Demonstrative Exhibits of Patent Owner XiFi

Samsung v. XiFi

IPR2025-01203 (Patent 11,849,337 B1)
IPR2025-01204 (Patent 11,818,591 B2)
IPR2025-01205 (Patent 12,003,976 B1)
IPR2025-01206 (Patent 11,950,105 B1)
IPR2025-01207 (Patent 12,015,933 B1)
IPR2025-01208 (Patent 11,974,143 B2)
IPR2025-01209 (Patent 11,856,414 B1)
IPR2025-01270 (Patent 12,114,177 B2)
PGR2025-00067 (Patent 12,190,198 B1)
PGR2025-00068 (Patent 12,169,756 B2)
PGR2025-00069 (Patent 12,250,564 B2)

XiFi's Invention

1. A method of improving the performance of a wireless networking device, comprising the steps of:

connecting an application interface to a processing interface, the application interface being associated with a first application, the first application providing, when the wireless networking device is being used, a first data stream and having a first wireless bandwidth requirement;

connecting first and second actual MAC interfaces to the processing interface;

connecting first and second actual PHY interfaces respectively to the first and second actual MAC interfaces;

respectively associating first and second wireless transceivers with the first and second actual PHY interfaces, wherein each of the first and second wireless transceivers is suitable for use in a wireless local area network, and the first and second wireless transceivers, respectively, (i) have a first and second bandwidth availability up to first and second actual bandwidths, and (ii) are adapted to emit radio waves in first and second different bands of frequencies;

forming in the processing interface (i) at least one virtual MAC interface and (ii) first and second virtual PHY interfaces that, during operation of the wireless networking device, feed information regarding the bandwidth availabilities of the first and second wireless transceivers back to the at least one virtual MAC interface;

wherein the processing interface is configured to, when the wireless networking device is being used, and in a manner transparent to any layer of the wireless networking device above the processing interface,

(a) request or create (i) a first association between a recipient and the first actual MAC and PHY interfaces and (ii) a second association between the recipient and the second actual MAC and PHY interfaces,

(b) identify at least one first portion of the first actual bandwidth of the first wireless transceiver, the identified at least one first portion comprising a set of given resources,

(c) evaluate whether any of the given resources of the first identified actual bandwidth portion are unavailable for communication, and

(d) use the first wireless transceiver to transmit the first data stream to the recipient, without requiring disassociation of the recipient from either or both of the first and second actual MAC and PHY interfaces, using a subset of frequencies corresponding to only the given resources of the first bandwidth portion that are not unavailable for communication to thereby at least partially satisfy the first wireless bandwidth requirement of the first application; and

wherein the wireless networking device's utilization of the first available bandwidth portion of the first wireless transceiver does not prevent any wireless networking device devices from utilizing a range of frequencies corresponding to the remaining portion of the bandwidth availability of the first wireless transceiver for data transmission or reception purposes at the same time that the first bandwidth portion is being used for data transmission purposes.

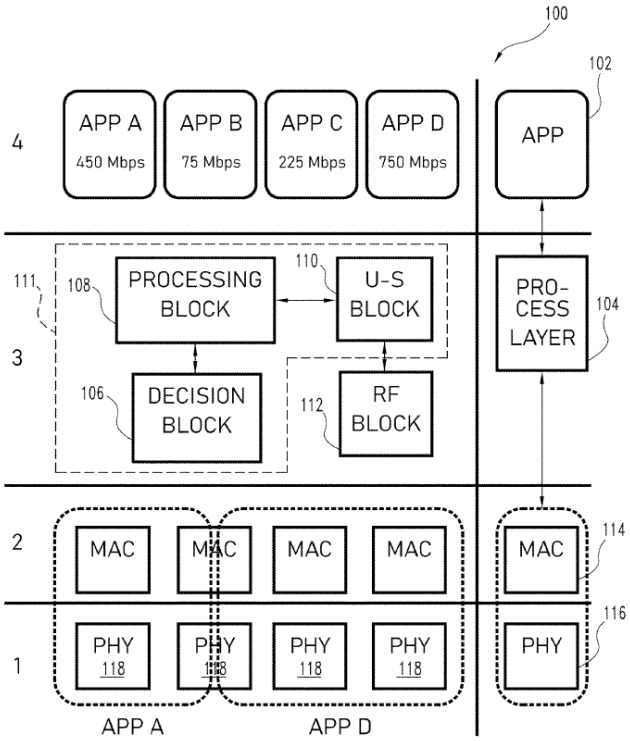


Fig. 1

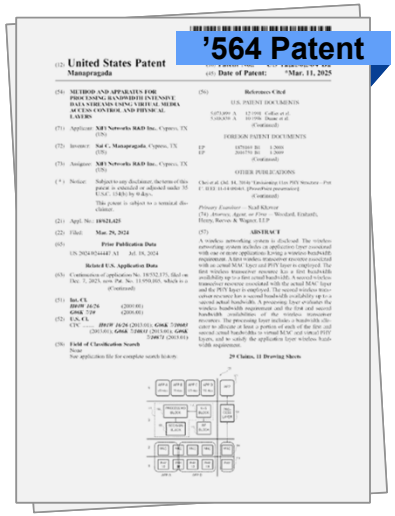
'105 EX1001 at 11:54-12:49, Fig. 1.

“virtual MAC interface”: “separately addressable”

All Patents

All Claims

“virtual MAC interface”: “separately addressable”



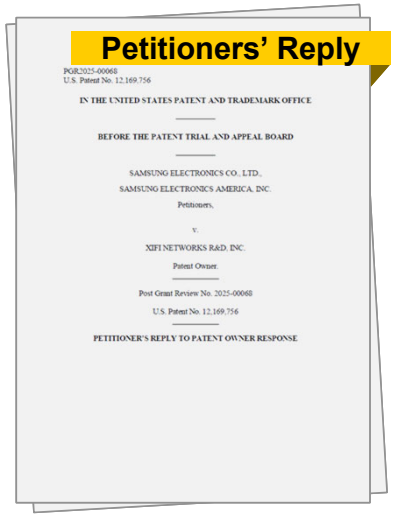
first and second actual MAC interfaces connected to the processing interface;

at least one virtual MAC interface and at least one resource monitoring interface formed in the processing interface that, during operation of the wireless networking device, feeds information regarding the bandwidth availabilities of the first and second wireless transceivers back to the at least one virtual MAC interface;

wherein the processing interface is configured to, when the wireless networking device is being used, and in a manner transparent to any layer of the wireless networking device above the processing interface,

’564 EX1001 at 12:12-13, 12:25-34;’564 POR at 8, 47.

“virtual MAC interface”: “separately addressable”

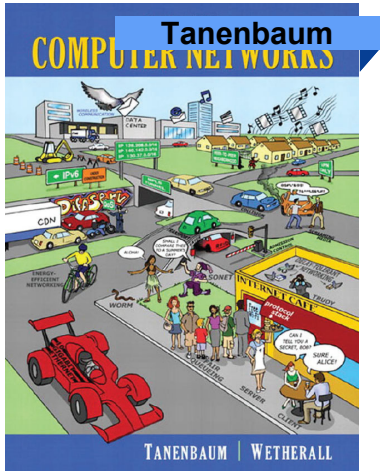


1. Chincholi discloses the “virtual MAC interface”

The Petition demonstrates that Chincholi’s OMMA layer contains a “virtual MAC interface” under the stipulated construction—*i.e.*, “a software- or logical-based interface that is separately addressable from the recited actual MAC interfaces and that obscures the recited actual MAC interfaces from higher protocol stack layers.” Pet. 25-28.

’564 Reply at 5-6.

“virtual MAC interface”: “separately addressable”



The bridges must first choose one bridge to be the root of the spanning tree. To make this choice, they each include an identifier based on their MAC address in the configuration message, as well as the identifier of the bridge they believe to be the root. MAC addresses are installed by the manufacturer and guaranteed to be unique worldwide, which makes these identifiers convenient and unique. The bridges choose the bridge with the lowest identifier to be the root. After enough messages have been exchanged to spread the news, all bridges will agree on which bridge is the root. In Fig. 4-44, bridge *B1* has the lowest identifier and becomes the root.

’564 EX2010 at 291 (Tanenbaum at 339); ’564 EX2008 (Akl POR Decl.) at ¶ 53.

“virtual MAC interface”: “separately addressable”

Dr. Akl
(Patent Owner’s Expert)



51. This understanding of “virtual” is also consistent with the contrast with the “actual MAC interface” claimed in the ’564 Patent, which a POSITA would have understood to be permanent and installed by the manufacturer, *i.e.*, physical. *See, e.g.*, EX2010 (Tanenbaum) at 339 (“MAC addresses are installed by the manufacturer and guaranteed to be unique worldwide…”).

’564 EX2008 (Akl POR Decl.) at ¶ 51.

“virtual MAC interface”: “separately addressable”

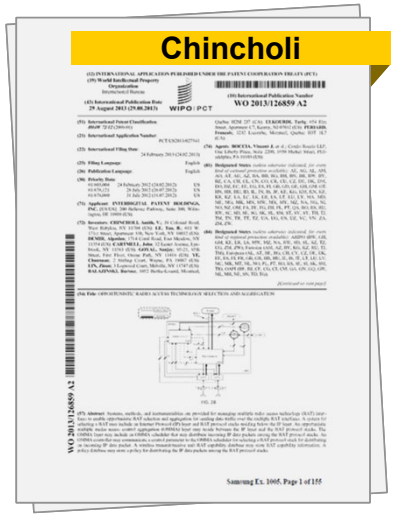
Dr. Akl
(Patent Owner’s Expert)



53. As explained above, a virtual MAC interface would have a programmed, non-static address. *See, e.g.*, EX1001, Fig. 1; *id.* at 2:63-65. This is unlike Chincholi’s OMMA layer. In fact, Chincholi’s OMMA layer is not disclosed as being a separately addressable entity at all. A POSITA would understand that Chincholi’s OMMA layer acts as a conduit to pass on packets received from different RATs (each with its own actual MAC address), taking multiple inputs and sending them out as one output. EX1005 at [0137]-[0143], [0383].

’564 EX2008 (Akl POPR Decl.) at ¶ 53.

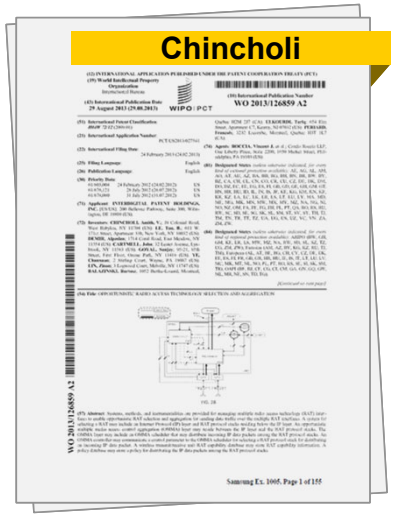
“virtual MAC interface”: “separately addressable”



[0120] A mechanism to aggregate two or more RATs operating independently on two or more bands to enhance the total IP throughput of the link may be described herein. For example, a single thin software layer (*e.g.*, an opportunistic multi-medium access control (MAC) aggregation (OMMA) layer) may be described herein. For example, the single thin software layer may reside above the medium access control (MAC) layers of the protocol stacks but below the IP layer. For example, the single thin software layer may enable one RAT to operate over industrial scientific medical (ISM) and another RAT to operate over a TVWS band for the same IP flow. This may allow for enhanced throughput and reduced latency for a single IP flow.

’564 EX1005 at [0120]; ’564 EX2017 (Akl POR Decl.) at ¶¶ 80, 83.

“virtual MAC interface”: “separately addressable”



[0192] The OMMA layer may receive metadata/link statistics feedback from each RAT. Within the OMMA layer, an OMMA scheduler may be responsible for traffic shaping, for example, by policy-based routing of IP packets across bands or feedback-based routing of packets across bands. The OMMA layer may be transparent in that it distributes and/or combines packets from different RATs and forwards the packets to the IP layer. The OMMA layer may be non-transparent, in that it adds additional headers at the transmitter, and/or reads and removes the headers at the receiver. The OMMA layer may utilize a packet distribution mode. As described herein, the packet distribution mode may be a diversity mode, a multiplexing mode, a hybrid mode, and a dynamic RAT selection mode.

’564 EX1005 at [0192]; ’564 EX2017 (Akl POR Decl.) at ¶ 80.

“virtual MAC interface”: “separately addressable”

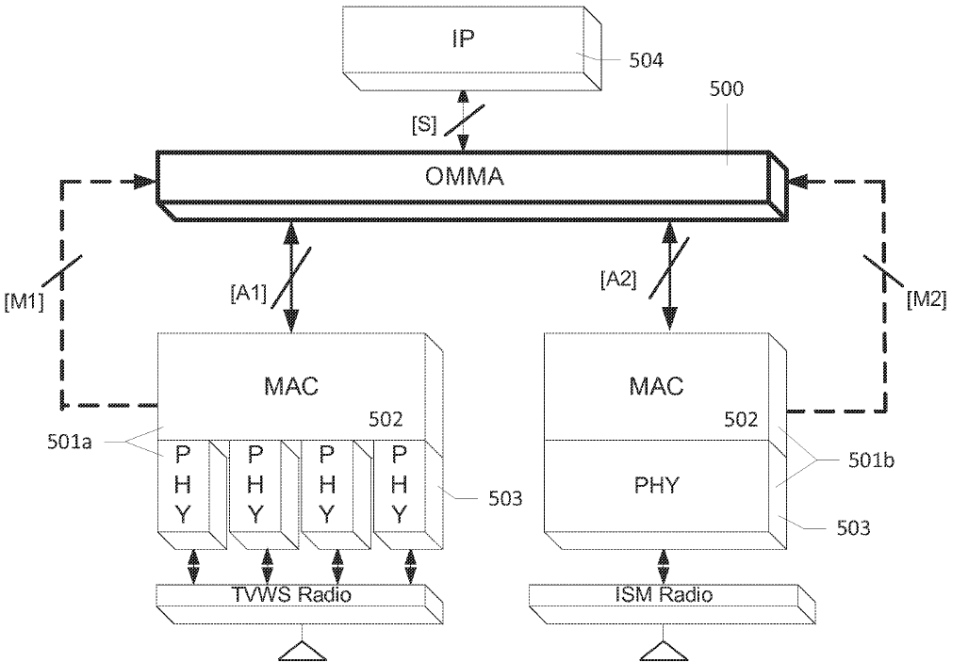


FIG. 5

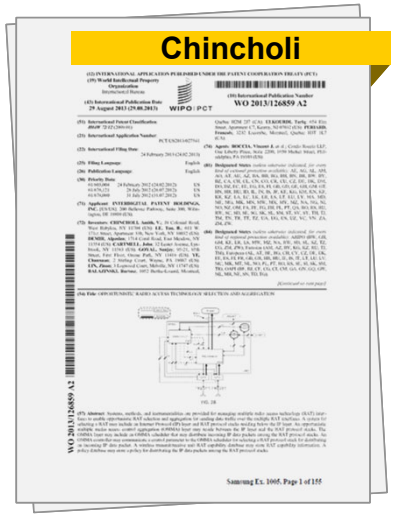
[0138] FIG. 5 is a diagram illustrating an example of dual-RAT aggregation with a common OMMA layer residing above MAC. FIG. 5 shows an exemplary device (*e.g.*, NT or WTRU) architecture which is aggregating two RATs 501a, 501b, for example, an 802.11n based RAT operating on ISM band and another 802.11 based RAT with non-contiguous carrier aggregation operating on TVWS band. The RATs 501a, 501b may comprise a MAC layer/module 502 and one or more physical layers/modules 503. The OMMA layer 500 may receive meta-data feedback from each of the RATs 501a, 501b. The OMMA layer 500 may decide to split IP packets based on received meta-data. Table 1 may provide the interfaces between an OMMA layer (*e.g.*, OMMA layer 500) and an IP layer (*e.g.*, IP layer 504) and one or more RATs (*e.g.*, RATs 501a, 501b), for example, as shown in FIG. 5.

