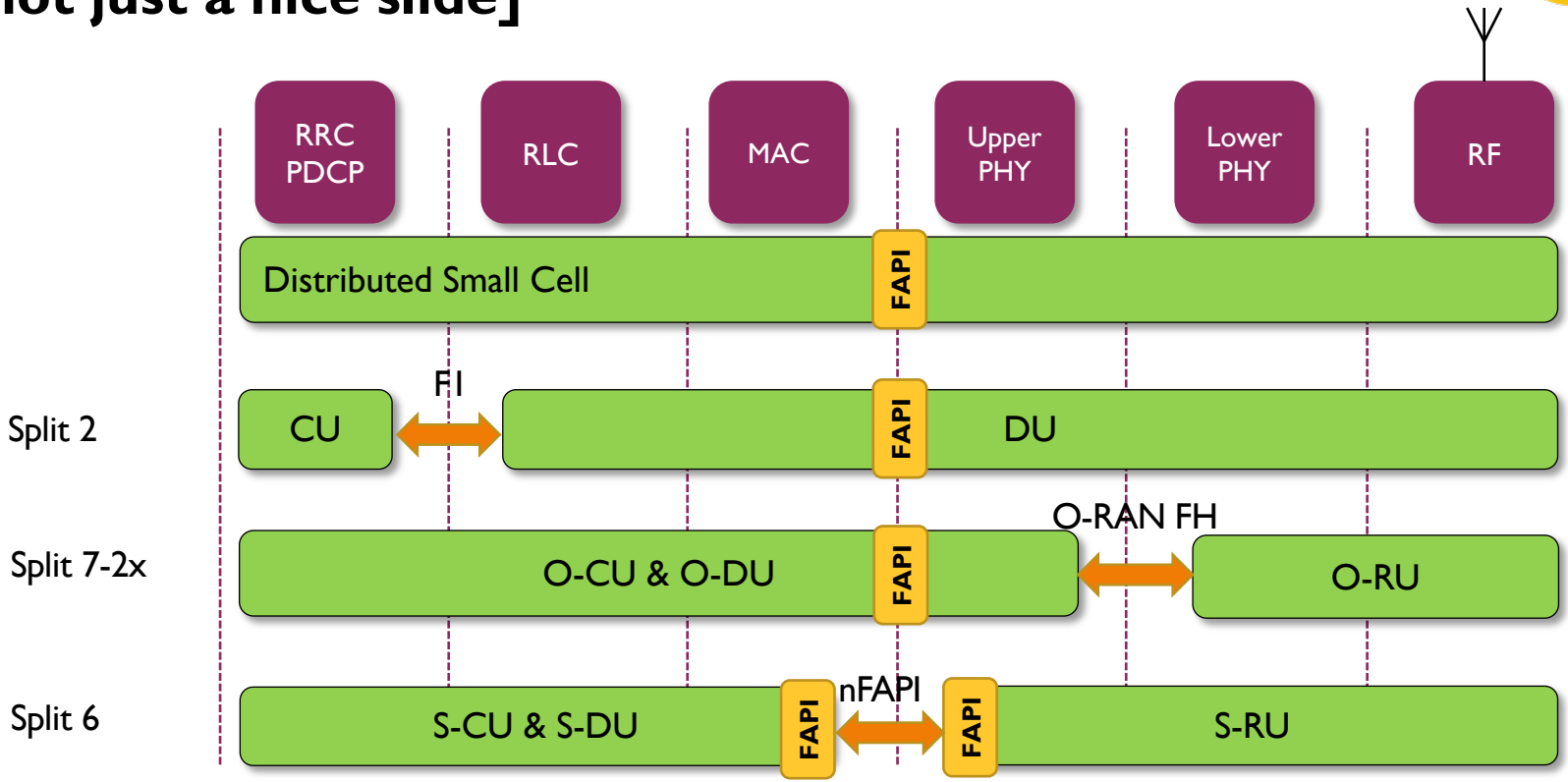
SCF

MOBILIZING ENTERPRISES & COMMUNITIES

FAPI: Enabling Multiple Architectures [not just a nice slide]



