Roles in the 5G Media Production Ecosystem

The implementation and deployment of mobile technologies as part of media production workflows paves the way for a new ecosystem of equipment, devices and roles in the industry.

With this new ecosystem, new roles emerge, which need new definitions and clarification in their responsibilities. Some of these roles have been around for a long time but, over the years, their meaning or ownership have changed. Other roles are completely new in the context of media production and therefore require a precise introduction to foster understanding and support for them.

This report:

- introduces traditional roles for media production and contribution based on RF/OFDM links,
- explains the vertical ecosystem within 5G,
- introduces new roles for content production and contribution networks based on NPNs, and
- defines responsibilities of and dependencies between these new roles.

Contents

Roles for media production based on traditional RF/OFDM links

This scenario refers to deployments based on the setup and use of RF/OFDM equipment consisting of transmitters and receivers with tuneable operation frequency. The number of transmitters and receivers (and number of used frequencies) differ per event and involve accurate spectrum coordination to avoid interferences and ensure the appropriate assignment of frequencies.

During operation, QoS is acquired by securing interference-free operation.

The following diagram shows the key roles and functions for such kind of setup. Note that one person or entity may hold multiple roles or a given role may be spread across multiple persons or entities.

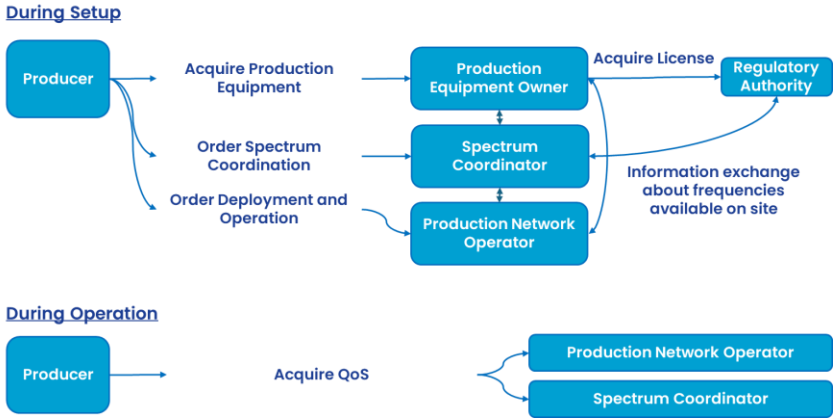


Table 1: Roles for media production based on traditional RF/OFDM links

Role	Description / responsibility
Producer	Responsible for ensuring and managing a flawless production flow. It is responsible for acquiring production equipment, spectrum coordination and order services from a production network operator.
Production equipment owner	Responsible for the procurement of production equipment: it makes it available, maintains it, ensures that it works properly, and takes care of and holds all necessary spectrum licenses.
Spectrum coordinator	Responsible of the on-site temporary frequency coordination of the production equipment for the lifetime of the event.
Production Network Operator	Responsible for the faultless operation of the media production network including the wireless connections according to the spectrum coordinator's information and national regulations
Regulatory Authority	Responsible for managing and granting spectrum licenses.

Roles for media contribution based on traditional RF/OFDM links

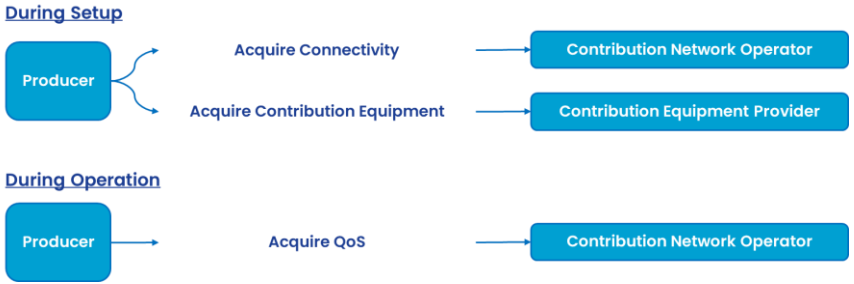
This scenario refers to deployments based on the setup and use of RF/OFDM equipment to transport data from a remote source, e.g. an outside broadcast unit, to a production hub. These contribution links can be deployed by means of terrestrial connection as well as by satellite links and are stablished by means of point-to-point or point-to-multipoint connections. These contribution links rely on frequencies assigned for such operations (e.g. a satellite transponder or a microwave link) and involve ensuring interference-free operation and the appropriate assignment of frequencies.

