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Datasheet for the decision of 17 September 2025

Case Number: T 1499/22 - 3.5.06

Application Number: 17731941.5

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Title of invention:
INFRASTRUCTURE RESOURCE STATES

Applicant:
Alcatel Lucent

Headword:
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Relevant legal provisions:
EPC Art. 56

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Catchword:

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Boards of Appeal

Chambres de recours

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Case Number: T 1499/22 - 3.5.06

D E C I S I O N
of Technical Board of Appeal 3.5.06
of 17 September 2025

Appellant: (Applicant)	Alcatel Lucent Site Nokia Paris Saclay Route de Villejust 91620 Nozay (FR)
Representative:	Louis Pöhlau Lohrentz Patentanwälte Postfach 30 55 90014 Nürnberg (DE)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 22 February 2022 refusing European patent application No. 17731941.5 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman	M. Müller
Members:	A. Teale
	K. Kerber-Zubrzycka

Summary of Facts and Submissions

I. This is an appeal against the decision, dispatched with reasons on 22 February 2022, to refuse European patent application No. 17 731 941.5 on the basis that the subject-matter claimed in auxiliary request 5, found to be the narrowest request, lacked inventive step, Article 56 EPC, in view of the following document in Chinese language:

D3: WO 2015/042937 A1.

On 30 April 2021 the EPO provided a machine translation of D3, referred to as D3'. D3 stems from international patent application CN 2013/084686, filed on 30 September 2013 and later published by the EPO under Article 153(4) EPC in English as the following document:

D3": EP 3 024 174 A1.

The board introduced D3" into the proceedings, Article 114(1) EPC, since it is more complete than D3' in also translating the tables in the description and the figures.

II. Amongst others, the following document was cited in the decision:

D8: "Network Functions Virtualisation (NFV); Virtual Network Functions Architecture", 1 December 2014, XP055856513, retrieved from the Internet URL https://www.etsi.org/deliver/etsi_gs/nfv-swa/

001_099/001/01.01.01_60/gs_nfv-swa001v010101p.pdf on 30 October 2021.

III. A notice of appeal and the appeal fee were received on 21 April 2022, the appellant requesting that the decision be set aside and a patent granted on the basis of one of auxiliary requests 2 to 5. The appellant also made an auxiliary request for oral proceedings.

IV. With a statement of grounds of appeal, received on 9 June 2022, the appellant refiled previous auxiliary requests 2 to 5 as a new main request and auxiliary requests 1 to 3, respectively.

V. The board issued a summons to oral proceedings and, in an annex, set out its preliminary opinion on the appeal as follows. The board had doubts regarding the inventive step, Article 56 EPC, of the subject-matter of the independent claims of all requests in view of D3 in the light of D3". The board also had doubts regarding the clarity of the independent claims of all requests.

VI. In a response dated 18 August 2025, the appellant withdrew their auxiliary request for oral proceedings and stated that they would not attend the scheduled oral proceedings. The appellant requested a decision on the appeal. The appellant did not submit amendments or further substantive arguments. The board then cancelled the oral proceedings.

VII. The application is being considered in the following form:

Description (all requests):

pages 1 to 3 and 83, received on 9 June 2022 (pages 84-88 were deleted in the same letter, page 4, I.1.2), and pages 4 to 82, as published in WO 2017/191509 A1.

Claims (refiled on 9 June 2022):
Main request: 1 to 15, originally received on 20 October 2021 as auxiliary request 2.
Auxiliary request 1: 1 to 15, originally received on 20 October 2021 as auxiliary request 3.
Auxiliary request 2: 1 to 15, originally received on 20 October 2021 as auxiliary request 4.
Auxiliary request 3: 1 to 15, originally received on 20 October 2021 as auxiliary request 5.

Drawings (all requests):
Pages 1/37 to 37/37, as published in WO 2017/191509 A1.

VIII. Claim 1 of the main request reads as follows:

"An apparatus (3300), comprising: at least one processor (3302); and at least one memory (3304) including computer program code; wherein the at least one memory (3304) and the computer program code are configured to, with the at least one processor (3302), cause the apparatus (3300) at least to: receive, at a network element from a first support system based on a transitioning of a state of a virtualized network resource, VNR, hosted by the network element from a first VNR state to a second VNR state at the first support system, a first message comprising an indication of the transitioning of the state of the VNR from the first VNR state to the second VNR state at the first support system; configure, based on the indication of the transitioning of the state of the VNR from the first VNR state to the second VNR state at the first support system, the network element to support