Table 1

Interface	Description
M1	Meta-data/link statistics from TVWS band protocol stack to thin layer
M2	Meta-data/link statistics from ISM band protocol stack to thin layer
A1	Incoming/Outgoing MAC MSDUs on TVWS band, and MAC resource reservation control signaling
A2	Incoming/Outgoing MAC MSDUs on ISM band, and MAC resource reservation control signaling
S	Incoming/Outgoing IP Packets

’564 EX1005 at [0138], Fig. 5; ’564 EX2017 (Akl POR Decl.) at ¶ 78.

“virtual MAC interface”: “separately addressable”

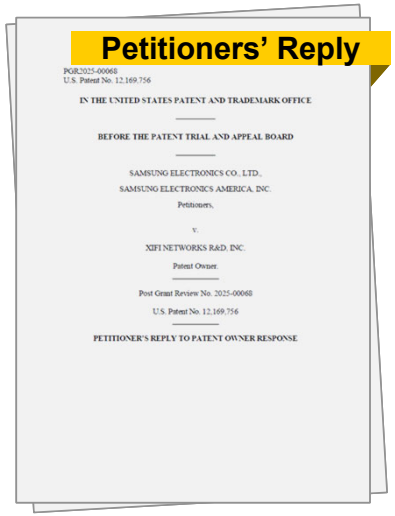


[0244] At the WTRU side, the OMMA Scheduler 3180 (*e.g.*, RAT Update Sender) may query (*e.g.*, periodically query) the RAT Availability Database 3170 for a RAT availability list of an associated NT, for example, via a STA_RAT_Capability_Query_A4 signal on interface A4 (*e.g.*, as shown in FIG. 28). After receiving a response (*e.g.*, STA_RAT_Capability_Response_A4) for the above request, the OMMA scheduler 3180 may generate a STA_RAT_Availability message, for example, with one or more of the following parameters, to be sent using over-the-air signaling:

- STA_Addr : Self Address
- AP_Addr : Address of a NT (*e.g.*, which it needs to send a message)
- RAT_Ids : List of Ids of RATs (*e.g.*, which are available) (*e.g.*, [RAT_1, RAT_2 …..])

’564 EX1005 at [0244]; ’564 Sur-reply at 9.

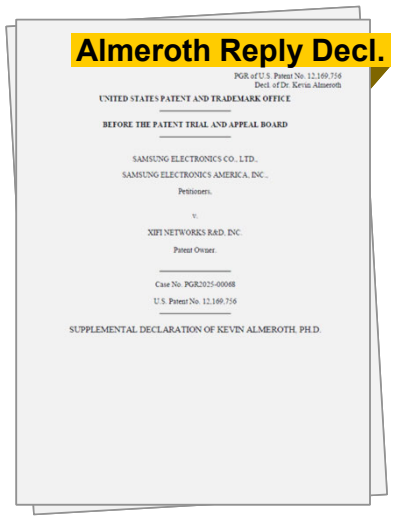
“virtual MAC interface”: “separately addressable”



Third, Chincholi’s OMMA Controller is separately addressable from the actual MAC addresses. WTRUs in Chincholi send signaling messages regarding their availability to the OMMA of associated NTs. EX1026 ¶¶37-43. Chincholi teaches that (i) an NT advertises its RAT capabilities, (ii) a WTRU responds with a STA_RAT_Availability message, and (iii) the OMMA Controller at the NT receives the message and uses it to update its capability database. EX1005 [0243]-[0245], Fig. 31; EX1026 ¶¶39-40. The STA_RAT_Availability message directed from WTRUs to the OMMA of NTs includes “AP_Addr,” EX1005 [0244], which is the address of the NT separate from actual MAC addresses of the NT’s individual RATs. EX1026 ¶¶40-43. The AP_Addr is a unique address, separate from the NT’s actual MAC addresses, and is used by WTRUs to send signaling packets to the OMMA of associated NTs over the wireless medium. EX1026 ¶43. This confirms that the OMMA of each NT is “separately addressable” from the actual MAC interfaces. EX1026 ¶¶42-43.

’564 Reply at 7.

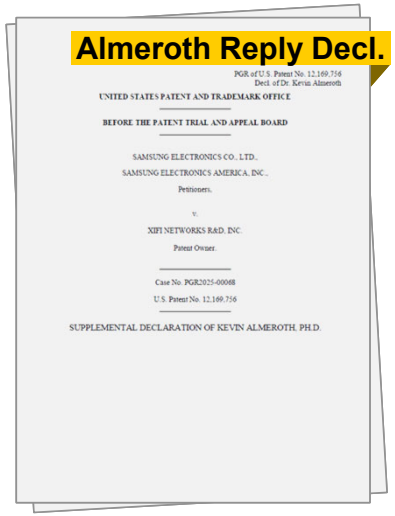
“virtual MAC interface”: “separately addressable”



43. The STA_RAT_Availability message includes addressing information for the OMMA of the destination NT/AP, including AP_Addr. EX1005 [0244]-[0245]. A POSITA would have understood AP_Addr to be destination address information for the NT, separate from the actual MAC addresses of the NT's individual RATs. A POSITA would further understand that this address information is used to exchange signaling packets between WTRUs and the OMMA functionality of associated NTs over the wireless medium. Thus, the STA_RAT_Availability signaling confirms that the OMMA of the NT is separately addressable from the actual MAC interfaces.

’564 EX1026 (Almeroth Reply Decl.), ¶ 43; ’564 Reply at 7.

“virtual MAC interface”: “separately addressable”



40. Importantly, the STA_RAT_Availability message sent from the WTRU to the NT includes the following parameters: “STA_Addr,” which is the self-address of the WTRU, “AP_Addr,” which is the device-level address of the NT to which the message is sent, and “RAT_Ids,” which is a list of the available RATs on the WTRU. EX1005 at [0244]. After the NT receives the STA_RAT_Availability message, it then signals the OMMA Controller to update information of the WTRU RAT availability in the RAT Capability Database. *Id.* at [0245].

’564 EX1026 (Almeroth Reply Decl.), ¶ 40; ’564 Reply at 7.

“virtual MAC interface”: “separately addressable”

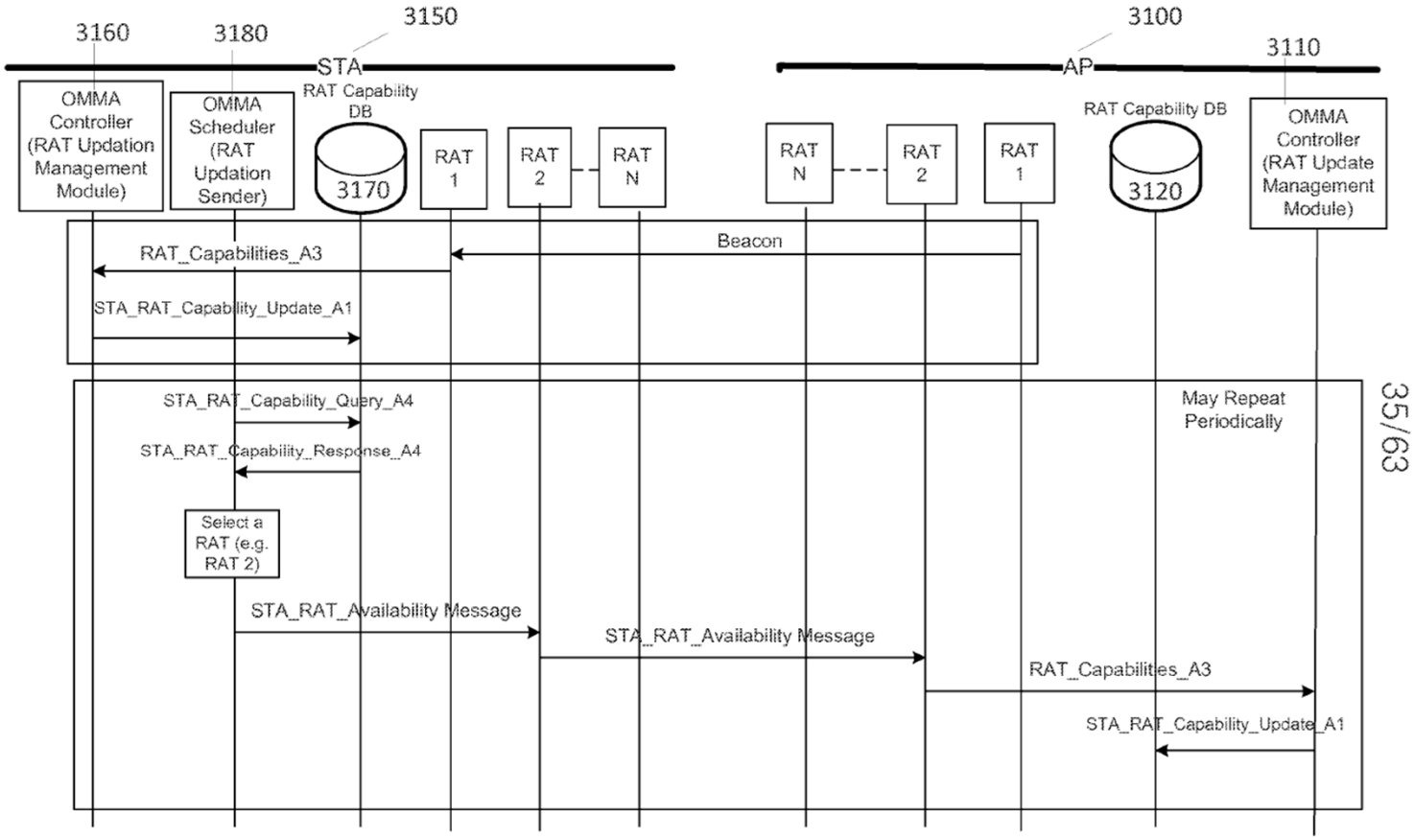
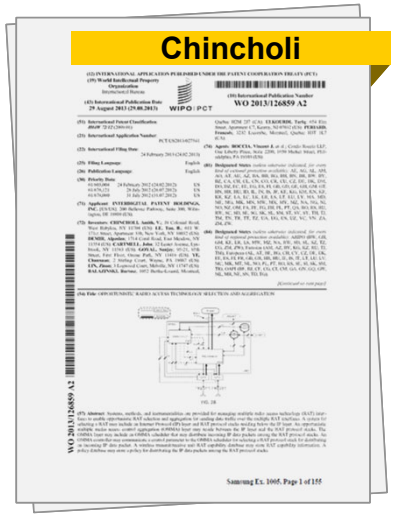


FIG. 31

’564 EX1005, Fig. 31; ’564 Sur-reply at 4-5.

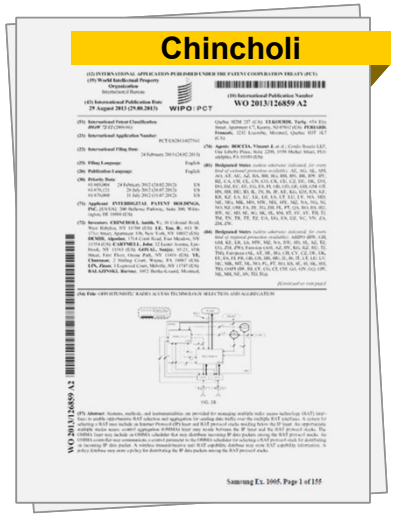
“virtual MAC interface”: “separately addressable”



[0245] The OMMA Scheduler 3180 (*e.g.*, RAT Update Sender) at the WTRU 3150 may transmit RAT availability information to the NT 3100 using one of the operational RATs at that time. At the NT 3100, the RAT that receives the STA_RAT_Availability message may signal the OMMA Controller 3110 (*e.g.*, RAT Update Management module), for example, via a RAT_Capablities_A3 on interface A3 (*e.g.*, as shown in FIG. 28). The OMMA Controller 3110 (*e.g.*, RAT Update Management module) may update information of RAT Availability in the RAT Capability Database 3120 for that WTRU, for example, via a STA_RAT_Capability_Update_A1 signal on interface A1 (*e.g.*, as shown in FIG. 28). The RAT Availability information of a WTRU-NT pair may be refreshed (*e.g.*, periodically refreshed).

’564 EX1005 at [0245]; ’564 Sur-reply at 9.

“virtual MAC interface”: “separately addressable”



[0243] FIG. 31 illustrates an example call flow illustrating signaling corresponding to an example of a RAT availability update procedure described herein. A NT 3100 may send one or more beacons on its RATs (*e.g.*, periodically). A WTRU 3150 may receive knowledge of RAT availability for an associated NT through one or more beacons. A RAT that receives a beacon may inform/update the OMMA Controller 3160 (*e.g.*, RAT Update Management module) regarding RAT availability, for example, via a signal RAT_Capablities_A3 on interface A3 (*e.g.*, as shown in FIG. 28). The OMMA Controller 3160 (*e.g.*, RAT Update Management module) may update information of RAT availability in the RAT Capability Database 3170, for example, via a STA_RAT_Capability_Update_A1 signal on interface A1 (*e.g.*, as shown in FIG. 28).

’564 EX1005 at [0243]; ’564 Sur-reply at 9.

“virtual MAC interface”: “separately addressable”

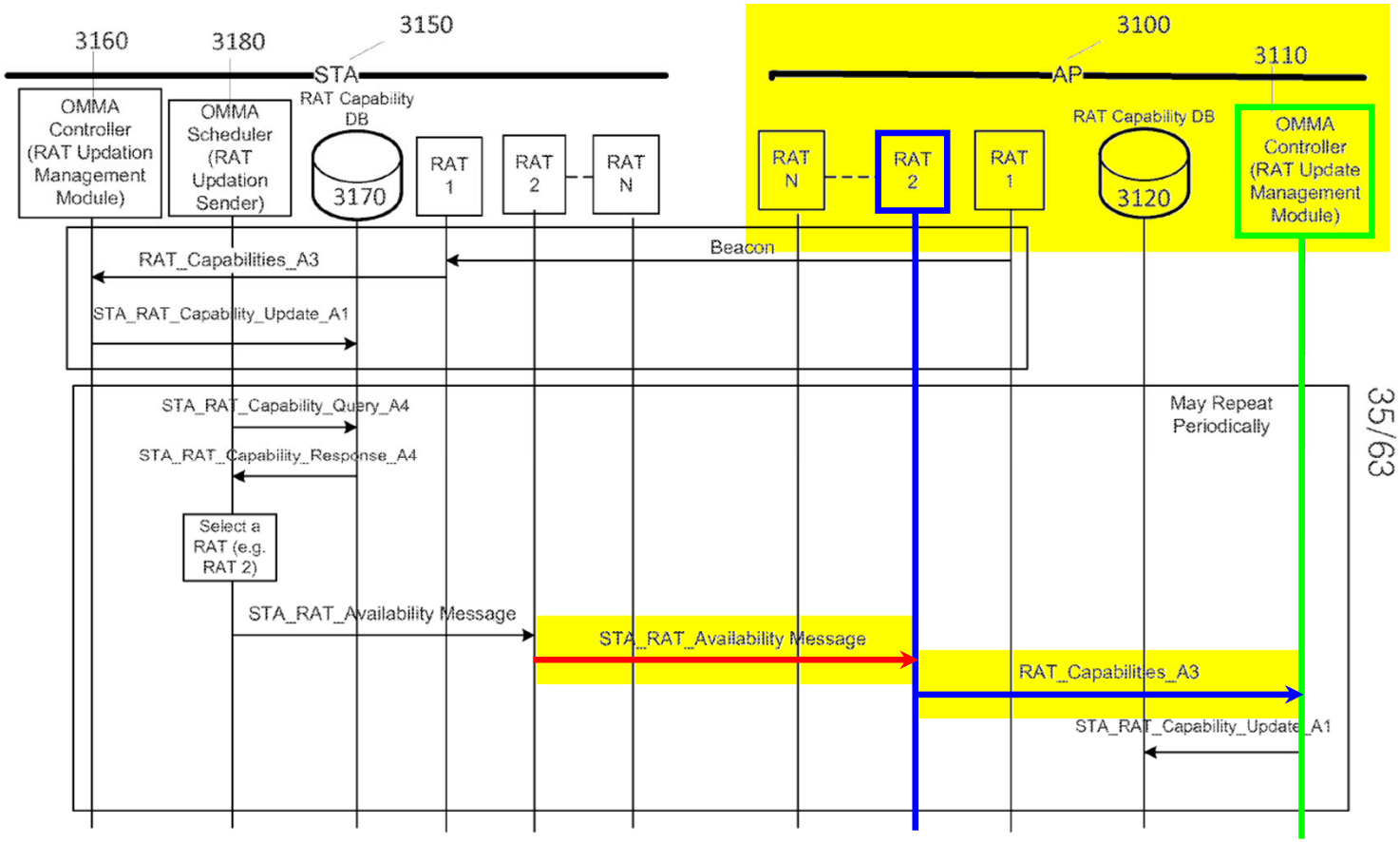
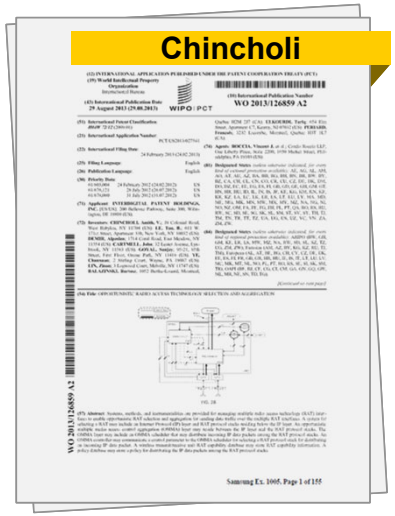


FIG. 31

’564 EX1005, Fig. 31; ’564 Sur-reply at 4-5.

