DT507T-BA-040

Material for the Open RAN Promotion Subcommittee

Sep 8th, 2022

KYOCERA Corporation

Advantages of O-RAN* (1/3)

1. Opening the common IF of O-RAN to the public allows a general-purpose RU to be developed

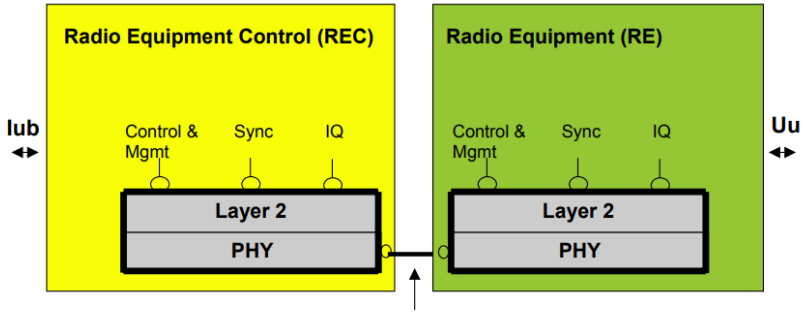
Previously, there was vendor lock-in between REC (equivalent to CU plus DU) and RE (equivalent to RU).

- To develop RE independently, it was necessary to receive the IF specifications from the REC vendor.

The REC-to-RE IF specifications are generally not disclosed to the public.

- RE vendors that were not recognized by REC vendors had no opportunity to join the market.

→ For O-RAN, common IF specifications are created and opened to the public, which provides more opportunities to join the market.



Source:

http://www.cpri.info/spec.html

The specifications of a layer that is higher than CPRI, such as control & management, and IQ mapping, are vendor-specific.

In the 3G and 4G eras too, there were standards for establishing connection between REC and RE by CPRI.

Although many vendors used CPRI, information flowing on CPRI was vendor-specific, and after all, it was not possible to establish connection between different vendors.

*: O-RAN refers to the O-RAN Alliance.

Note: A combination of REC and RE is equivalent to a combination of CU, DU, and RU.

In this document, the abbreviations CU, DU, and RU are used for 5G, and the abbreviations REC and RE for 3G/4G.

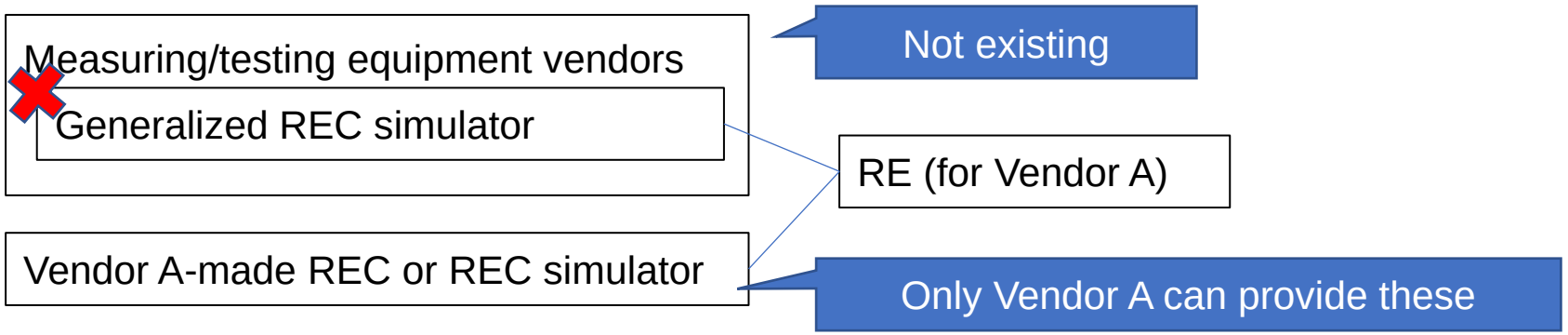
Abbreviation list	
REC	Radio Equipment Control
RE	Radio Equipment
CU	Central Unit
DU	Distributed Unit
RU	Radio Unit
CPRI	Common Public Radio Interface
Mgnt	Management
IF	Interface
IQ	In-phase Quadrature

Advantages of O-RAN (2/3)