the VNR; receive, at the network element from a second support system based on a transitioning of a state of a virtualized service resource, VSR, hosted by the network element and associated with the VNR from a first VSR state to a second VSR state at the second support system, a second message comprising an indication of the transitioning of the state of the VSR from the first VSR state to the second VSR state at the second support system; and configure, based on the indication of the transitioning of the state of the VSR from the first VSR state to the second VSR state at the second support system, the network element to support the VSR, characterized in that the at least one memory (3304) and the computer program code are configured to, with the at least one processor (3302), cause the apparatus (3300) to allocate virtualized infrastructure resources, VIRs, the VIRs including VNRs and VSRs, to multiple owners and multiple tenants based on a hierarchical arrangement of the owners and tenants, and to configure infrastructure resource states, the infrastructure resource states comprising VNR states and VSR states, to reflect various hierarchies associated with virtualization of infrastructure resources, IRs, to provide VIRs."

IX. Claim 1 of auxiliary request 1 differs from that of the main request in the addition of the following passage at the end: "and to support various types of resource transfers between owners and tenants".

X. Claim 1 of auxiliary request 2 differs from that of the previous request in the addition of the following passage at the end: "and in configuring the infrastructure resource states to configure the infrastructure resource states to enable resource transfers in a programmable virtual infrastructure

having one or more owners at one or more hierarchical layers and one or more tenants at one or more hierarchical layers".

XI. Claim 1 of auxiliary request 3 differs from that of the previous request in the addition of the following passage at the end: "and in supporting transfer of a VNR, at each layer of a virtualized infrastructure hierarchy, to transition the VNR through a set of VNR states supported for VNRs, and in supporting transfer of a VSR, at each layer of the virtualized infrastructure hierarchy, to transition the VSR through a set of VSR states supported for VSRs".

Reasons for the Decision

1. Admissibility of the appeal

In view of the facts set out at points I, III and IV above, the appeal fulfils the admissibility requirements under the EPC and is consequently admissible.

2. Summary of the invention

2.1 The application relates to software-defined communication networks (CNs) having a separate control "plane" (for decision making) and data "plane" (for packet forwarding); see page 1, lines 9 to 16. The communications network can, for instance, be an optical network supporting Ethernet-based or IP-based services; see page 8, lines 10 to 13. Specifically, the application relates to virtualised infrastructure resources (VIRs), in particular virtualised network

resources (VNRs) supporting virtualised service resources (VSRs).

2.2 The overall structure of a system for network infrastructure virtualisation is shown in figure 1, the communication network (CN) itself (110) comprising infrastructure resources (111), namely network resources (112) and service resources (113). Network resources, for instance optical and packet network resources, such as routers, switches and multiplexers (see page 8, line 23, to page 9, line 6), support service resources, such as point-to-point and point-to-multipoint Ethernet services; see page 9, lines 8 to 13.

2.3 The communication network is linked to support systems (120-1 to 120-N), and both are linked to a "network infrastructure virtualisation system" (130), comprising virtualised infrastructure resources, namely virtualised network resources (VNRs)(132) and virtualised service resources (VSRs)(133). The network infrastructure virtualisation system (130) also comprises infrastructure virtualisation data structures (135-139).

2.4 The VNRs can transition between a number of possible VNR states, such as "network ready" (NR), "service ready" (SR) and "in service" (IS).

2.5 The application mentions several different approaches to virtualisation, but the claims are aimed at multi-owner virtualisation in which multiple owners share portions of the network infrastructure (NI) of the communication network. Different owners may be provided with ownership of respective sets of VNRs or VSRs sharing portions of the network/system; see sentence

bridging pages 6 and 7. Similarly, the claims set out multi-tenant virtualisation by which multiple tenants, at multiple hierarchical levels, may share portions of the network, different tenants being allocated respective sets of VNRs or VSRs; see page 7, lines 1 to 5.

2.6 The invention can involve various types of support systems (120), such as network planning systems and network provisioning systems; see page 10, line 27, to page 11, line 3.

2.7 As illustrated in the flowchart of figure 31 (see page 79, line 30, to page 80, line 12), a first support system comprising a processor and memory can cause the VNRs to change states from "network ready" to "service ready". Once a VNR is in the "service ready" state, it sends a message to a second support system causing the VNR to transition into the "in service" state and informing the first processor. The processor can support a hierarchical multi-owner and multi-tenant system for a communication network based on a set of VNRs associated with a set of infrastructure resources; see page 16, lines 4 to 14. The owners and tenants may be organised hierarchically, each owner being able to allocate portions of the VNI (virtual network infrastructure) to tenants on one or more hierarchical levels; see page 17, lines 7 to 11, page 25, line 16, to page 26, line 12, and page 36, line 14, to page 37, line 3, and the owner/tenant hierarchies in figure 9. The owners and entities may fall into a plurality of categories, such as communication service providers (CSPs), carrier neutral providers (CNPs) and internet content cloud providers (ICCPs); see page 17, line 12, to page 19, line 11.