5G FAPI Ecosystem:

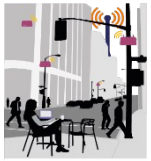
- diverse, mature, 3GPP, O-RAN compliant -

- **5G FAPIv2**: Focus on small cells

Semester releases

- **5G FAPIv7**: Mature specification ecosystem
  - Macro, Small, MIMO cells, FR1/2.
  - Broad, Stable: Rel-15 and core Rel-16 support.
  - Diverse ecosystems of vendors and operators.
  - Standalone/S-RU, D-RAN, V-RAN.
  - Interworking with O-RAN FH.

Outdoor



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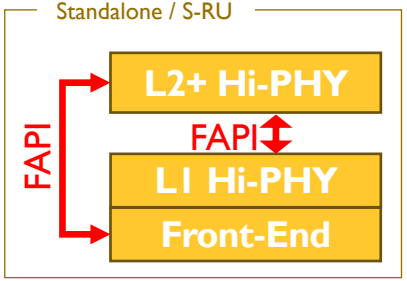

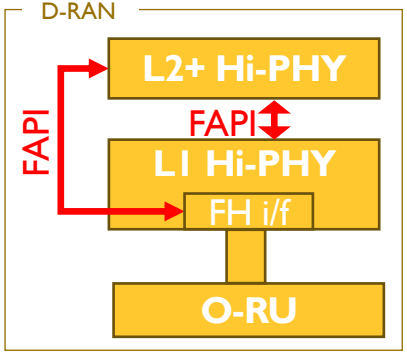

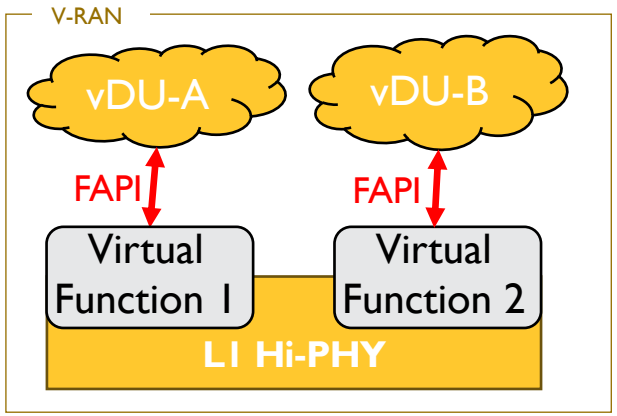

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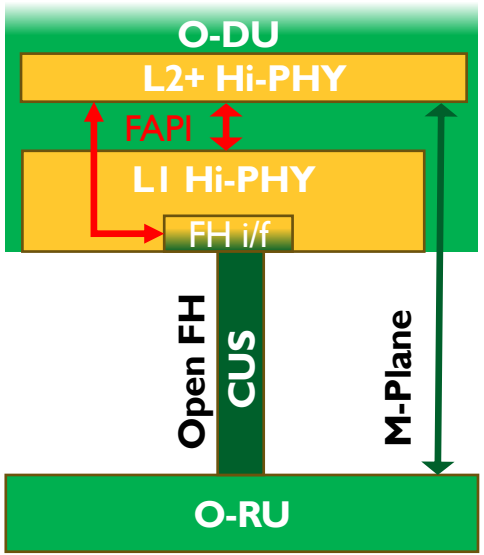