2. Preparedness and diversity of test environments

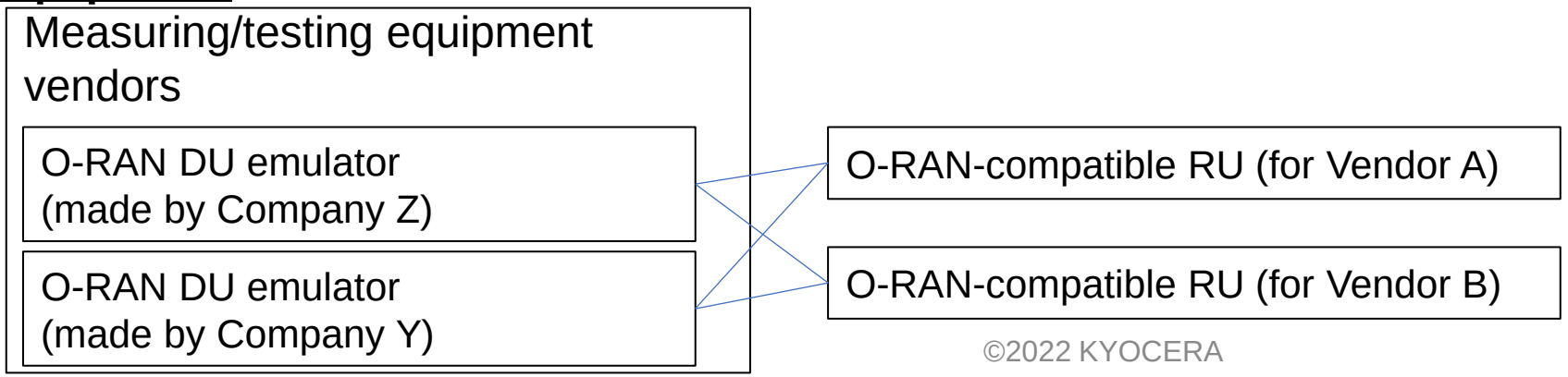
The IF specifications are specific to the REC vendor only, as described in Section 1.

REC-to-RE connection testing is not possible if REC is not borrowed or supplied from the REC vendor.



→ With O-RAN, the IOT profiles are made publicly available.

It has become possible to select and obtain evaluation environments from multiple vendors of testing equipment.



Abbreviation list	
IOT	Inter Operability Test

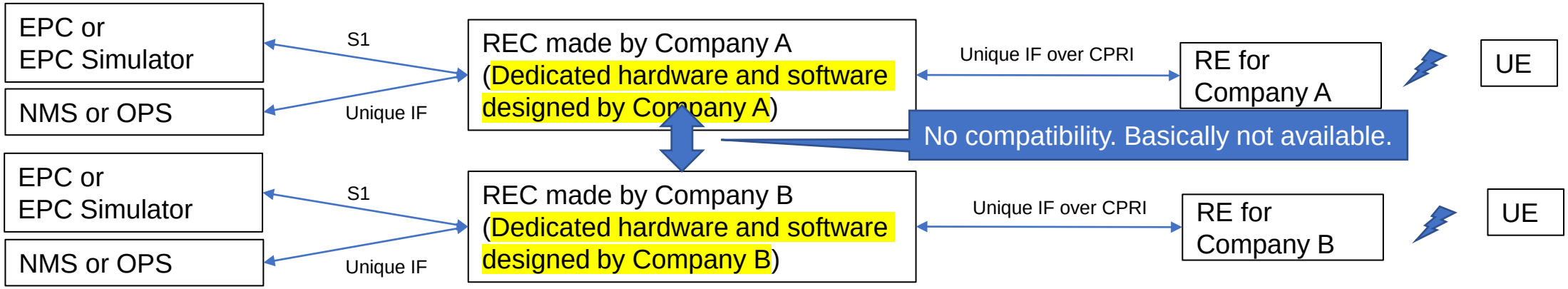
Advantages of O-RAN (3/3)

3. Easy construction of an end-to-end (E2E) evaluation system

Previously, a company needed to develop the whole system on its own or build it by borrowing or purchasing parts other than its own from partner companies.

Dedicated hardware and software are used and basically not available.