2.8 Resources also have various states, for instance "network unequipped" (NU), "network equipped" (NE), "network ready" (NR), "service ready" (SR) and "in service" (IS).

2.9 The "value cube" shown in figure 11A has a "VI slicing" dimension, a "multi-tenancy" dimension and a "VI application" dimensions. The figure shows a multi-tenant hierarchy; see page 44, line 1, to page 45, line 2.

2.10 The transitioning of NRs, VNRs, SRs and VSRs between various states is discussed from page 56, line 30, to page 57, line 27.

2.11 Figure 16 (see page 61, line 14, to page 63, line 20) illustrates a VNR transitioning from a first VNR state (NR) to a second VNR state (SR), as set out in the independent claims of all requests; see also figure 18 and page 66, line 5, to page 69, line 17, and figure 19 and page 69, line 18-27. The transitioning of a VSR is described from page 65, line 1, to page 69, line 27. VNRs are put into the IS state before the VNRs are put into the IS state; see sentence bridging pages 65 and 66.

2.12 Figure 26 (see page 74, line 15, to page 75, line 1) shows the transitions between VNR and VSR states set out in the independent claims of all requests.

2.13 The VNR (NR-SR) and VSR (SR-IS) state transitions are also set out in the flow charts of figures 30 (see page 79, lines 13 to 29) and 31 (page 79, line 30, to page 80, line 12.

2.14 The flowchart of figure 32 relates to a hierarchical multi-owner and multi-tenant system for a communication network; see page 80, lines 13 to 30, and figure 33 shows a general computer architecture for proving the functions of the invention; see page 81, line 12, to page 82, line 12. According to page 82, lines 13 to 29, the functions of the invention may be provided in software or hardware.

3. The board's understanding of the invention

3.1 The description sets out the invention in somewhat abstract terms, the most concrete embodiment being that illustrated in the flowchart of figure 31 (see page 79, line 30, to page 80, line 12) in which a first support system comprising a processor and memory causes VNRs to change states from "network ready" to "service ready".

3.2 Once a VNR is in the "service ready" state, it sends a message to a second support system which causes the VNR to transition into the "in service" state and informs the first processor; see page 16, lines 4 to 14.

3.3 The board understands the network and support virtualised resources (VNR,VSR) to be software programs running on shared hardware, the changes in their state being changes in the state of the software programs which do not necessarily have a technical effect.

3.4 The board understand the references to "owners" and "tenants" as referring to the provision and usage of software and hardware resources by users linked by contractual relationships; see page 7, lines 1 to 13. The hierarchical relationships amongst the owners and amongst the tenants are features relating to the owners

and tenants, these relationships not limiting the claimed apparatus and method.

4. Clarity, Article 84 EPC

Despite the doubts regarding clarity expressed by the board in its preliminary opinion, the board finds that claim 1 of each request is sufficiently clear for the purposes of assessing inventive step.

5. The prior art on file

5.1 Document D3 (WO 2015/042937 A1)

5.1.1 D3 relates to fault management in a system having multiple virtual machines (VM)(see figure 1), the acronyms "NFV" (Network Function Virtualisation") and "VNF" occurring widely in the Chinese text of the description (57 pages).

5.1.2 Based on D3", which has a different paragraph numbering to D3', referred to in the decision, D3 discloses the system architecture shown in figure 1 comprising computing, storage and network hardware. A virtualisation layer runs on a hardware layer, a host OS and hypervisor running on the virtualisation layer to provide multiple virtual machines (VMs) and, an operation support system (OSS) and a business support system (BSS); see [73-75]. System faults are detected and identified; see [78].

5.1.3 The virtualisation network functions (VNFs) in D3 are a form of virtualised network resource (VNR), set out in the claims. However D3 does not disclose, in particular in the EMS (element management system) units, a

virtualised service resource (VSR) supported by the VNR.

5.1.4 In the terms of claim 1 of the main request, D3 discloses an apparatus ([74], figure 1), comprising: at least one processor ("computing hardware") and at least one memory ("storage" hardware) including computer program code. The virtual network functions (VNFs) in D3 cover the virtualised network resource (VNR) in claim 1.