During operation, QoS is acquired by securing interference-free operation.

The following diagram shows the key roles and functions for such kind of setup.

Table 2: Roles for media contribution based on traditional RF/OFDM links

Role	Description / responsibility
Producer	Responsible for ensuring and managing a flawless contribution flow. It is responsible for acquiring contribution equipment, and order services from a contribution network operator.
Contribution Equipment Provider	Responsible for the procurement of contribution equipment: it makes it available, maintains it, and ensures that it works properly.
Contribution Network Operator	Responsible for the faultless operation of the media contribution link (point-to-point or point-to-multipoint) and owner of a license, e.g. satellite link operator.



Roles for media contribution based on cellular bonding

This scenario refers to deployments based on the setup and use of cellular bonding equipment to transport data from a remote source, e.g. a wireless camera with a modem, to a production hub. Cellular bonding equipment generally rely on connectivity provided by public network operators, on a best-effort basis, and using multiple redundant connections. While mobile networks are deployed on assigned spectrum, the mobile modems may use different carrier frequencies during operation.

During operation, a certain degree of QoS is achieved by means of the cellular bonding protocols and algorithms (best-effort).

The following diagram shows the key roles and functions for such kind of setup.

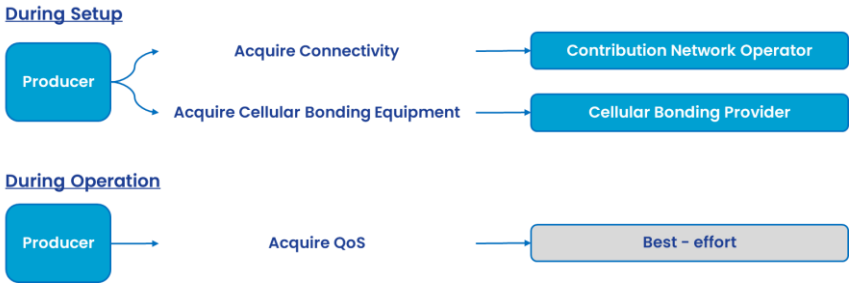


Table 3: Roles for media contribution based on cellular bonding

Role	Description / responsibility
Producer	Responsible for ensuring and managing a flawless contribution flow. It is responsible for acquiring contribution equipment, and order connectivity services from a mobile network operator.
Cellular Bonding Provider	Responsible for the procurement of cellular bonding equipment: it makes it available, maintains it, and ensures that it works properly.
Contribution Network Operator	Responsible for providing best-effort connectivity and data services, typically one or several Mobile Network Operator.

The 5G connectivity ecosystem for media production and contribution

The white paper "5G ecosystems"[1] by the 5G Infrastructure Association defined "ecosystem" as "a complex network of interacting cross-industry actors who work together and are dependent on each other to define, build and deliver value creating customer solutions. The depth and breadth of potential collaborations among actors defines the ecosystem with each actor delivering a piece of the solution or a contribution to the strength of the ecosystem. The power of the ecosystem comes from the fact that no single actor needs to own or operate all components of a solution, with the value of the ecosystem being greater than the combined value of each actor.". In addition, it suggests using the following two different points of views: the *5G provisioning ecosystem* and the *vertical ecosystem*.

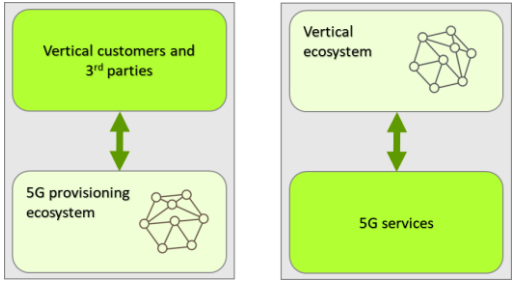


Figure 1: Two points of view on the 5G ecosystems

[1] 5G IA: "5G ecosystems", Sep 09, 2020 (5G-PPP white paper)

The 5G provisioning ecosystem encompasses those roles and actors that take part in developing, delivering, and providing 5G services to the customer.

The vertical ecosystem is composed of actors from vertical industries that assume roles necessary to adopt 5G services provided by the 5G provisioning ecosystem, assuming complementary and specific roles to their industry. This document focuses on the vertical ecosystem point of view where new roles may be created and previous roles dropped when applying 5G to media production and contribution deployments (see Figure 2).