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SCF222 PHY FAPI/OAM Roadmap

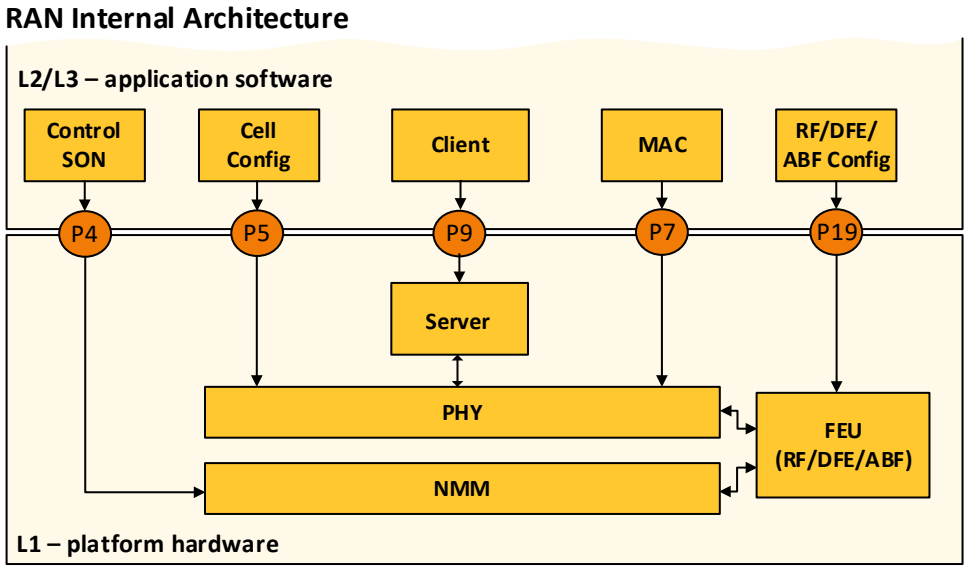
Q1/2020: v1,v2	Q2/2021: v3	Q4/2021: v4	Q2/2022: v5	Q4/2022: v6	Q2/2023: v7

Rel-15 Support
• PHY = Carrier
• P5: Config
• P7: Slot Operations
  • DL Ctrl, Data & RS
  • UL Ctrl, Data, RS, UCI
• Core support
  • BWP, Coresets, flexible num-lgy, minislots, etc,
  • 3GPP-based pwr profile
• Digital BF & precoding
	• DL Rate Match, DSS
	• Multi-SSB & RACH
	• UCI Control
	• CSG Retx [alternative]
	• etc
		• CBG re-tx • PRACH Offset
		• Missing Capabilities
		• TBS-TLV length • SR Len
		• RSRP reports • TA
		• etc
			• SRS/MIMO
			• PRACH power
			• Mixed Numerology
			• Pi/2-BPSK capability
			• Failed-CRC TBS handling
				• mMIMO Optimizations
				• SR Payload
				• General Corrections
				• [mMIMO Beam Reporting & L2-based precoders]
					• General Corrections
					• EPRE definitions
					• 3GPP/SCF Bitmap alignments
					• CRB0, PRG definitions, etc

	Rel-16 • eMIMO (mTRP, MU-CSI) • DSS	• eMIMO (low-PAPR RS) • 2-Step RACH	• 2-Step Maintenance • Positioning	• Maintenance (eMIMO CSI)	• Maintenance (eMIMO, CSI, continued)
	Features & Optimization • PUCCH-related pre-compute • PDU counts; bit alignment • SSS-based Pwr Profile • Integration w/ P19, • nFAPI-style headers	• mMIMO (SRS-based) • CP/UP split • Universal RM; signaling associations • P7-based by-ref RM • P7 Parameter Padding • Transp. UCI for PUCCH • SRS hop patterns	• 7.2x FH State Awareness • Extended Errors • Shared Memory for UL • 64-bit pointers • Config.reply TLV clarification	• RM Indexing • O-RAN Alignment (P9) • Multi-vDU Support • PHY Profile (#antennas) • Straight Wire Precoding	• O-RAN Alignment (P9 Notifications) • Optimized signaling of 2-part CSI • State machine restrictions
General • Timing: SFN/slot sync • State Machines • P5 Configuration Procedures • P7 Stateless operati	• Timing: Delay Management, • SFN/slot Corrections • Supervisory PHY	• Common Context • nFAPI Headers Adaptation	• Timing: Delay Mgmt w/o Timestamps • Explicit array sizes	• O-RAN Alignment: P9 • Terminology, int16_t • Delay Mgmt clarification	• Strict backward compatibility

FAPI Interfaces: not just about PHY Control

- P5/P7: PHY Control
  - In FAPIv2 OAI codebase.
- P4: NMM
- P19: Front-End control
- P9: OAM for O-RAN Fronthaul