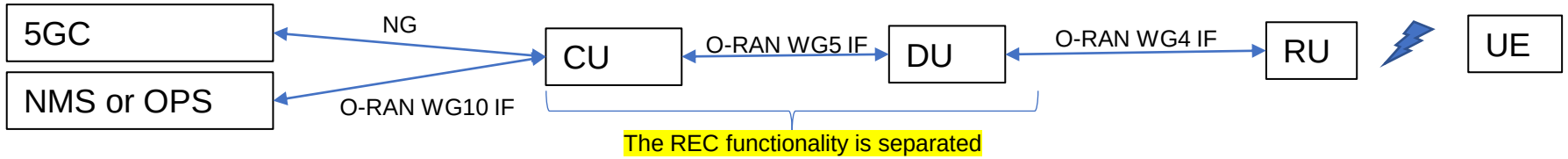
Since REC is not available, it is difficult for an RU vendor alone to conduct verification by building an end-to-end system.



→ With O-RAN, an interface can be divided, which allows for development on a component basis.

There are suppliers other than base station vendors. **It has become easy to build the system by purchasing third-party products.**

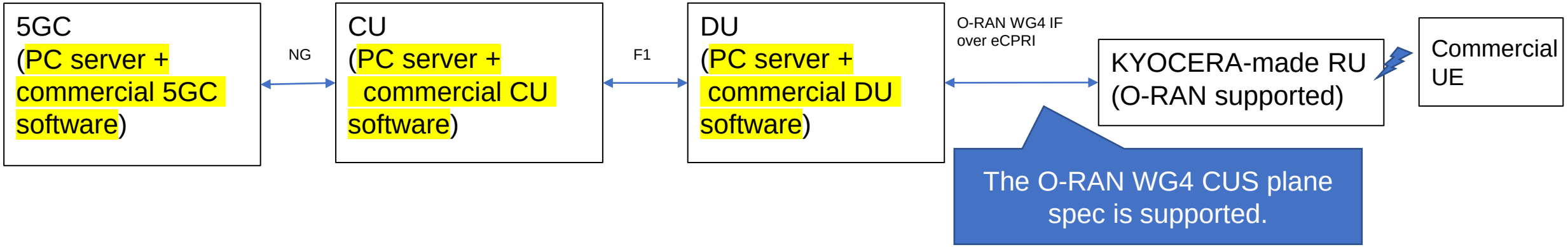
IF has been standardized, so that it has become possible to use the same end-to-end environment if a vendor at a connection destination is different.



Abbreviation list	
EPC	Evolved Packet Core
NMS	Network Management System
OPS	Operation System
5GC	5G Core Network
UE	User Equipment

Effects of Using O-RAN in Field Trials

In field trials, an end-to-end environment was built on a commercial PC server with combined use of software of multiple vendors.



Compared to when a prototype LTE (integrated REC/RE system) was created by KYOCERA in the past (about 10 years ago), a field trial environment was able to be built as follows:

- One-tenth in terms of the cost
- One-fourth in terms of the period

→ This was largely because the environment was able to be built without developing CU/DU-specific hardware and software.

Resources can be concentrated on RU development only.

Problems and Solutions

Of the problems that occurred in field trials, three problems that took time to solve are provided below with requests to O-RAN test environments.

	Problems	Reason why it took time to solve the problem	Requests to O-RAN test environments
1) Delay of a packet between DU and RU	The transmission method is changed to eCPRI and synchronization by s-plane, and because of packet transfer, failure of on-time reception occurs on the RU side.	It was not possible to identify the suspected area unless IQ data was captured on both the DU and RU sides. It took time to prepare an environment for capturing the CU data of FU.	Because there are individual differences in processing between DU and RU, ・Multiple kinds of DU/RU connection environments ・A neutral monitor environment for FH
2) A signal arrives too early at the time of connection at the UE end	Because there was a difference in timing between the RU internal processing and the ANT end, a signal was discarded on the UE side when an actual UE was connected.	The problem occurred only in a UE-connected end-to-end environment, so reproduction testing in an end-to-end environment was required.	An end-to-end evaluation system including UE
3) RACH preamble cannot be received from UE	When RACH preamble from UE was received on the DU side, there was an unexpected RB. It appeared to be due to a frequency drift or a problem on the UE side, and thus it took time to solve the problem.	As with 1), it was necessary to build an environment for capturing FH and follow the data one by one.	Development of an FH monitor environment including a CU-plane analysis tool