“virtual MAC interface”: “separately addressable”



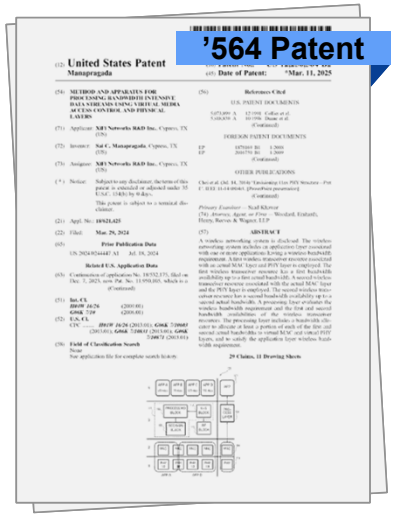
[0200] As described herein, a node (*e.g.*, a NT or a WTRU) comprising an OMMA layer may aggregate bandwidth available on multiple radio access technologies (RATs). The node may establish a communication path via one or more RATs. For example, the node may establish a first communication path via a first RAT associated with the node, and establish a second communication path via a second RAT associated with the node. The node may receive feedback information associated with the one or more RATs. For example, the node may receive first feedback information associated with the first RAT, and receive second feedback information associated with the second RAT. The node may determine to send one or more IP packets of an IP flow across the one or more RATs, for example, as described herein (*e.g.*, using feedback information, one or more policies/rules, a distribution mode, *etc.*). For example, the node may determine a first IP packet to send via the first RAT according to the first and second feedback information. The node may also determine a second IP packet to send via the second RAT according to the first and second feedback information. The first and second IP packets may be part of an Internet Protocol (IP) flow addressed to a receiving node (*e.g.*, which may be a NT or a WTRU). The node may send one or more IP packets via the one or more RATs. For example, the node may send the first IP packet via the first RAT and send the second IP packet via the second RAT.

’564 EX1005 at [0200]; ’564 Sur-reply at 8.

“virtual MAC interface”: “obscures”

All Patents
All Claims

“virtual MAC interface”: “obscures”



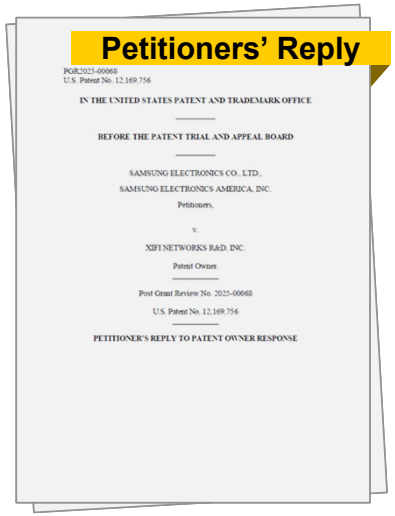
first and second actual MAC interfaces connected to the processing interface;

at least one virtual MAC interface and at least one resource monitoring interface formed in the processing interface that, during operation of the wireless networking device, feeds information regarding the bandwidth availabilities of the first and second wireless transceivers back to the at least one virtual MAC interface;

wherein the processing interface is configured to, when the wireless networking device is being used, and in a manner transparent to any layer of the wireless networking device above the processing interface,

’564 EX1001 at 12:12-13, 12:25-34;’564 POR at 8, 47.

“virtual MAC interface”: “obscures”

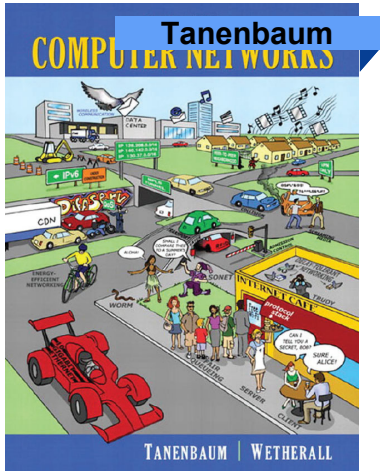


1. Chincholi discloses the “virtual MAC interface”

The Petition demonstrates that Chincholi’s OMMA layer contains a “virtual MAC interface” under the stipulated construction—*i.e.*, “a software- or logical-based interface that is separately addressable from the recited actual MAC interfaces and that obscures the recited actual MAC interfaces from higher protocol stack layers.” Pet. 25-28.

’564 Reply at 5-6.

“virtual MAC interface”: “obscures”



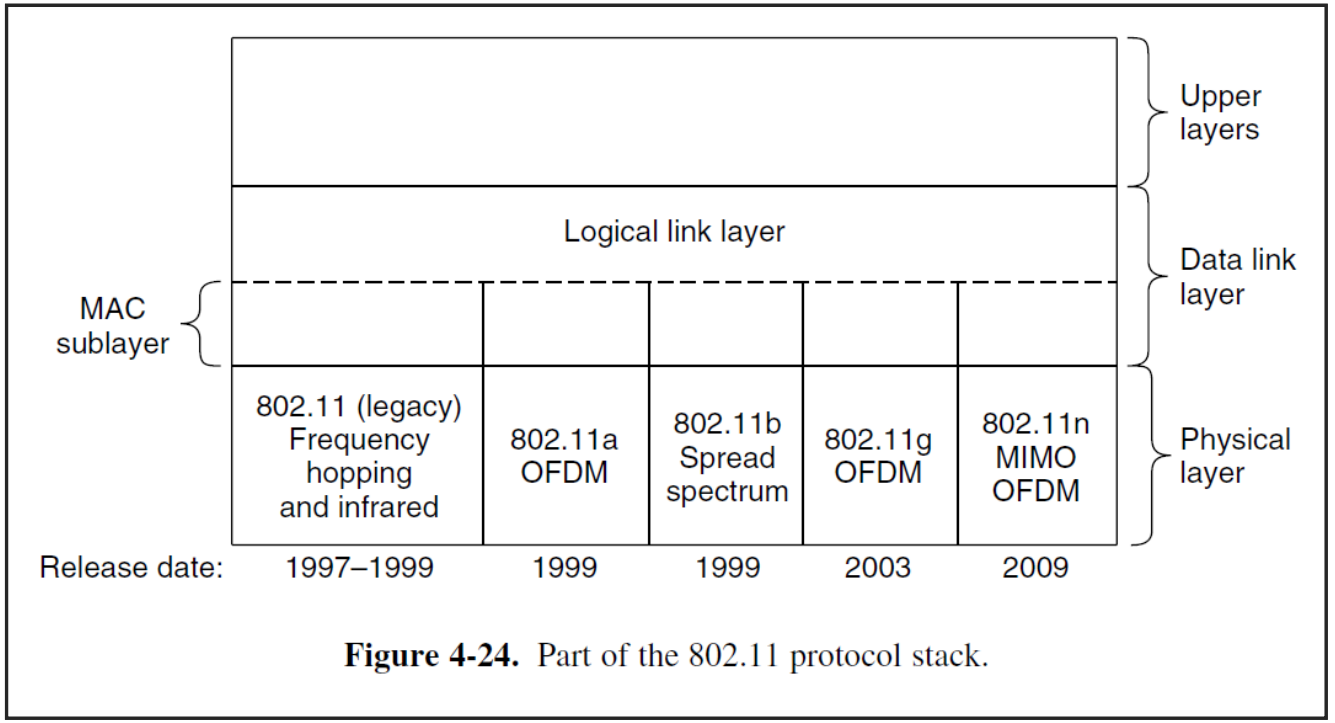
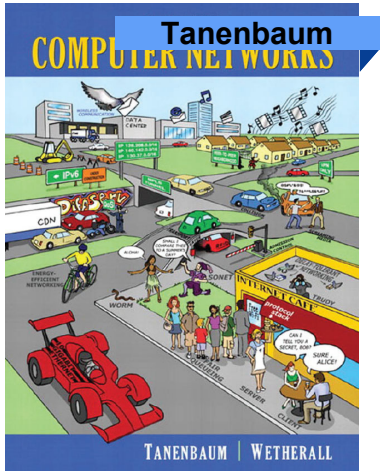


Figure 4-24. Part of the 802.11 protocol stack.

‘564 EX2010 at 148 (Tanenbaum at 300); ’564 Sur-reply at 9-10.

“virtual MAC interface”: “obscures”



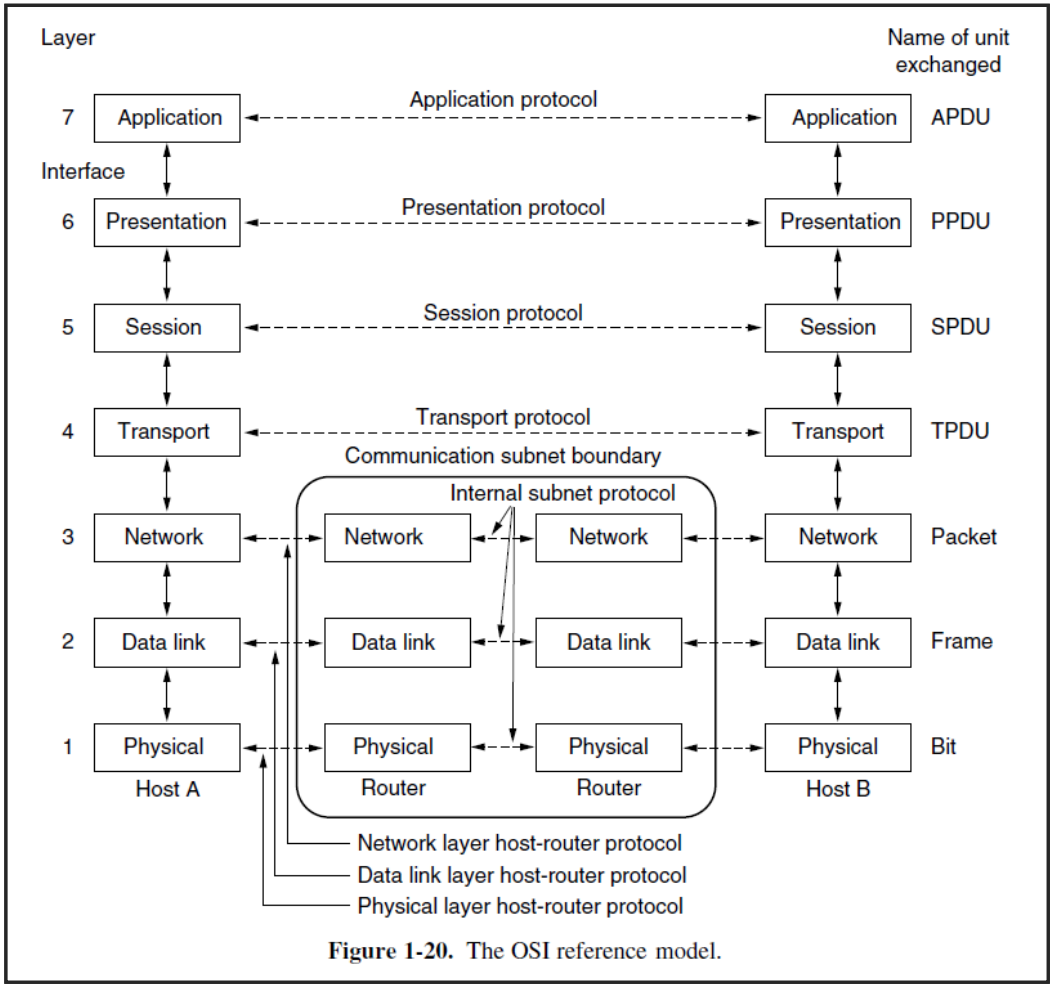


Figure 1-20. The OSI reference model.

‘564 EX2018 at 046 (Tanenbaum at 42); ’564 Sur-reply at 9-10.

“virtual MAC interface”: “obscures”

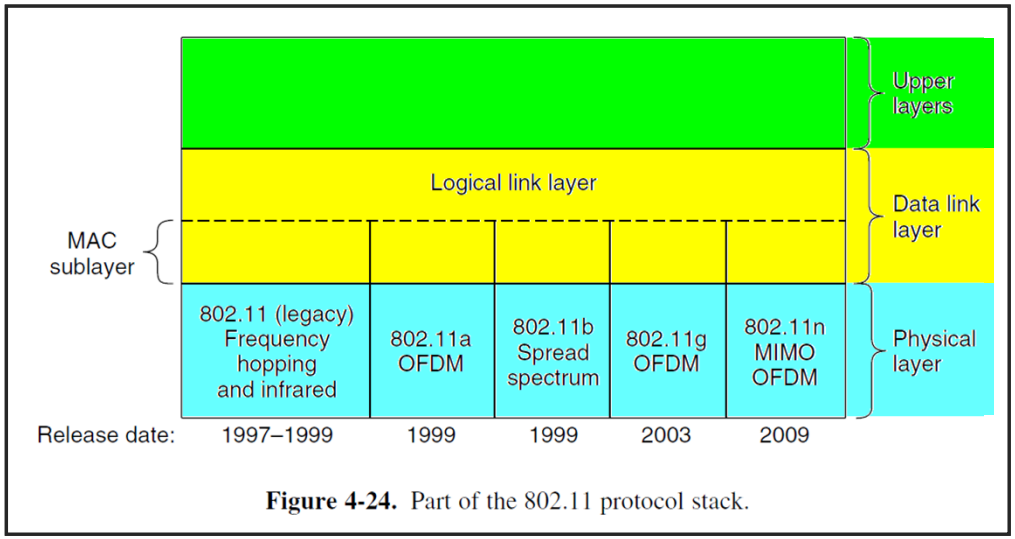


Figure 4-24. Part of the 802.11 protocol stack.