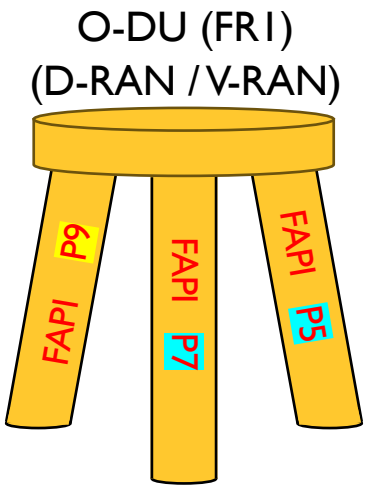


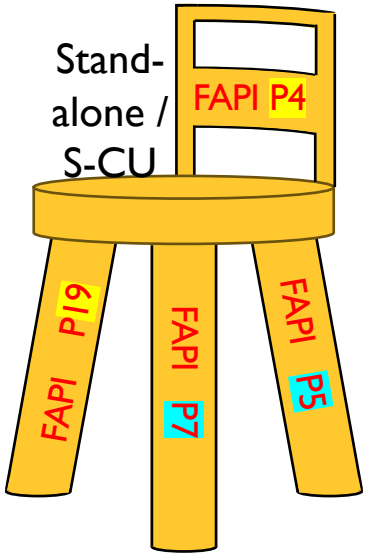
SON (Self Organizing Networks), MAC (Medium Access Control), NMM (Network Monitor Mode), FEU (Front End Unit), including DFE (Digital Front End) and ABF (Analog Beam Forming)

P5/P7: Immediate Open Sourcing Target

- SCF & OAI: agreed on maintaining an interface (in form of C header files), consistent with the SCF FAPI releases
  - Initial focus in P5/P7
  - General principles:
    - SCF owns and maintains FAPI Specifications
    - OAI will implement a Stage 3 FAPI API in the form of C headers
    - SCF and OAI will coordinate to ensure consistency and alignment under cooperation agreement
    - OAI will produce a Stage 3 reference implementation
  - Testing can build on OAI unit test cases and code (details TBD for future work)

FAPI-based L1 architectures





- Legend:
  - SCF & OAI Interfaces (P5, P7)
  - SCF-only interfaces (P4, P9, P19)

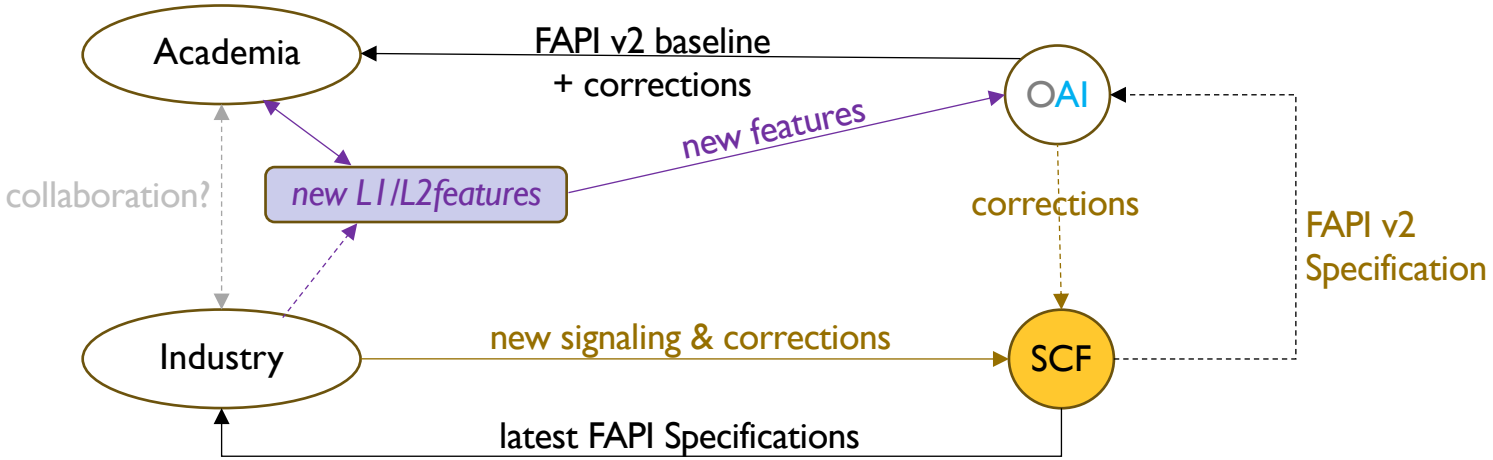
P9: Next Open-Sourcing Target?