Abbreviation list	
FH	Front Haul

Requests to O-RAN Test Environments (1/2)

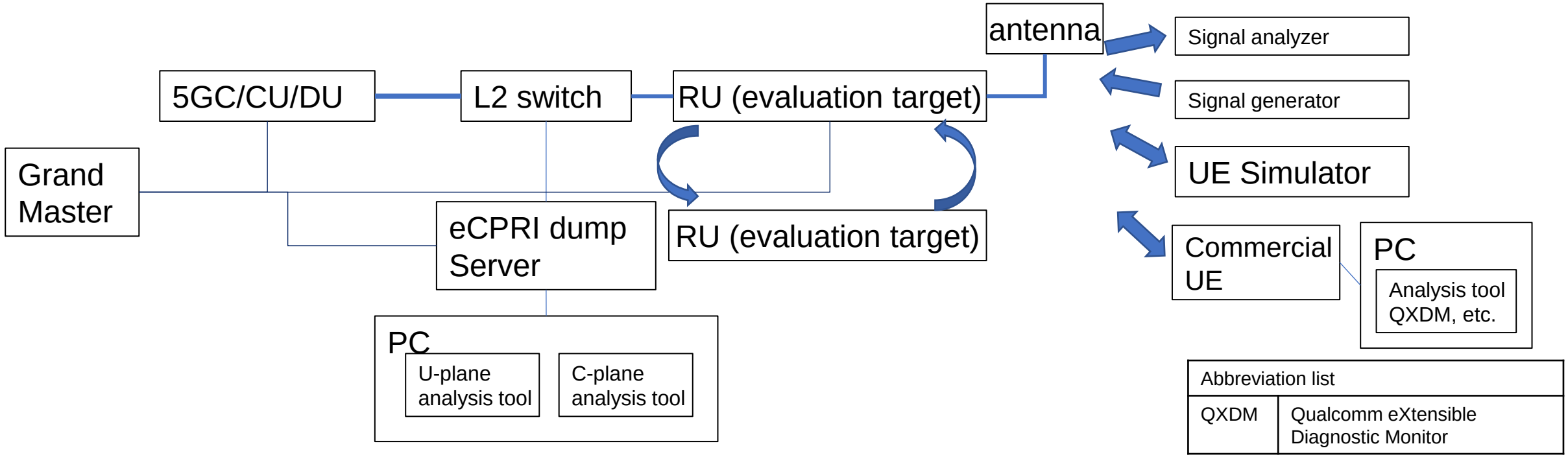
Two requests are proposed on the basis of the problems that occurred in field trials and the experience in solving them.

1) Evaluation and authentication in an end-to-end environment

- In an evaluation environment with an RU alone using a signal analyzer, there are many problems that do not surface.
- End-to-end evaluation is a big hurdle for a vendor that specializes in RU development.

As an O-RAN test environment, end-to-end evaluation and authentication is expected to have the following effects:

- Reduction in the time taken for problem analysis during IOT
- End-to-end evaluation results and authentication improve the RU competitiveness.



Requests to O-RAN Test Environments (2/2)

2) Evaluation and authentication in a field environment and a special 5G development zone

A field environment is more complex than an end-to-end environment and is an environment where what will happen is unknown.

- It is not possible for a vendor alone to actually perform evaluation outdoors or in a field.
- However, it is considered that there is know-how that cannot be acquired without field demonstration results.

Photo: Evaluation in our anechoic chamber

Evaluation that can be performed by a vendor alone is evaluation in an anechoic chamber.
In this closed environment, it is difficult to assign enough parameters to temperature change, sufficient distance, weather, and other influences.

Therefore, by 5G evaluation including test users in a field environment, such as in a special 5G development zone:

- Feedback about effects due to wide-ranging environmental changes
- Operation results and authentication in an actual field

The above are considered to be very valuable for RU vendors.

Thanks

We would like to thank Softbank for allowing us the opportunities to conduct field trials and make reports.

The O-RAN WG4 IF that was used in field trials was due to significant contributions made by contributors.

We appreciate the situation that allows us to take advantage of the contributions by these preceding vendors.

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