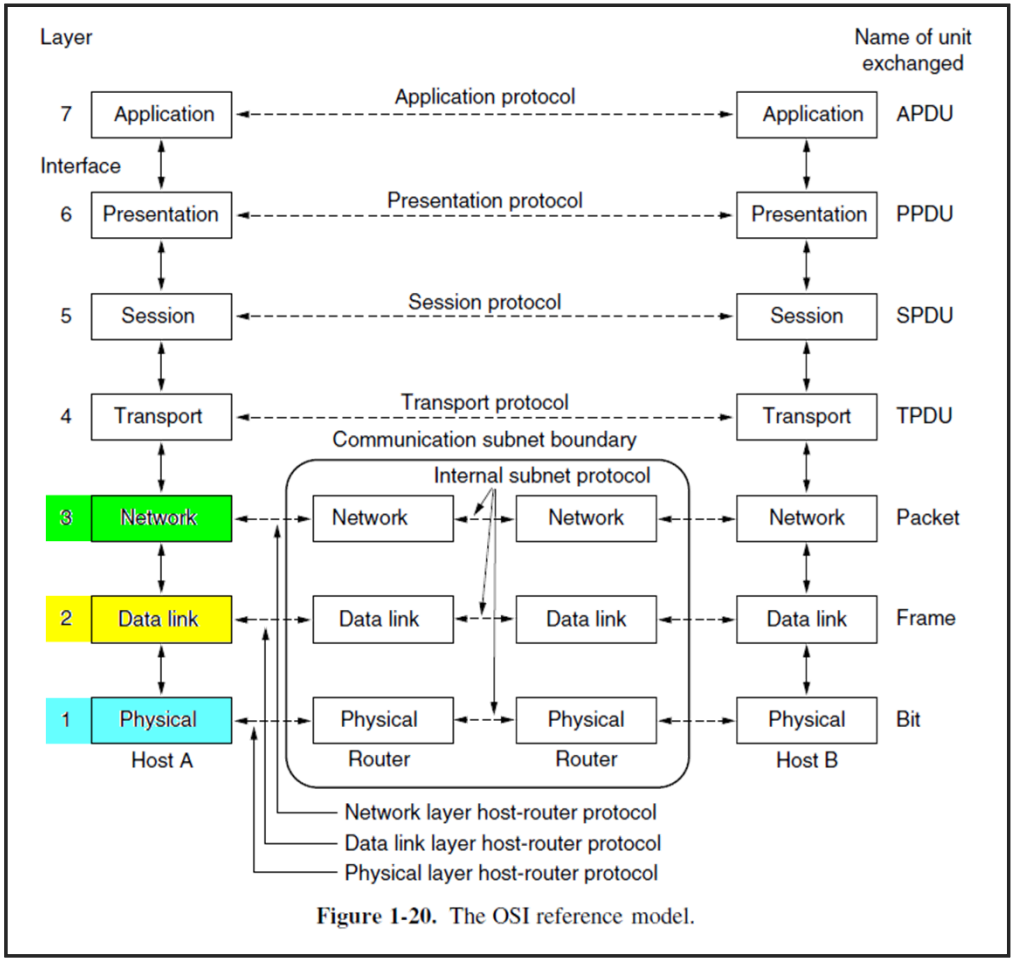
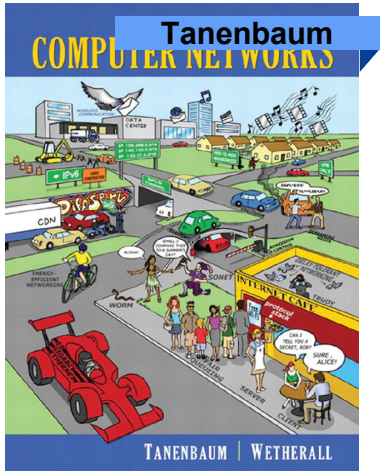


Figure 1-20. The OSI reference model.

’564 EX2010 at 148 (Tanenbaum at 300); ’564 EX2018 at 046 (Tanenbaum at 42); ’564 Sur-reply at 9-10.

“virtual MAC interface”: “obscures”



The Data Link Layer

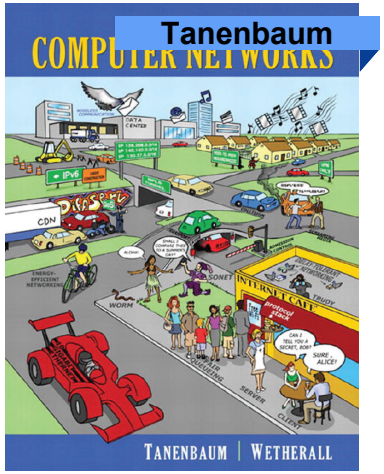
The main task of the **data link layer** is to transform a raw transmission facility into a line that appears free of undetected transmission errors. It does so by masking the real errors so the network layer does not see them. It accomplishes this task by having the sender break up the input data into **data frames** (typically a few hundred or a few thousand bytes) and transmit the frames sequentially. If the service is reliable, the receiver confirms correct receipt of each frame by sending back an **acknowledgement frame**.

Another issue that arises in the data link layer (and most of the higher layers as well) is how to keep a fast transmitter from drowning a slow receiver in data. Some traffic regulation mechanism may be needed to let the transmitter know when the receiver can accept more data.

Broadcast networks have an additional issue in the data link layer: how to control access to the shared channel. A special sublayer of the data link layer, the **medium access control** sublayer, deals with this problem.

’564 EX2018 at 047 (Tanenbaum at 43); ’564 Sur-reply at 9-10.

“virtual MAC interface”: “obscures”



The Network Layer

The **network layer** controls the operation of the subnet. A key design issue is determining how packets are routed from source to destination. Routes can be based on static tables that are “wired into” the network and rarely changed, or more often they can be updated automatically to avoid failed components. They can also be determined at the start of each conversation, for example, a terminal session, such as a login to a remote machine. Finally, they can be highly dynamic, being determined anew for each packet to reflect the current network load.

If too many packets are present in the subnet at the same time, they will get in one another’s way, forming bottlenecks. Handling congestion is also a responsibility of the network layer, in conjunction with higher layers that adapt the load they place on the network. More generally, the quality of service provided (delay, transit time, jitter, etc.) is also a network layer issue.

When a packet has to travel from one network to another to get to its destination, many problems can arise. The addressing used by the second network may be different from that used by the first one. The second one may not accept the packet at all because it is too large. The protocols may differ, and so on. It is up to the network layer to overcome all these problems to allow heterogeneous networks to be interconnected.

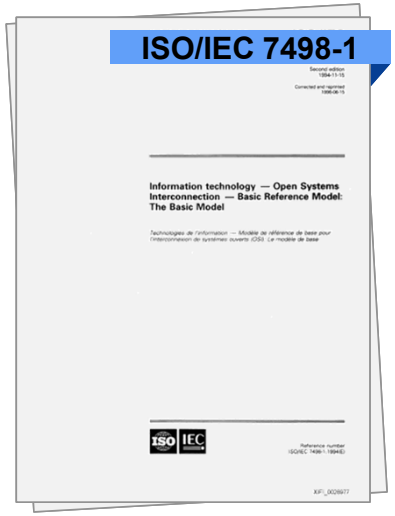
In broadcast networks, the routing problem is simple, so the network layer is often thin or even nonexistent.

’564 EX2010 at 047-048 (Tanenbaum at 43-44); ’564 Sur-reply at 9-10.

“virtual MAC interface”: “obscures”

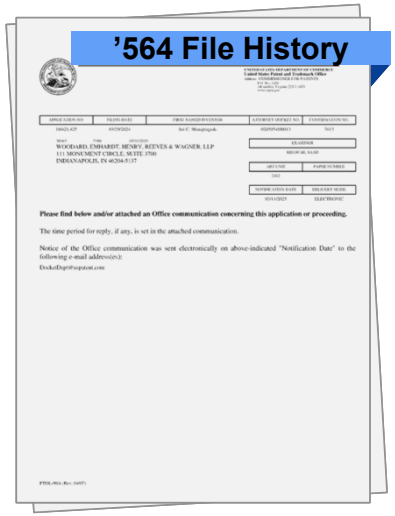
ISO/IEC 7498-1, Open Systems Interconnection Model

7.5.4.2.2 The control of interconnection of data-circuits (which are in the Physical Layer) from the Network Layer requires interaction between a network-entity and a physical-entity in the same open system. Since the Reference Model permits direct interaction only between adjacent layers, the network-entity cannot interact directly with the physical-entity. This interaction is thus described through the Data Link Layer which intervenes transparently to convey the interaction between the Network Layer and the Physical Layer.



’564 EX2019 at 050 (ISO/IEC 7498-1 at § 7.5.4.2.2); ’564 Sur-reply at 10.

“virtual MAC interface”: “obscures”

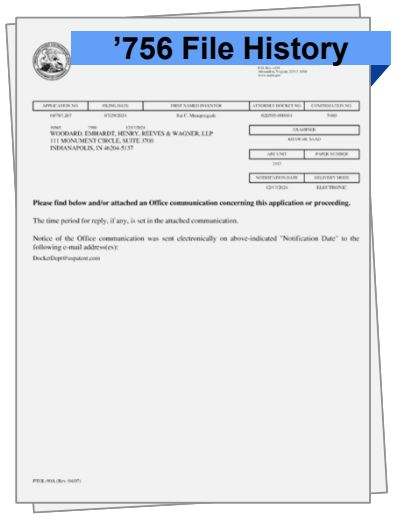


Patentability

The amended claims recite a “virtual MAC interface” formed in the “processing interface” that receives information regarding the “bandwidth availabilities” of the first, second and third transceivers that is provided by a “resource monitoring interface.” The “resource monitoring interface” operates in a processing layer below the logical link layer and provides information about the bandwidth availability of the transceivers associated with the actual PHY interfaces. The bandwidth availability information the “resource monitoring interface” provides to the “virtual MAC interface” allows the “virtual MAC interface” to allocate portions of the actual bandwidth of each transceiver to satisfy application bandwidth needs.

’564 EX1004 (’564 File History) at 385-386 ; ’564 POR at 22-23, 40; ’564 Sur-reply at 9-10.

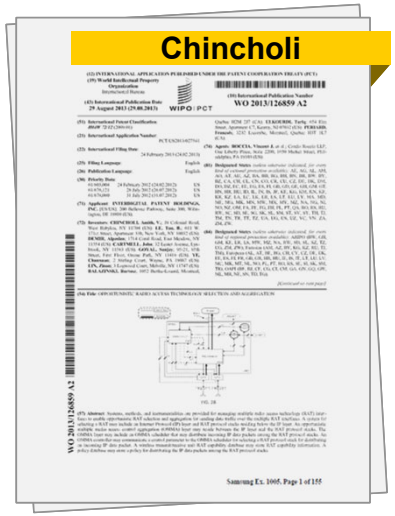
“virtual MAC interface”: “obscures”



1) The dashed line box surrounding two boxes labelled “MAC” 114 and “PHY” 116 in Figure 1 are schematic representations of the actual MAC and PHY layers of a wireless networking device that includes at least two wireless transceivers. A two-way arrow connects the dashed box with a “process layer” 104. This discloses that each actual MAC and each actual PHY in a particular wireless networking device communicates directly with the processing layer to allow it to receive information regarding bandwidth availabilities from the wireless transceiver associated with each MAC/PHY pair.

‘564 EX2026 (’756 File History) at 8; ’564 POR at 21-22, 40; ’564 Sur-reply at 9-10.

“virtual MAC interface”: “obscures”



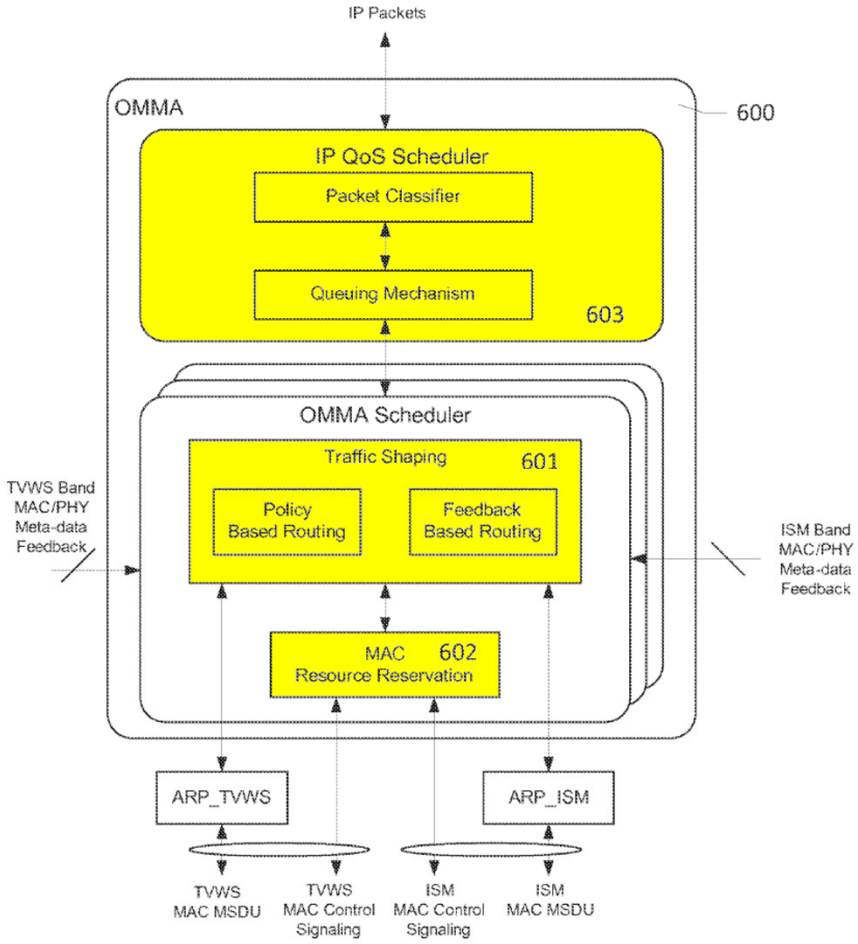
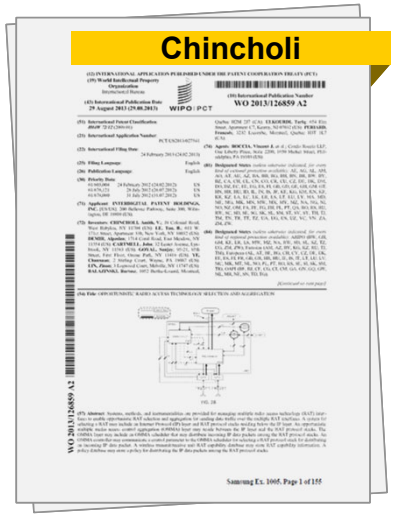


FIG. 6

’564 EX1005, Fig. 6; ’564 Petition at 26-28.

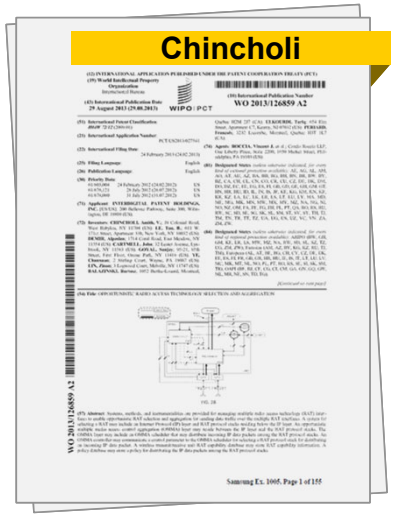
“virtual MAC interface”: “obscures”



[0139] FIG. 6 is a block diagram of an example OMMA layer. The OMMA layer 600 may comprise one or more of the following: a traffic shaping module 601, a MAC resource reservation module 602, and an internet protocol (IP) quality of service (QoS) scheduler 603. The traffic shaping module 601 may responsible for determining the way packets are routed across RATs. For example, the traffic shaping module may determine the way a packet is routed using policy based routing or feedback based routing.

’564 EX1005 at [0139]; ’564 POR at 38-39; ’564 Sur-reply at 11.

“virtual MAC interface”: “obscures”



[0142] The MAC Resource Reservation module 602 may determine an amount of time duration and/or spectral fragment/bandwidth required by a packet or a set of packets. This module may transmit specific requests to the RATs over the A1/A2 interface.

[0143] The IP QoS Scheduler module 603 may segregate a single IP packet stream comprising multiple IP QoS types into distinct IP QoS streams, for example, so that the traffic shaping module 601 may treat each IP QoS stream independently and satisfy the specific QoS requirements when routing the IP packets.

’564 EX1005 at [0142]-[0143]; ’564 POR at 38-39.