- **P9: key enabler of O-RAN compatible architectures, with FAPI-based O-DU**
  - OAM between L1 implementations and O-RAN architectures

- **Ripe for open sourcing**:
  - SCF-specified operations are defined using Google Protobuf
  - Data model uses O-RAN Open-FH M-Plane YANG modules, w/ SCF YANG extensions
    - Extensions help align port definitions and L1 notifications

Community Opportunities

- OAI interfaces, with well-specified FAPI documentation => can focus on feature adoption, proposal and improvements.
  - FAPI header open sourcing reduces interface friction between SCF layers and across SCF/O-RAN interaction
- Virtuous cycle to use/add/improve features and contribute to specifications



☺ Before

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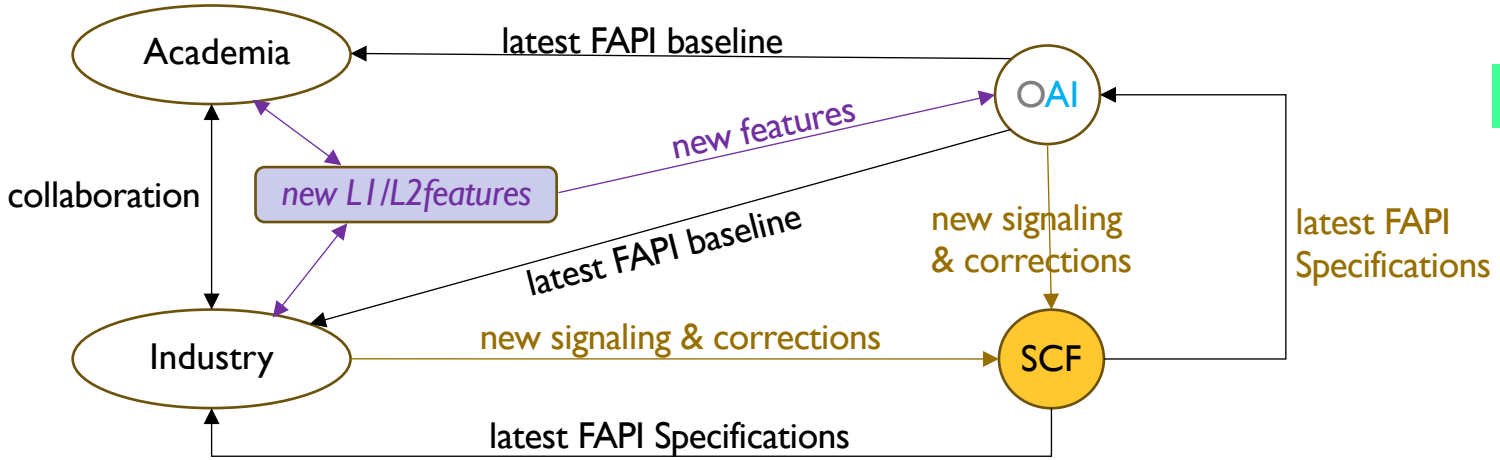

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After

Community Opportunities

- Ecosystem build-up:
  - Rapid spec adoption => OAI codebase to remain fresh
  - FAPI backward compatibility => Safe to upgrade to latest specification
  - Building, tracking, testing, logging & tracing: => quality interfaces => focus on features.

- Open areas of collaboration: scheduling (MU-MIMO, multi-utility / URLLC), RIC assistance, Edge computing, NES, NTN, Testing, etc.

Thank you

Q&A

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