5.2 D8 ("Network Functions Virtualisation (NFV); Virtual Network Functions Architecture", XP055856513)

5.2.1 D8 was cited in the decision (see page 11, first paragraph) regarding configuration information relating to a resource being changed when a resource is allocated to a user; see page 44.

5.2.2 D8 is a standard for to network functions virtualisation (NFV). Its scope (page 7) covers software architectural patterns for virtualising network functions. The abbreviations on pages 10 to 12 include neither "VNR" nor "VSR". Figure 1 on page 13 is very similar to figure 1 in D3. The decision seems to be referring to REQ-027 on page 44.

6. Inventive step, Article 56 EPC

6.1 According to the appealed decision, the claims of auxiliary request 5 (now auxiliary request 3) were the narrowest of all requests, and their subject-matter lacked inventive step in view of D3, understood in the light of its English translation D3'. Hence the subject-matter of all requests lacked inventive step in view of D3.

6.2 The subject-matter of claim 1 differed from the disclosure of D3 in that the at least one processor, at least one memory and the computer program code are configured to cause the apparatus to:

A. allocate virtualized infrastructure resources, VIRs, the VIRs including VNRs and VSRs, to multiple owners and multiple tenants based on a hierarchical arrangement of the owners and tenants,

B. and to configure infrastructure resource states, the infrastructure resource states comprising VNR states and VSR states, to reflect various hierarchies associated with virtualization of infrastructure resources, IRs, to provide VIRs,

C. and to support various types of resource transfers between owners and tenants,

D. and in configuring the infrastructure resource states to configure the infrastructure resource states to enable resource transfers in a programmable virtual infrastructure having one or more owners at one or more hierarchical layers and one or more tenants at one or more hierarchical layers, and

E. in supporting transfer of a VNR, at each layer of a virtualized infrastructure hierarchy, to transition the VNR through a set of VNR states supported for VNRs, and in supporting transfer of a VSR, at each layer of the virtualized infrastructure hierarchy, to transition the VSR through a set of VSR-states supported for VSRs.

6.3 Differences A, C and D were interrelated, since they concerned the organization of users ("tenants" and "owners") into a hierarchy. Differences B and E were also interrelated, since they both featured a hierarchy of the virtualized "infrastructure" resources. The two groups of differences (A,C,D vs. B,E) were however not interrelated, as B and E did not relate to users. The applicant had nor shown that the hierarchical arrangement was linked to the transitioning of states of VNFs. Consequently, the two groups of difference features were considered separately.

6.4 Features A, C and D, addressed the problem of organising the allocation of resources to users. According to difference feature "A", tenants and owners were allocated resources "based on a hierarchical arrangement". The term "owner" was understood to refer to a network administrator, a user who could grant permissions to other users. The hierarchical arrangement of "tenants" and "owners" was a purely organizational and administrative matter, reflecting the relationships between users in their working environment. It was more convenient for administrators to manage user rights and permissions "based on" this organization in a hierarchy. This aspect was well-known *per se*. Difference feature C set out that "various types of resource transfers are supported between users and tenants". These features did not achieve a more accurate resource transfer or better resource usage, as argued by the applicant, as they were so vague and broad as to have no concrete technical meaning. It was self-evident that the state of the network element played some part in that element being available to a tenant. For instance, a VNF had to be instantiated and configured before it could be allocated to a tenant

(see, for example, D8, page 33). According to difference feature "D", tenants and owners were organized in a hierarchical manner, and resources transfers were enabled in the virtualized network. These two aspects were not interrelated. There were resource transfers, granting permissions to users, and then users were organized in a hierarchy. These features did not provide a more accurate solution for resource handling, as argued by the applicant, and the division considered these features to be so vague and broad that they also had no concrete technical meaning. These features did not limit the claim to a resource itself changing its state after being transferred from a first to a second tenant. Moreover, even if such a scenario were set out in the claim, it was unclear how this would relate to the network and tenant hierarchy. If a resource were allocated to a new user, the skilled person would have expected such an event to be reflected somehow in the configuration information managing the resource. For example, according to D8 (see page 44),

"In case of change in the VNF lifecycle (e.g. termination of a VNF or a VNFC), NFV management and orchestration" - NFV meaning "Network Function Virtualisation" - "shall enable reporting of events back to VNF instances and/or interested clients".

Thus a user of a VNF was notified if there was any change in the VNF, and this was unrelated to how a user was administered (in a hierarchy or otherwise). Consequently features of A, C and D did not provide a technical solution to a technical problem, instead expressing in a very broad manner an administrative aspect of user management (a hierarchy of users) in a network, which was furthermore a well-known aspect.