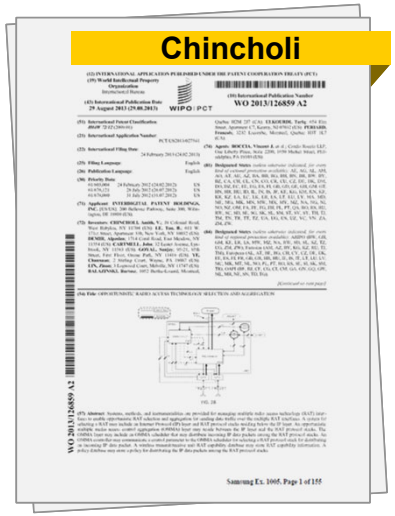
"virtual MAC interface": "obscures"

Patent Owner's Evidence: Dr. Akl

theoretical—it affects efficiency, scalability, and interoperability. On the other hand, it would be clear to a POSITA that each of the three components Dr. Almeroth equates with the components of the virtual MAC are performing layer 3 (network layer) functions. First, Chincholi states that the traffic shaping module is "responsible for determining the way packets are routed." EX1005, [0139]. A POSITA would understand packet routing to be a network layer function because it refers to "packets," as well as how those packets are routed. EX2018 (Tanenbaum) at 42 (noting "name of unit exchanged" at network layer is "packet"); *id.* at 43 (noting that a key issue for the network layer is "determining how packets are routed"). Second, the MAC resource reservation module determines time and bandwidth resources required "by a packet or set of packets"—again, a network layer function dealing with "packets." *Id.* at 42-43. Finally, the IP QoS Scheduler module states in its name that it is associated with the network layer—which a POSITA would know is also known as the IP layer. EX2018 (Tanenbaum) at 47 (noting that layer 3 may be known as the Internet layer or the IP layer in some protocol stack models). Further, the function of the IP QoS Scheduler module is to "segregate a single IP packet stream comprising multiple IP QoS types into distinct QoS streams," again, a function explicitly associated with layer 3—since it relates to management of IP packet streams. EX2018 (Tanenbaum) at 42-43.

'564 EX2017 (Akl POR Decl.), ¶88.

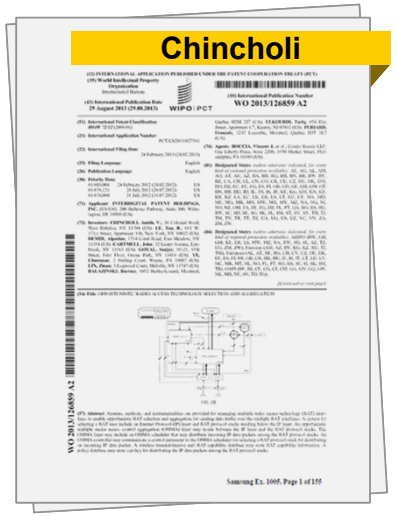
“virtual MAC interface”: “obscures”



[0173] The OMMA layer may interface the TCP layer of the stack to receive some of the internal data of the TCP entity. The OMMA layer may receive information about when the receiving TCP entity is about to signal to the sending TCP entity that is it receiving packets out of order. Upon receipt of this information, the OMMA entities at the sender and receiver may exchange this information and use it in the routing decisions that may be made by the sending OMMA entity. This TCP information may be in addition to any other information that the sending OMMA entity may use to make routing decisions on a packet-by-packet basis. FIG. 20 is a diagram illustrating an example architecture of such a solution. The parameters to be passed from the TCP entities to the OMMA entities may be related to the timers and other parameters that TCP uses to determine if congestion is occurring.

’564 EX1005 at [0173]; ’564 POR at 41 n.6; ’564 EX2017 (Akl POR Decl.) at ¶ 89.

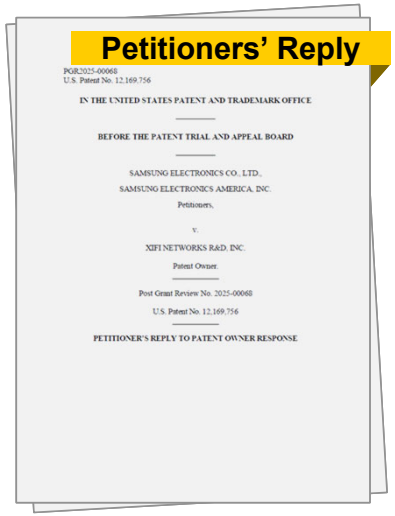
“virtual MAC interface”: “obscures”



[0122] An aggregation layer, which may be referred to an opportunistic multi-medium access control (MAC) aggregation (OMMA) layer, and may be common to all RATs in a NT 201 and/or WTRU 202 may be proposed. The OMMA layer (*e.g.*, or OMMA module) may reside below the IP layer and above the radio protocol stacks. The OMMA layer may not be an independent layer, but rather the functionality of the OMMA layer may reside partially on one or more layers (*e.g.*, the IP layer, the MAC layer, *etc.*) of the protocol stack. Functionality (*e.g.*, or modules) of the OMMA layer may reside on one or more NTs, for example, to allow the processing of the OMMA layer to be divided between network elements.

’564 EX1005 at [0122]; ’564 Reply at 10.

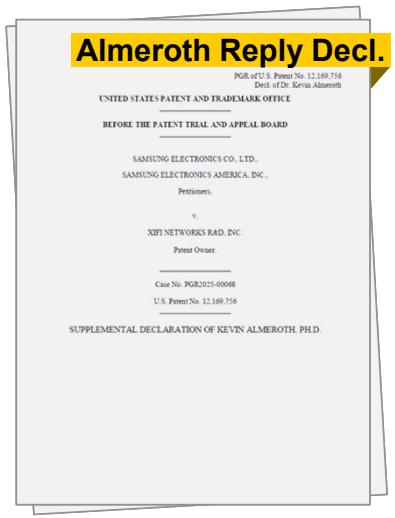
“virtual MAC interface”: “obscures”



Regardless, even if PO’s Layer-2 argument were correct as a matter of claim construction, the premise that Chincholi’s disclosures are limited to “layer 3” is wrong. Chincholi teaches, “[t]he OMMA layer may not be an independent layer, but rather the functionality of the OMMA layer may reside partially on one or more layers (e.g., the IP layer, ***the MAC layer, etc.***) of the protocol stack.” EX1005 [0122]. Chincholi therefore meets the claim limitation regardless. EX1026 ¶60.

’564 Reply at 10 (PGR2025-00068).

“virtual MAC interface”: “obscures”



60. I also disagree with Patent Owner’s argument that Chincholi cannot disclose a virtual MAC interface because the OMMA is allegedly limited to layer 3. Chincholi is not so limited. Chincholi teaches that “[t]he OMMA layer may not be an independent layer, but rather the functionality of the OMMA layer may reside partially on one or more layers (e.g., the IP layer, the MAC layer, etc.) of the protocol stack.” EX1005 [0122]. A POSITA would therefore have understood Chincholi to disclose OMMA functionality that may reside at, or be implemented in connection with, the MAC layer. Thus, even under Patent Owner’s attempt to impose a layer-specific requirement, Chincholi discloses OMMA functionality satisfying that requirement.

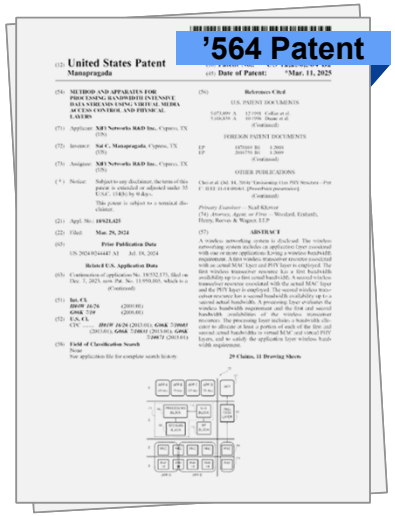
’564 EX1026 (Almeroth Reply Decl.), ¶60; ’564 Reply at 10.

“information regarding bandwidth availabilities”

All Patents

All Claims

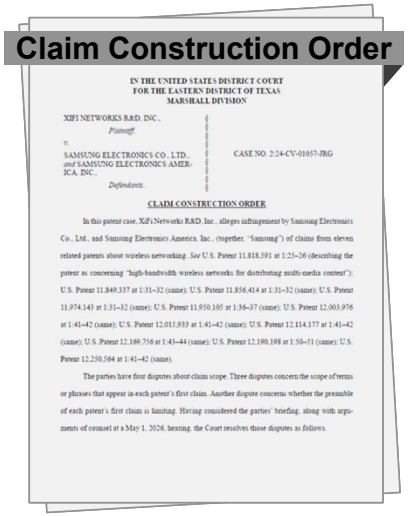
“information regarding bandwidth availabilities”



at least one virtual MAC interface and at least one resource monitoring interface formed in the processing interface that, during operation of the wireless networking device, feeds information regarding the bandwidth availabilities of the first and second wireless transceivers back to the at least one virtual MAC interface;

’564 EX1001 at 12:25-30 (claim 1).

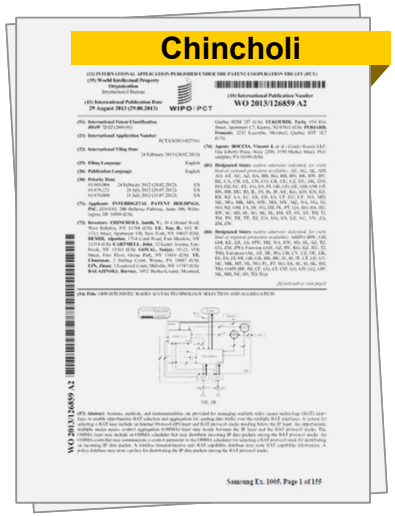
“information regarding bandwidth availabilities”



For this term, based on the foregoing, the Court adopts Samsung’s construction of “information regarding current bandwidth availabilities of each of the wireless transceivers.”

’564 EX1027 (E.D. Tex. Claim Construction Order) at 16.

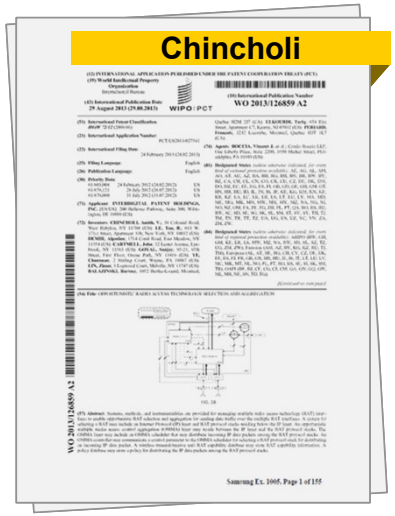
“information regarding bandwidth availabilities”



[0141] In feedback based routing, the packets may be transmitted on different RATs using the feedback metrics. The feedback metrics may include, but are not limited to, RSSI, medium access delay, *etc.* The feedback metrics may reflect the average state of the system operating on each RAT.

’564 EX1005 at [0141]; ’564 POR at 44; ’564 EX2017 (Akl POR Decl.) at ¶ 91.

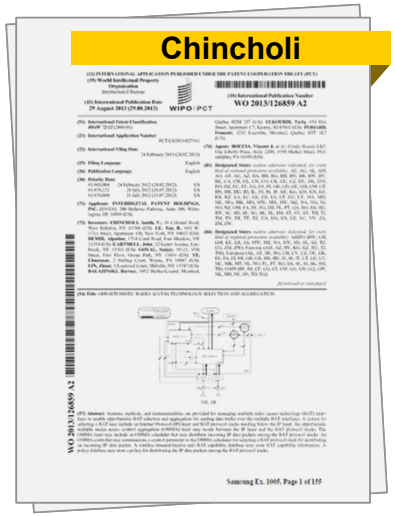
“information regarding bandwidth availabilities”



[0155] For example, if the channel quality of one RAT is 6dB or lower than the channel quality of the other RATs, the RAT with the low channel quality may be disabled. If the OMMA layer determines that the ratio of packets distributed across a dual RAT device is 9:1, Dynamic RAT Switching Mode may be enabled, for example, so the RATs with a better channel quality may be used. For example, channel quality events that may trigger this mode may include, but are not limited to, low throughput, low RSSI, transmission control protocol (TCP) re-ordering trigger, high medium access delay, and high end-to-end delay.

’564 EX1005 at [0155]; ’564 Sur-reply at 13.

“information regarding bandwidth availabilities”



[0161] In feedback based routing, the OMMA transmitter may use measurement metrics fed back from each RAT. The measurement metrics may include, but are not limited to, channel quality metrics and the number of available resources on the medium. The OMMA transmitter may utilized the measurement metrics to determine the instantaneous ratio of distribution of packets across the RATs. Table 2 provides examples of feedback metrics that may be used by an OMMA layer (*e.g.*, an OMMA transmitter).

’564 EX1005 at [0161]; ’564 POR at 44; ’564 EX2017 (Akl Decl.) at ¶ 91.

“information regarding bandwidth availabilities”

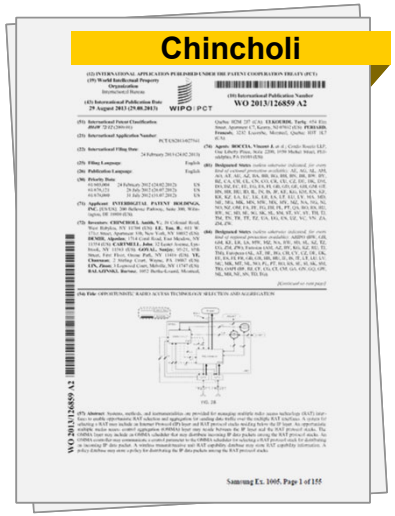
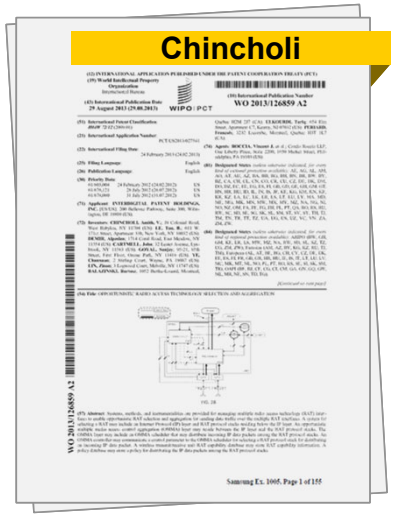


Table 2

Metric	Sender	Description
Medium Access Delay	MAC	Total packet delay in queue plus contention delay
RSSI	PHY	Received signal strength indication from PMD_RSSI.indication (*e.g.*, strength)
Frame error rate	MAC	Average rate at which packets are NACKed
Data rate	MAC	Average throughput
Queuing latency	MAC	Total packet delay in queue
End-to-end delay	MAC	Total delay from input to MAC at transmitter to output of MAC at receiver
TXOP duration	MAC	TXOP duration for video and voice access categories
AC with medium access	MAC	AC_BK, AC_BE, AC_VI, AC_VO, legacy
Backoff time	MAC	Random back off duration
Number of channels	PHY/MAC	Integer number of distinct channels
Channel bandwidth(s)	PHY/MAC	Vector/List of elements which are multiple of 0.5 MHz
MAC Aggregation Supported	MAC	Boolean: Yes, No
MAC Type	MAC	CSMA/CA, OFDMA, *etc.*

’564 EX1005 at [0161] (Table 2); ’564 POR at 44; ’564 EX2017 (Akl POR Decl.) at ¶ 91.

“information regarding bandwidth availabilities”

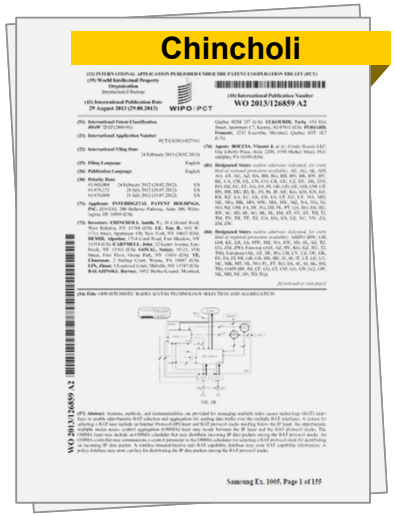


[0163] The cold start phase may be triggered when the device starts an OMMA layer/module for the very first time. In this phase, the OMMA layer may request the individual RATs to transmit the total channel bandwidths supported by them. The OMMA layer may use this information to distribute the IP packets across the RATs accordingly. For example, if two RATs are supported by the device, one operating on ISM band and the other operating on TVWS band, the ratio of packet distribution between the RAT on the ISM band to the RAT on the TVWS band may be determined by the OMMA layer utilizing the following:

$$BW_{ISM} : \sum_{k=1}^{N} BW_{TVWS}^{k}$$

’564 EX1005 at [0163]; ’564 Sur-reply at 13.