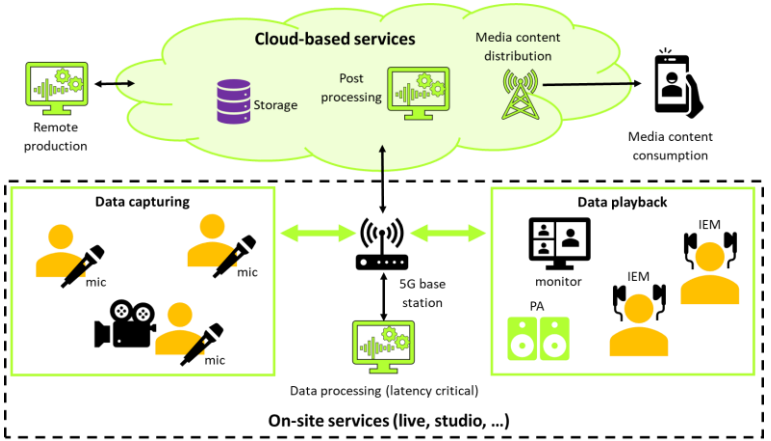


Figure 2: Vertical ecosystem for media production, contribution, distribution

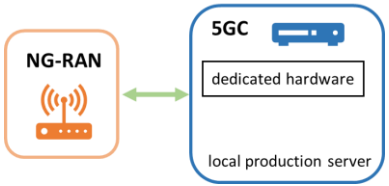
Whereas the previous scenarios considered the deployment of dedicated links (RF/OFDM) or an over-the-top use of third party mobile networks by means of cellular bonding, the deployment of 5G networks come with new architectures and network elements. These can be decomposed in different sub-systems (both physical and virtual) which may be provided by different actors and not necessarily by a single provider.

The network can be separated into two main blocks:

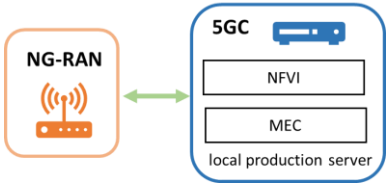
- the Next Generation Radio Access Network (NG-RAN) containing
  - RU (Radio Unit) with the lower part of the PHY (Physical Layer)
  - DU (Distributed Unit) with higher PHY, MAC (Medium Access Control) and RLC (Radio Link Control)
  - CU (Centralized Unit) with RRC (Radio Resource Control) and PDCP (Packet Data Convergence Protocol) layers
- the 5G core (5GC).

Depending on the realization of the 5GC, four deployment scenarios are considered:

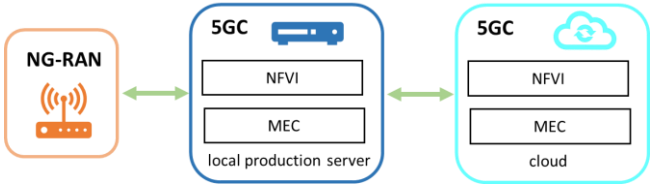
Scenario 1: all network functions (NFs) run on dedicated hardware located at e.g. the event venue.



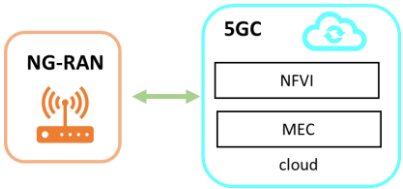
Scenario 2: NFVI (Network Functions Virtualization Infrastructure), on which virtual network functions (VNFs) run, replacing dedicated hardware and implemented on COTS (Commercial Off The Shelf) servers located at the event venue.



Scenario 3: the NFVI is split into VNFs running on the on-site server and into VNFs running in the cloud



Scenario 4: all 5GC functionalities run in the cloud



In addition, scenarios 2, 3, and 4 may support Mobile Edge Computing (MEC) which can be implemented in the on-site server or in the cloud.

Along with the new architecture and the different implementation scenarios, new roles and responsibilities emerge as shown below.

Table 4: New roles in the mobile connectivity ecosystem

Role	Description / responsibility
NG-RAN operator	Entity that operates and manages the RAN and its associated infrastructure that it may own or lease, e.g., a MNO in case of a public network or a PNO (Private Network Operator) in case of a SNPN
Local production server operator	Entity that provides all 5GC functionalities required on-site and additional local services that are made available by MEC functionalities
Cloud operator	Entity that provides all less time and resource critical 5GC functionalities that run in the cloud and additional cloud services that are made available by MEC functionalities
NFVI / MEC owner	Entity that provides all required NVFI and MEC functions on the local production server as well as all required cloud based NFVI and MEC routines
UE owner	Responsible for the procurement of user equipment able to connect to the SNPN.