6.5 Turning to the second group of difference features, B and E, feature B set out the infrastructure reflecting "various hierarchies" associated with the resources. These features did not enable various entities associated with the network to understand various types of metrics, as argued by the applicant, because hierarchical (software defined) network topology was in itself well-known. For example, according to D8, page 59, 1.5: "SDN controllers may be centralized, with a single controller for the network, or in a hierarchy." There was no interaction between the state transitioning of VNFs and the communication this involved between VNFs and their management. The effect of reporting on the network was unrelated to state transitioning of network elements. Features "B" and "E" had no technical effects. Feature "E" set out the transitioning of states being supported at each layer of the infrastructure hierarchy. This did not solve a technical problem. At best, these features set out that if network management was organized as a hierarchy of layers, then management information needed to pass through these layers, this being a natural consequence of such an organization. Hence features "B" and "E" did not provide a technical solution to a technical problem, instead merely expressing in a very broad manner that the network was organized into a hierarchical topology, which was known.

6.6 Consequently the subject-matter of claim 1 did not involve an inventive step, Article 56 EPC.

6.7 According to the appellant, although D8 (chapter 1.5, page 60) disclosed a hierarchical network architecture, it did not disclose any hierarchically-structured resource states. As shown in figure 14 of the

application, the invention involved configuration of infrastructure resource states, which were not known from D8. Merely because D8 disclosed hierarchies in a network, it did not follow that configuration of resource states lacked a technical effect. The resource states provided an understanding of network metrics, such as available bandwidth, and indicated which resources were available to tenants at which hierarchical layer. This was a technical effect. Regarding auxiliary request 1, the added feature set out a more accurate resource transfer and better resource usage and was not known from D8, in particular page 33. Compared to auxiliary request 1, the independent auxiliary request 2 set out an additional feature underlining the interaction in resource transfers between resource states and the owners and tenants arranged at hierarchical layers. Such a hierarchy of owners and tenants and a hierarchy of resource states was not disclosed by any document on file, in particular D8, page 44, "REQ-027". Compared to auxiliary request 2, the independent claims of auxiliary request 3 set out an additional feature defining the resource transfer in more detail, namely that at each layer of a virtualised infrastructure hierarchy a resource transitioned through a set of resource states during the transfer.

6.8 In view of the board's analysis above, the subject-matter of claim 1 of the main request differs from the disclosure of D3 (in the light of D3") in most of its features, namely that the at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus at least to: receive, at a network element from a first support system based on a transitioning of a state of a virtualized network resource, VNR, hosted by the

network element from a first VNR state to a second VNR state at the first support system, a first message comprising an indication of the transitioning of the state of the VNR from the first VNR state to the second VNR state at the first support system; configure, based on the indication of the transitioning of the state of the VNR from the first VNR state to the second VNR state at the first support system, the network element to support the VNR; receive, at the network element from a second support system based on a transitioning of a state of a virtualized service resource, VSR, hosted by the network element and associated with the VNR from a first VSR state to a second VSR state at the second support system, a second message comprising an indication of the transitioning of the state of the VSR from the first VSR state to the second VSR state at the second support system; and configure, based on the indication of the transitioning of the state of the VSR from the first VSR state to the second VSR state at the second support system, the network element to support the VSR, the at least one memory and the computer program code being configured to, with the at least one processor, cause the apparatus to allocate virtualized infrastructure resources, VIRs, the VIRs including VNRs and VSRs, to multiple owners and multiple tenants based on a hierarchical arrangement of the owners and tenants, and to configure infrastructure resource states, the infrastructure resource states comprising VNR states and VSR states, to reflect various hierarchies associated with virtualization of infrastructure resources, IRs, to provide VIRs.

6.9 The board agrees with the examining division that the difference features of claim 1 of all requests lack a technical effect and thus cannot contribute to inventive step. The states of the VNR and VSR set out

in the claims are not limited to any technical effect of the apparatus or the method and neither are the changes in those states. The inputs, outputs and functions of the VNRs and VSRs are, for instance, undefined. Likewise, the allocation of virtualised resources to multiple owners and tenants in hierarchical arrangements, in the absence of a definition of what an owner or a tenant is, or what "allocation" implies also lacks a technical effect.

6.10 Turning to the auxiliary requests, the features added to claim 1 do not restrict them to subject-matter having a technical effect over the disclosure of D3.

6.11 Hence the board finds that the subject-matter of claim 1 of all requests does not involve an inventive step, Article 56 EPC, in view of D3.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

L. Stridde M. Müller

Decision electronically authenticated