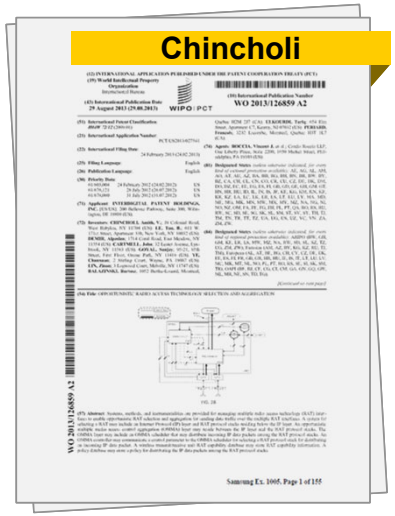
“information regarding bandwidth availabilities”



[0167] OMMA multi-RAT metric feedback management may be described herein. FIG. 14 is a diagram illustrating an example timeline for sending feedback metrics. At the transmitter, the feedback metrics from each RAT may be sent with a predetermined timing, for example, as shown in FIG. 14. At startup, the OMMA layer may receive the available bandwidth of each of the one or more RATs. At the beginning of the ramp-up phase, the OMMA layer may receive RSSI values as seen by the one or more RATs. Following the ramp-up phase, the steady state-phase may start where the RAT modules at the transmitter OMMA layer may report metrics periodically or aperiodically. The metrics may include, but are not limited to, medium access delay, RSSI, queuing delay, *etc.* The receiver OMMA layer may report certain RAT measurement metrics back to the transmitter OMMA layer. The OMMA layer algorithm may process the metrics received and update the ratio of distribution of packets across RATs periodically or aperiodically.

’564 EX1005 at [0167]; ’564 Sur-reply at 13.

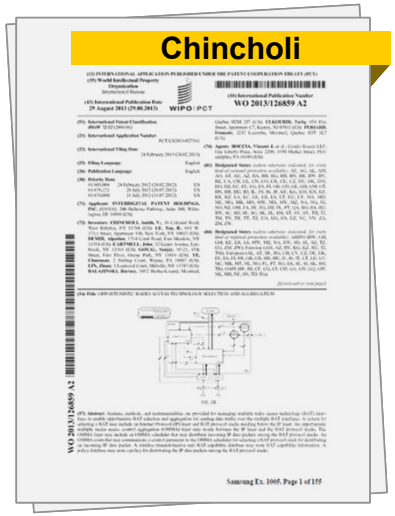
“information regarding bandwidth availabilities”



[0215] The OMMA Scheduler 3000 may comprise a Feedback Based Scheduler (FBS) module 3020. The FBS module 3020 may perform feedback based routing, for example, where packets may be sent on different RATs using feedback metrics (*e.g.*, RSSI, medium access delay, *etc.*), which may reflect the average state of the link between NT and WTRU on each RAT. These feedback metrics may be received from the OMMA Controller, for example, through interface A5a (*e.g.*, as shown in FIG. 28). As described herein, the feedback may include, but is not limited to, one or more of a medium access delay, jitter, a frame error rate, an average data rate, a received signal strength indication (RSSI) level, queuing latency per access category per RAT, end-to-end latency, a backoff time, a number of channels, channel bandwidth, a media access control (MAC) type, MAC aggregation support, an access category, a transmission opportunity (TXOP) duration, an estimated arrival rate of a packet, an average packet delay, packet loss rate (or frame error rate), queuing latency, number of MAC retransmissions, an average physical layer data rate, an average serving rate, an average serving latency, a serving delay variance, a second moment of average serving latency, vacation time, an average vacation time, a second average of vacation time, a vacation time variance, QoS_ID, TCP parameters, such as sequence number, acknowledgement number, and window size, for example, *etc.*

’564 EX1005 at [0215]; ’564 Reply at 11.

“information regarding bandwidth availabilities”



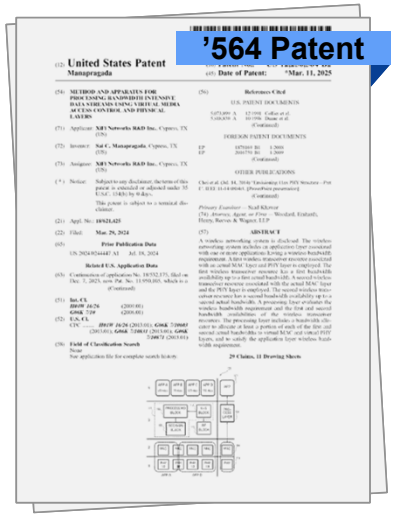
[0216] Feedback metrics, such as, but not limited to medium access delay, frame rate error, data rate, queuing latency, end-to-end latency, TXOP duration, AC with medium access, backoff time, number of channels, MAC aggregation supported, MAC type, jitter, serving delay, serving delay variance, vacation time, vacation time variance, STA_Addr, QoS_ID, and number of MAC retransmissions may be provided to the OMMA layer from the MAC layer. Feedback metrics, such as, but not limited to, RSSI, number of channels, and channel bandwidth may be provided to the OMMA layer from the MAC layer.

’564 EX1005 at [0216]; ’564 Reply at 11.

“in a manner transparent”

All Patents
All Claims

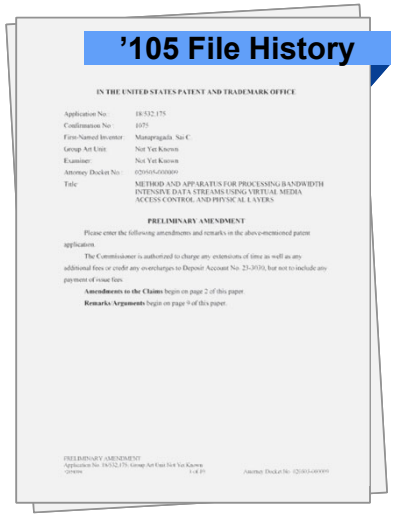
“in a manner transparent”



wherein the processing interface is configured to, when the wireless networking device is being used, and in a manner transparent to any layer of the wireless networking device above the processing interface,

’564 EX1001 at 12:31-34.

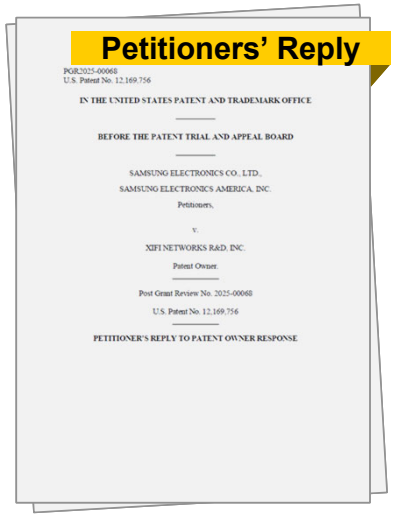
“in a manner transparent”



It is respectfully submitted that the claims presented herein are patentable for at least the same reasons that the previously pending claims are patentable as stated in the last preliminary amendment and related cases. These reasons include, for example, the inclusion of a processing interface having at least one virtual MAC interface and a virtual PHY interface for each band providing feedback to the at least one virtual MAC during operation about bandwidth availabilities for each band, as well as a requirement that all of the claimed operations of the wireless networking device take place in a manner transparent to the layers of the wireless networking device above its MAC/PHY interfaces. The Examiner’s confirmation of this and cooperation in connection with issuing a Notice of Allowance are respectfully requested.

’564 EX2023 (’105 File History) at 034;
’564 EX2017 (Akl POR Decl.) at ¶ 98 (citing ’564 EX2023 at 034).

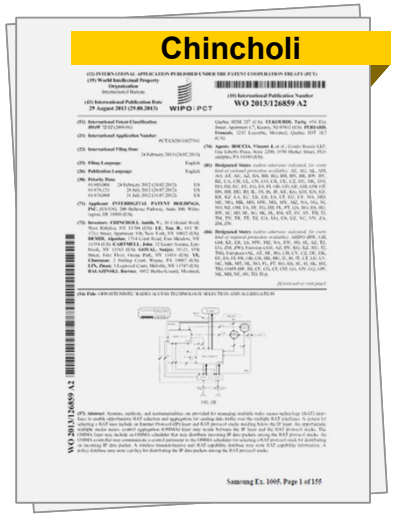
“in a manner transparent”



PO argues the claim requires a “particular manner of achieving transparency” with respect to various functions. POR 48-49. But the stipulated construction merely requires operation “in a manner where any protocol stack layer of the wireless networking device above the processing interface is unaware of the operation of the processing interface.” In transparent mode, the OMMA distributes, combines, and forwards packets without higher layers being aware of the OMMA’s internal routing, combining, and RAT-selection operations. EX1005 [0126], [0192]; EX1026 ¶¶72-74. That is the transparency the claim requires. *Id.*

’564 Reply at 12.

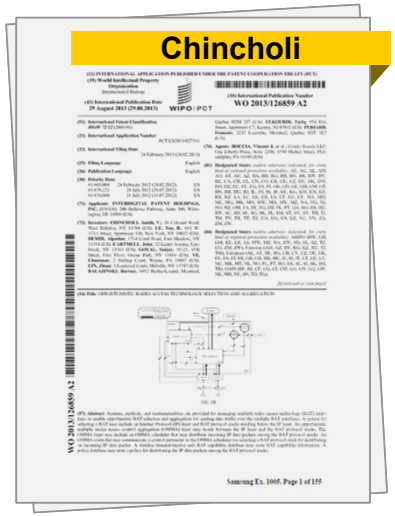
“in a manner transparent”



[0192] The OMMA layer may receive metadata/link statistics feedback from each RAT. Within the OMMA layer, an OMMA scheduler may be responsible for traffic shaping, for example, by policy-based routing of IP packets across bands or feedback-based routing of packets across bands. The OMMA layer may be transparent in that it distributes and/or combines packets from different RATs and forwards the packets to the IP layer. The OMMA layer may be non-transparent, in that it adds additional headers at the transmitter, and/or reads and removes the headers at the receiver. The OMMA layer may utilize a packet distribution mode. As described herein, the packet distribution mode may be a diversity mode, a multiplexing mode, a hybrid mode, and a dynamic RAT selection mode.

’564 EX1005 at [0192]; ’564 EX2017 (Akl POR Decl.) at ¶¶ 94, 95, 98.

“in a manner transparent”



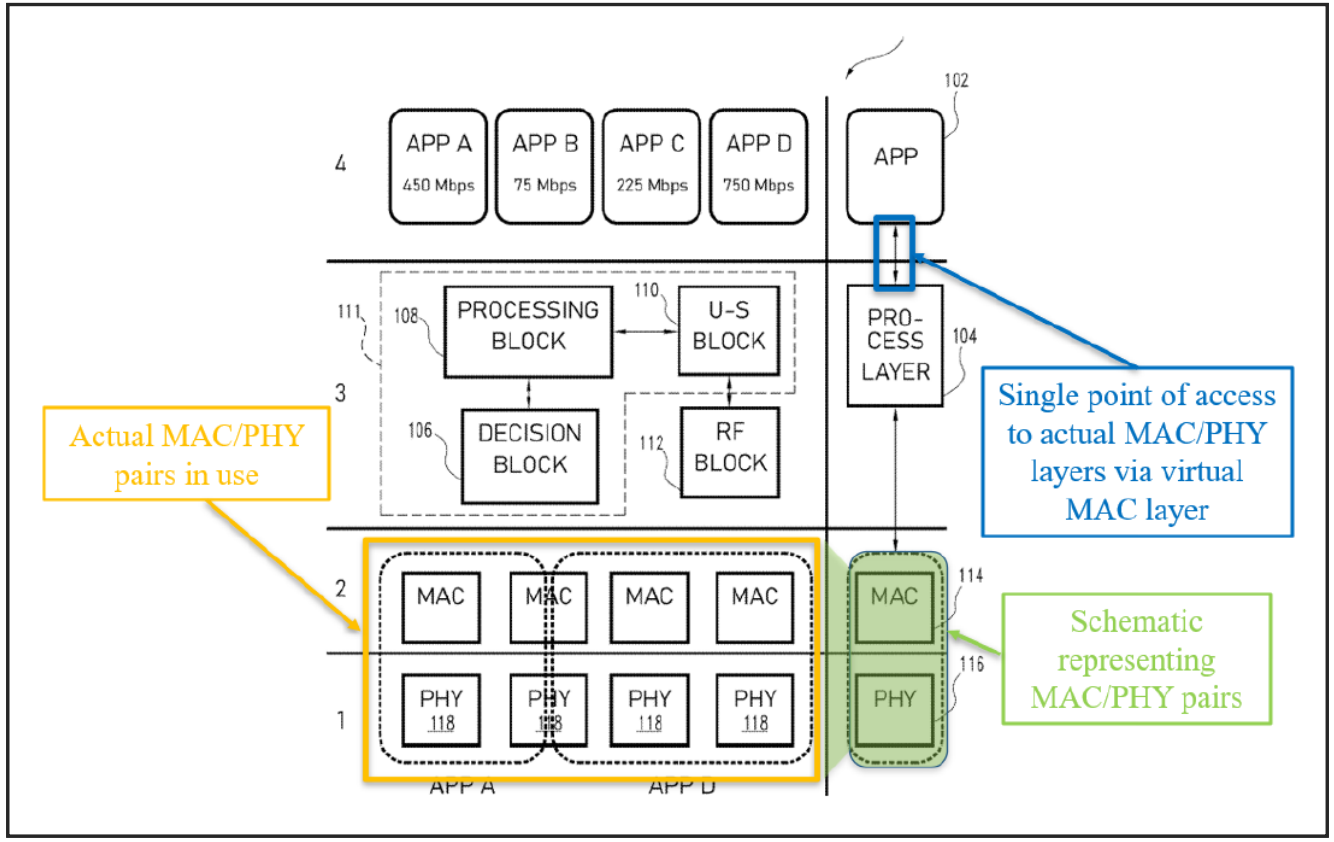
[0126] The OMMA layer may be transparent. If the OMMA layer is transparent, then the OMMA layer may distribute/combine packets from different RATs and forward the packets to the IP layer. The OMMA layer may be non-transparent. If the OMMA layer is non-transparent, then the OMMA layer may add one or more additional headers to an IP packet at the transmitter and read and/or remove the headers at the receiver. The OMMA layer may utilize a packet distribution mode. For example, the packet distribution mode may be a diversity mode, a multiplexing mode, a hybrid mode, or a dynamic RAT selection mode.

’564 EX1005 at [0126]; ’564 EX2017 (Akl POR Decl.) at ¶ 94.

“in a manner transparent”

Dr. Akl
(Patent Owner’s Expert)





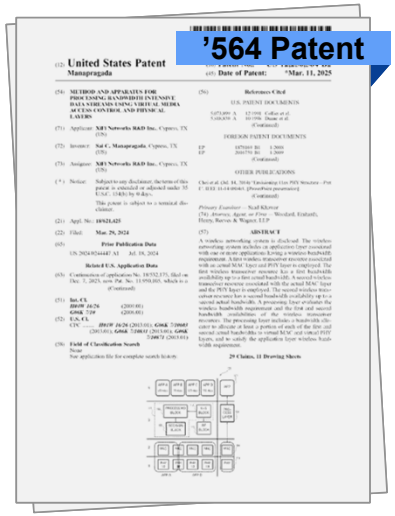
’564 EX2017 (Akl POR Decl.) at ¶¶ 96, 130; ’564 Sur-reply at 24.