Roles for media production and contribution based on 5G SNPN

This scenario refers to deployments based on the setup and use of mobile equipment within a 5G Stand-alone Non-Public Network (SNPN). The deployment of SNPNs ensure interference-free operation between different networks. However, the presence of multiple devices within the network may require the obtention of additional network services and/or the setup of appropriate policies to ensure the desired QoS during operation, which may become more challenging when the number of devices sharing the network increases.

The following diagram shows the key roles and functions for such kind of setup.

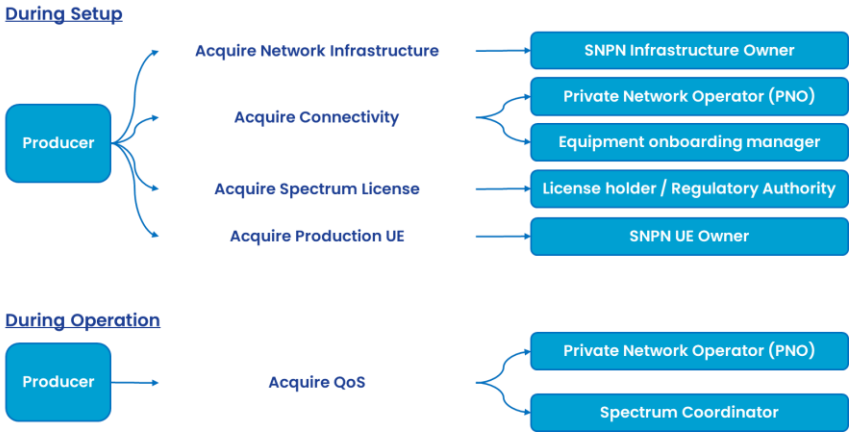


Table 5: Roles for media production and contributions based on 5G SNPN

Role	Description / responsibility
Producer	Responsible for ensuring and managing a flawless production/contribution flow. It is responsible for acquiring network infrastructure, connectivity, spectrum licenses and the production user equipment.
SNPN infrastructure owner	Responsible for providing the physical and/or virtual SNPN infrastructure, including NG-RAN, 5G Core. It may also provide computing capabilities.
SNPN UE owner	Responsible for the procurement of user equipment able to connect to the SNPN.
Equipment onboarding manager	Responsible for registration, authentication, and onboarding procedures for all mobile terminals in the SNPN.
Spectrum coordinator	Responsible of temporary frequency coordination of user equipment for the lifetime of the event.
Private Network Operator	Responsible for the faultless operation of the SNPN according to the spectrum coordinator's information and national regulations
License holder / Regulatory Authority	Responsible for managing and granting spectrum licenses.

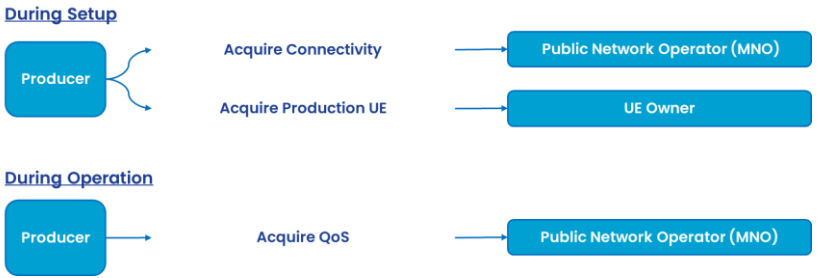
Roles for media production and contribution based on 5G PNI-NPN

This scenario refers to deployments based on the setup and use of mobile equipment within a 5G Public-Network-Integrated Non-Public Network (PNI-NPN). In this case, the public network operator may be able to offer network services and the configuration of appropriate policies to guarantee the desired QoS during operation.

The following diagram shows the key roles and functions for such kind of setup.

Table 6: Roles for media production and contributions based on 5G PNI-NPN

Role	Description / responsibility
Producer	Responsible for ensuring and managing a flawless production/contribution flow. It is responsible for acquiring production equipment, and order connectivity services from a mobile network operator.
UE owner	Responsible for the procurement of user equipment able to connect to the PNI-NPN.
Public Network Operator	Responsible for providing connectivity and data services alongside network services to e.g. configure QoS policies and obtaining network assistance.



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