“do[es] not prevent”

’591, ’337, ’414, ’105, ’143, ’976, ’933, ’177, ’564 Patents

All Claims

“do[es] not prevent”



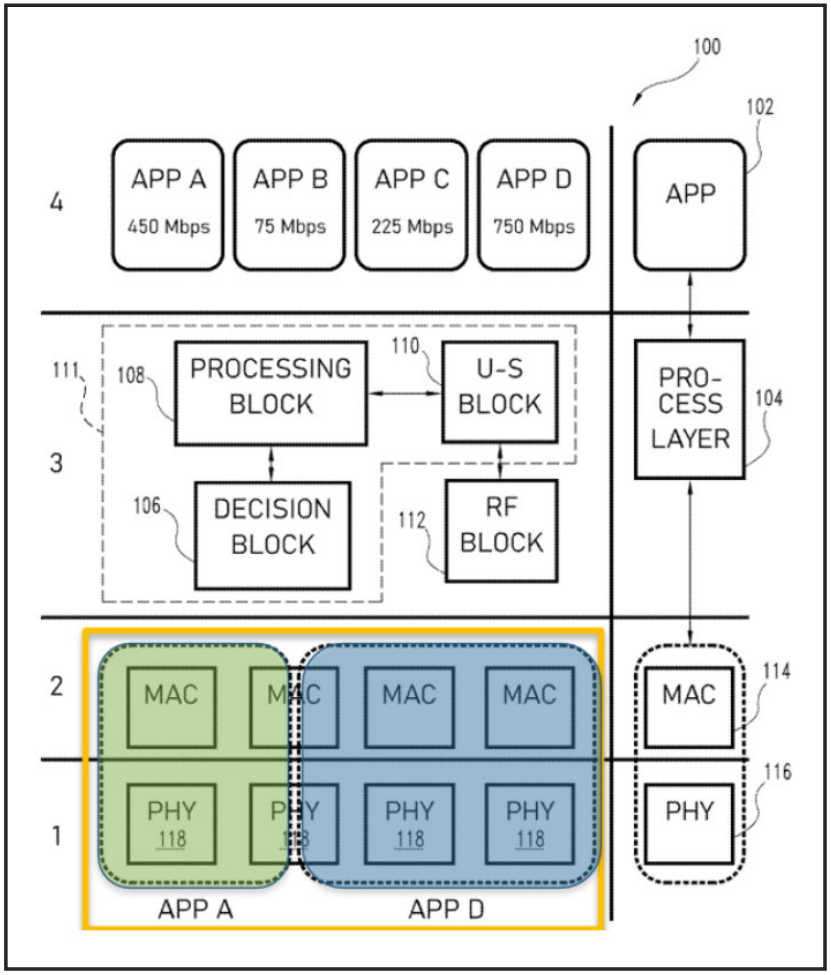
wherein, when the wireless networking is being used, the wireless networking device’s utilization of the first and second identified bandwidth portions do not prevent any wireless networking device from utilizing a range of frequencies corresponding to the remaining portion of the bandwidth availability of the first wireless transceiver for data transmission or reception purposes at the same time that the first or second identified bandwidth portions are being used for data transmission purposes.

’564 EX1001 at 13:5-13 (claim 1).

“do[es] not prevent”

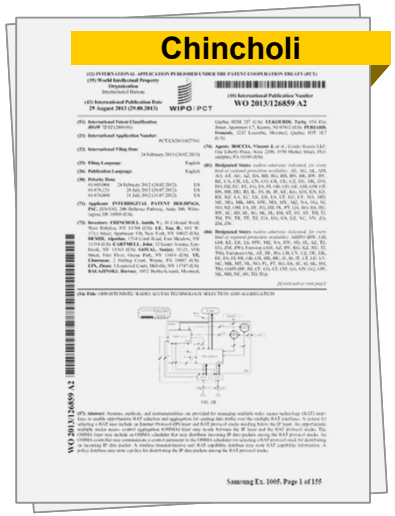
Dr. Akl
(Patent Owner’s Expert)





’564 EX1001 at Fig. 1; ’564 EX2017 (Akl POR Decl.), ¶ 148 (citing ’564 EX1001, Fig. 1).

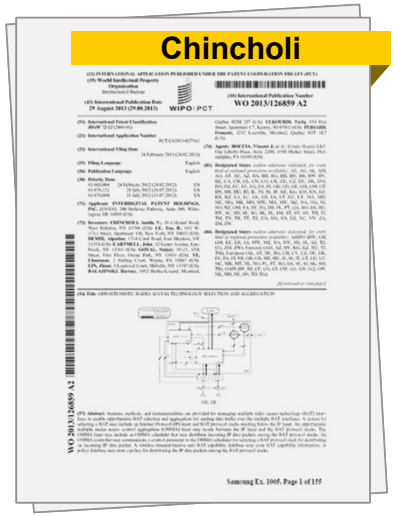
“do[es] not prevent”



[0118] The NT and WTRU may communicate with each other over a single radio frequency (RF) spectral band, for example, 2.4GHz ISM band, or 5 GHz ISM band, or TVWS band or 60GHz band, using a channel within the band or aggregating multiple contiguous or non-contiguous channels. A WTRU and NT may be multi-band and/or multi-RAT capable devices. A WTRU may support multiple internet protocol (IP) streams, for example, with a different QoS requirement per packet. A WTRU may select a RAT to communicate over the air interface with the other WTRU or NT.

’564 EX1005 at [0118]; ’564 POR at 53.

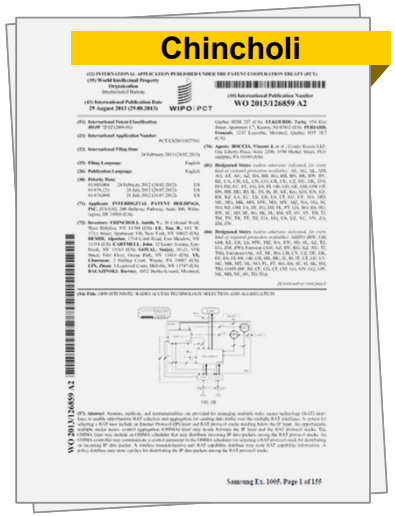
“do[es] not prevent”



[0117] A multi-band multi-mode NT may support a WTRU operating over 2.4GHz ISM band using the 802.11n protocol and a WTRU operating over TVWS band. WTRUs operating on an ISM band may contend with each other for ISM channel access. WTRUs operating over a TVWS band may contend with each other for TVWS channel access. WTRUs operating over an ISM band and WTRUs operating over a TVWS band may not contend with each other, for example, since they are on different operating frequencies. A WTRU may be able to communicate (*e.g.*, simultaneously) with a NT over, for example, an ISM channel and a TVWS channel.

’564 EX1005 at [0117]; ’564 EX2017 (Akl POR Decl.) at ¶ 101.

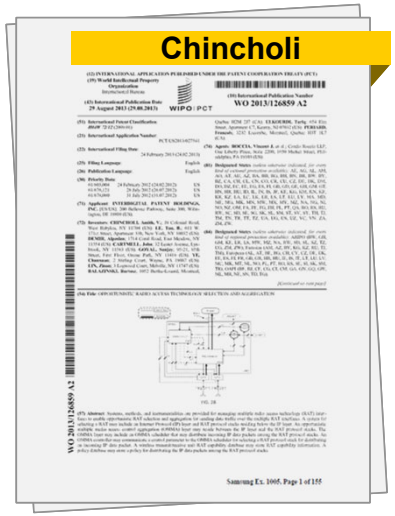
“do[es] not prevent”



[0130] A WTRU 315 in the system 300 may operate on one or more RATs (*e.g.*, those described herein). For example, one or more WTRUs 315 may support 802.11n based RAT operating on 802.11af RAT operating on 512MHz to 698 MHz TVWS band, one or more WTRUs 315 may support 2.4 GHz ISM band, 802.11ac RAT operating on 5GHz ISM band, one or more WTRUs 315 may support LTE RAT operating on 2 GHz licensed band, one or more WTRUs 315 may support WCDMA/HSPA RAT operating on 900 MHz licensed band, *etc.* WTRUs 315 operating on a particular spectral band may contend with each other for wireless medium access.

’564 EX1005 at [0130]; ’564 EX2017 (Akl POR Decl.) at ¶ 101.

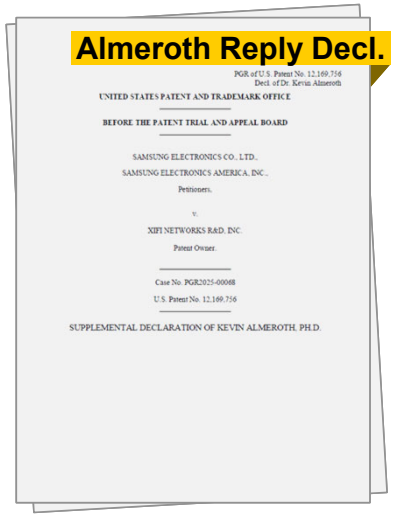
“do[es] not prevent”



[0119] The medium access delay per channel may be high due to contention among WTRUs, for example, due to a high number of devices crowding each spectral band. The transmit opportunity per WTRU may be small compared to the medium access delay, which may reduce the effective throughput on each channel. A device using a single RAT at a time may experience high latencies, which may impact IP QoS requirements.

’564 EX1005 at [0119]; ’564 EX2017 (Akl POR Decl.) at ¶ 101.

“do[es] not prevent”



134. Chincholi further discloses how utilization of the available transceiver bandwidth for one WTRU does not prevent other WTRUs from utilizing a range of frequencies corresponding to the remaining transceiver bandwidth at the same time. As discussed above, Chincholi’s OMMA layer receives feedback metrics from each RAT. (EX1005 ¶[0161].) Amongst the feedback metrics are the “MAC Type,” for example “OFDMA.” (EX1005 ¶[0161] & Table 2.) OFDMA stands for “Orthogonal Frequency Division Multiple Access,” which was a known wireless communication technique for dividing an available bandwidth into smaller subcarriers (*i.e.* frequency ranges) which are then allocated to different users. These subcarriers are described as orthogonal because they do not interfere with each other when simultaneously transmitted. A POSITA would have recognized that OFDMA techniques would allow multiple WTRUs to access different channels of the transceiver resources simultaneously and without interference.

’564 EX1026 (Almeroth Reply Decl.) at ¶ 134.

“do[es] not prevent”

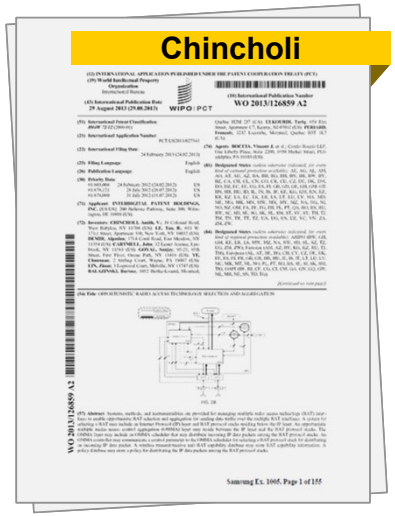
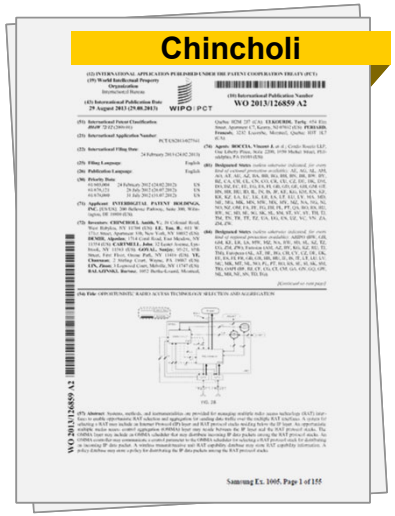


Table 2

Metric	Sender	Description
Medium Access Delay	MAC	Total packet delay in queue plus contention delay
RSSI	PHY	Received signal strength indication from PMD_RSSI.indication (*e.g.*, strength)
Frame error rate	MAC	Average rate at which packets are NACKed
Data rate	MAC	Average throughput
Queuing latency	MAC	Total packet delay in queue
End-to-end delay	MAC	Total delay from input to MAC at transmitter to output of MAC at receiver
TXOP duration	MAC	TXOP duration for video and voice access categories
AC with medium access	MAC	AC_BK, AC_BE, AC_VI, AC_VO, legacy
Backoff time	MAC	Random back off duration
Number of channels	PHY/MAC	Integer number of distinct channels
Channel bandwidth(s)	PHY/MAC	Vector/List of elements which are multiple of 0.5 MHz
MAC Aggregation Supported	MAC	Boolean: Yes, No
MAC Type	MAC	CSMA/CA, OFDMA, *etc.*

’564 EX1005 at [0161] (Table 2); ’564 POR at 54.

“do[es] not prevent”



[0116] In the infrastructure mode, the NT may be the central controller for the system and may act as the gateway to the wired network. The NT may operate using an 802.11 system (*e.g.*, 11a/b/g/n) over a band (*e.g.*, 2.4GHz or 5GHz) when communicating with the WTRU. For example, an 802.11 based system may operate in a time division duplexing (TDD) mode, for example, over a single 20/40MHz channel in the case of industrial scientific medical (ISM) band, or over a single 5/10/20 MHz channel in television white space (TVWS) band (*e.g.*, using contiguous/non-contiguous carrier aggregation).

’564 EX1005 at [0116]; ’564 EX2017 (Akl POR Decl.) at ¶ 103.

“do[es] not prevent”

Dr. Akl
(Patent Owner’s Expert)



103. I understand that Dr. Almeroth further opines that Chincholi discloses this limitation because “Chincholi’s OMMA layer receives feedback metrics from each RAT,” including the “MAC Type” “OFDMA.” EX1002, ¶134. A POSITA would understand that OFDMA, or “Orthogonal Frequency Division Multiple Access” is a technology that is only incorporated into certain wireless standards—*e.g.*, Wi-Fi 6 (IEEE 802.11ax) and later, which was officially certified in 2019. Chincholi cites only older versions of the standard—including 802.11 a/b/g/n, which were certified in 2009 or before. EX1005, [0116]. These versions of the standard do not implement OFDMA. Nor does any part of Chincholi, including the text and figures of its specification, describe any deviation or variation from those standards, or how to modify its Wi-Fi only WTRUs to implement OFDMA. Therefore, a POSITA would not understand Chincholi to demonstrate use of OFDMA.

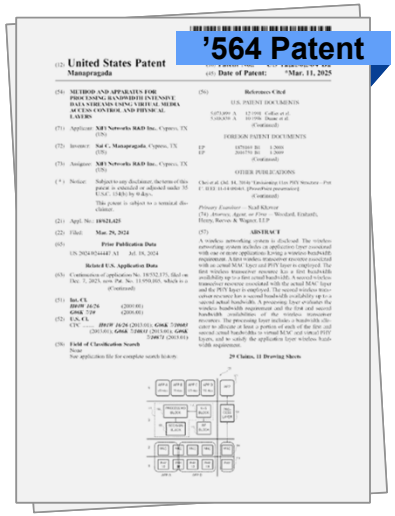
’564 EX2017 (Akl POR Decl.) at ¶ 103.

“without requiring disassociation”

’591, ’337, ’414, ’105, ’143, ’976, ’933, ’177, ’564 Patents

All Claims

“without requiring disassociation”



(d) if the data transfer characteristics of the first identified bandwidth portion are better than those of the second identified bandwidth portion, use the first wireless transceiver to transmit the first data stream to the recipient, without requiring disassociation of the recipient from either or both of the first and second actual MAC and PHY interfaces, using a subset of frequencies corresponding to only the given resources of the first identified bandwidth portion that are available for communication to thereby at least partially satisfy the first wireless bandwidth requirement of the first application, and

’564 EX1001 at 12:48-59; ’564 POR at 55-56.

“without requiring disassociation”

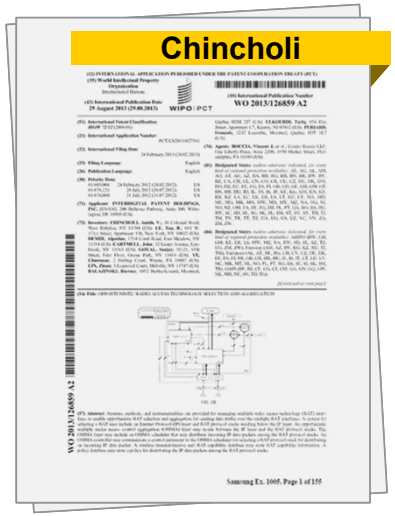
Dr. Akl
(Patent Owner’s Expert)



105. I understand that the parties in the district court agreed that this term would be understood by its plain and ordinary meaning and I agree. EX2020 at 4. A POSITA would understand that limitation [1.j] and its claim language “without requiring disassociation” indicates that claim 1 of the ’564 Patent does not operate based on a concept known colloquially as “break before make.” To transmit data over a network, there needs to be an association between the transmitter and receiver of the data. In prior art Wi-Fi networks, when a decision was made to switch from one transmitter/receiver operating on one band to a different transmitter/receiver on a different band, or from one channel in one band to different channel on that band, the current association had to be broken before a new association could be created. This—“break before make”—was necessary to reduce interference. However, the process of breaking and creating a new association can cause delay and latency as a new association is created.

’564 EX2017 (Akl POR Decl.) at ¶ 105.

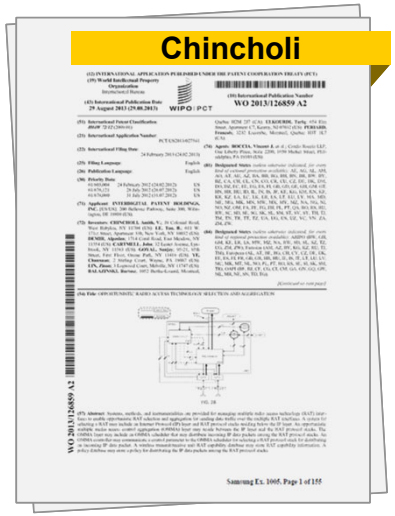
“without requiring disassociation”



[0255] A RAT switch may occur when the selected RAT is not able to fulfill the requirement of a given IP flow QoS Class. If the PBS module 3210 detects this situation, the PBS module 3210 may query the RAT Capability Database 3215 for RAT availability information, for example, through a *STA_RAT_Capability_Query_A4* signal on interface A4 (*e.g.*, as shown in FIG. 32). After determining the RATs that are available for the WTRU (*e.g.*, through the *STA_RAT_Capability_Response_A4* signal on interface A4), the PBS module 3210 may select (*e.g.*, randomly select) a RAT other than the current selected RAT from the RAT availability list. When a RAT switch occurs, the PBS module 3210 may signal the FBS module 3230 to duplicate one or more packets across the RATs to avoid out-of-order packet reception at the OMMA receiver. The RAT with the best feedback metrics, for example, such as but not limited to average packet delay or packet error rate, may be selected.

’564 EX1005 at [0255]; ’564 Sur-reply at 16.

“without requiring disassociation”



[0381] When a RAT switch occurs, the FBS may duplicate one or more packets across one or more RATs (*e.g.*, two RAT, for example, a RAT which is not able to fulfil the QoS requirement and a RAT chosen to replace this RAT) to enable a soft handover across RATs and/or avoid out-of-order packet reception at OMMA receiver.

’564 EX1005 at [0381]; ’564 Sur-reply at 16.

“without requiring disassociation”

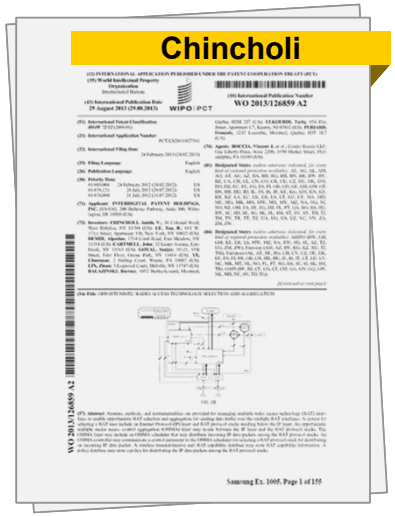
Dr. Akl
(Patent Owner’s Expert)



107. A POSITA would not understand that Chincholi adopts the ’564 Patent’s “without disassociating” functionality, and would rather understand Chincholi to employ the typical “break before make” functionality. Chincholi discloses that, in a “dynamic RAT switching mode,” “the OMMA layer 1300 may select the best RAT possible... and not use the remaining RATs”—and wherein a RAT with the low channel quality may be ***disabled***.” EX1005, [0154]-[0155]. A POSITA would understand this to mean that, once a different RAT is chosen, the previous one is effectively released or disabled. A POSITA would understand that “disabling” a RAT would involve the OMMA layer disassociating from that RAT at the MAC/PHY level. A POSITA would also recognize that this is consistent with

’564 EX2017 (Akl POR Decl.) at ¶ 107.

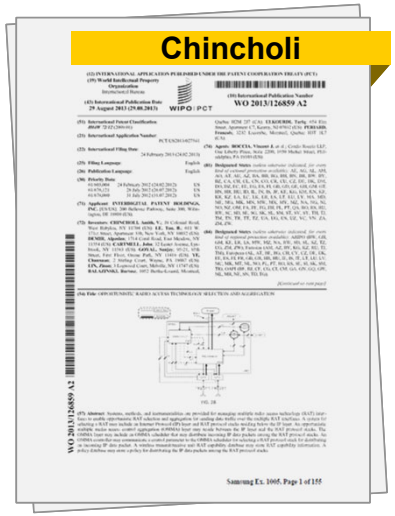
“without requiring disassociation”



[0154] FIG. 13 is a diagram illustrating an example of dynamic RAT switching mode. In dynamic RAT switching mode, the OMMA layer 1300 may select the best RAT possible (*e.g.*, RAT 1301a) at any given time and not use the remaining RATs (*e.g.*, RAT 1301b). For example, the OMMA layer 1300 may make this determination based on the instantaneous channel quality/availability of the RATs 1301a, 1301b. As the channel quality/availability of RATs 1301a, 1301b changes, the best RAT may be selected which may be different from the one previously used.

’564 EX1005 at [0154]; ’564 EX2017 (Akl POR Decl.) at ¶ 107.

“without requiring disassociation”



[0155] For example, if the channel quality of one RAT is 6dB or lower than the channel quality of the other RATs, the RAT with the low channel quality may be disabled. If the OMMA layer determines that the ratio of packets distributed across a dual RAT device is 9:1, Dynamic RAT Switching Mode may be enabled, for example, so the RATs with a better channel quality may be used. For example, channel quality events that may trigger this mode may include, but are not limited to, low throughput, low RSSI, transmission control protocol (TCP) re-ordering trigger, high medium access delay, and high end-to-end delay.

’564 EX1005 at [0155]; ’564 EX2017 (Akl POR Decl.) at ¶ 107.

“without requiring disassociation”

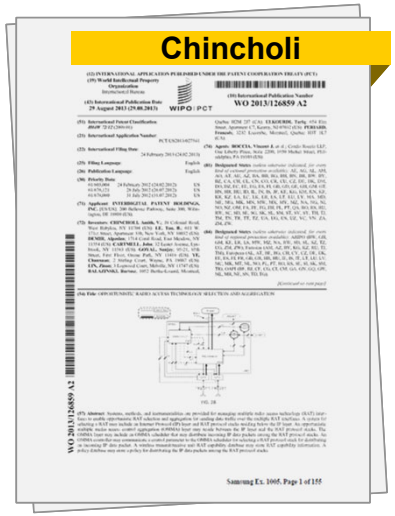
Dr. Akl
(Patent Owner’s Expert)



the MAC/PHY level. A POSITA would also recognize that this is consistent with other portions of Chincholi that discuss “enabl[ing] RATs at different times” based on availability as indicating that OMMA would disassociate from RATs to make them available. *Id.* at [0207]. A POSITA would understand this disassociating before forming a new association discussed throughout Chincholi to be the conventional “break before make” methodology—and not the novel transmission of a data stream “without requiring disassociation of the recipient from … MAC and PHY interfaces” claimed by the ’564 Patent.

’564 EX2017 (Akl POR Decl.) at ¶ 107.

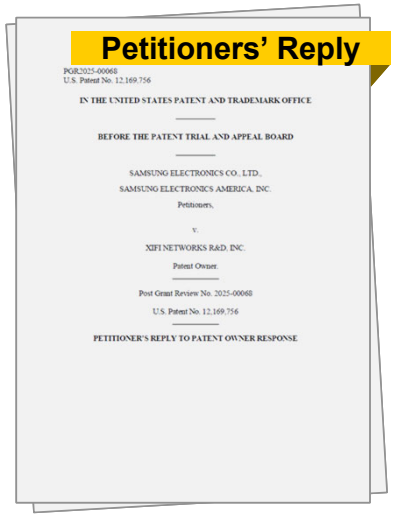
“without requiring disassociation”



[0207] The OMMA Controller 2900 may comprise a RAT Update Management module 2950. RAT availability of a device (*e.g.*, WTRU) may change with time (*e.g.*, due to mobility, a device may have different RATs enabled at different times), so the RAT Update Management module 2950 may keep track of RAT capability/availability of associate devices. The RAT Update Management module 2950 may receive the knowledge of RAT availability by using interface A3 with the RAT Protocol stack (*e.g.*, as shown in FIG. 28). The RAT Update Management module 2950 may maintain the associated device's RAT availability list via a periodic update message from each WTRU, for example, at the NT side. It may use the Beacons received from a NT (*e.g.*, periodically) to maintain the NT's RAT availability list, for example, at the WTRU side. The RAT Update Management module 2950 may reflect changes of available RATs in a RAT Capability Database (*e.g.*, RAT capability database 2830), for example, on both sides, for example, through interface A1 (*e.g.*, as shown in FIG. 28).

EX1005 at [0207]; EX2017 (Akl POR Decl.) at ¶ 107.

“without requiring disassociation”



> ***Second***, PO’s “break before make” arguments are misdirected. The Petition did not rely on Clegg or Choi to supply the “without requiring disassociation” limitation. Rather, the Petition relied on Chincholi’s RAT-switching disclosure.

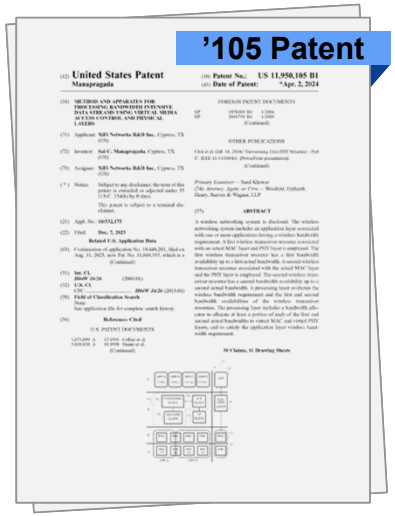
’564 Reply at 18.

“virtual PHY interface”

’591, ’337, ’414, ’105, ’143, ’976, ’933 Patents

All Claims

“virtual PHY interface”



forming in the processing interface (i) at least one virtual MAC interface and (ii) first and second virtual PHY interfaces that, during operation of the wireless networking device, feed information regarding the bandwidth availabilities of the first and second wireless transceivers back to the at least one virtual MAC interface;

’105 EX1001 at 12:8-14 (claim 1).

“virtual PHY interface”

EX1006, Fig. 8 (annotations added). A POSITA would understand that any feedback that is transmitted by the system of Riggert would be across these devices. Riggert states, “[a]s shown in FIG. 8, application program 230 provides data to the bondable virtual interface 236.” *See* EX1006, [0113]. A POSITA would also understand that the bondable virtual physical interface 336 of Riggert operate at the application layer (or layer 7) of the protocol stack. Riggert states, “the bondable virtual interface 336 sends the combined data to the application program 330.” *See* EX1006, [0114].

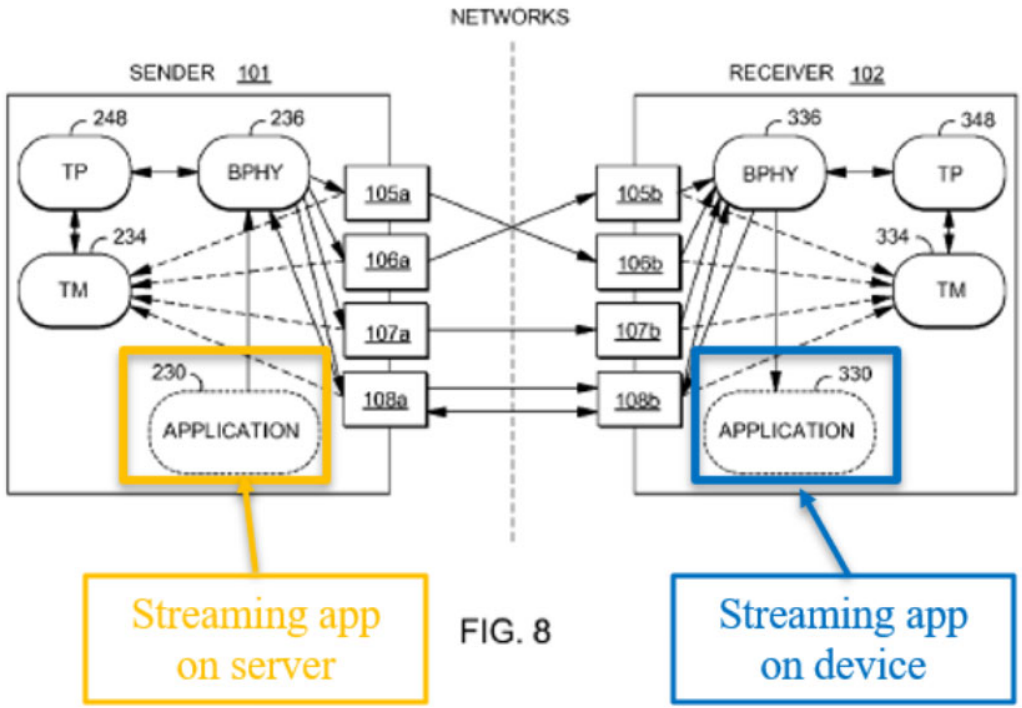


FIG. 8

’105 EX2017 (Akl POR Decl.) at ¶ 110; ’105 EX1006 (Riggert) at Fig. 8.

“virtual PHY interface”

Dr. Akl
(Patent Owner’s Expert)



111. This is in contrast to Chincholi, which, to the extent it discloses feedback transmission at the OMMA layer, only discloses collection of data within a single device, and at layer 3. EX1005, [0161]; *see supra*, ¶80, 98. A POSITA would not be motivated to modify the OMMA of Chincholi (with only intra-device feedback transmission, at layer 3) with the bondable interfaces of Riggert (transmitting data across devices, at layer 7). Dr. Almeroth provides no explanation for why the bondable virtual interfaces of Riggert should be added to the OMMA Controller to perform a function different from what Chincholi describes and at a different layer. A POSITA would not be motivated to combine different functions, especially when those functions are carried out by different layers of the protocol stack. Therefore, a POSITA would not look to Riggert to modify Chincholi.

’105 EX2017 (Akl POR Decl.) at ¶ 111.

Section 101

’756, ’198, ’564 Patents
All Claims

Section 101

first and second actual MAC interfaces connected to the processing interface;

first and second actual PHY interfaces respectively connected to the first and second actual MAC interfaces;

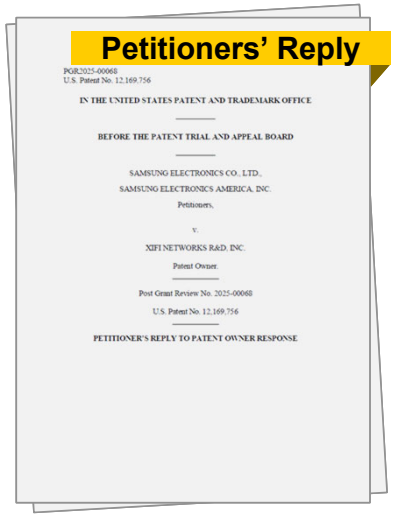
first and second wireless transceivers respectively associated with the first and second actual PHY interfaces, wherein each of the first and second wireless transceivers is suitable for use in a wireless local area network, and the first and second wireless transceivers, respectively, (i) have a first and second bandwidth availability up to first and second actual bandwidths, and (ii) are adapted to emit radio waves in first and second different bands of frequencies;

at least one virtual MAC interface and at least one resource monitoring interface formed in the processing interface that, during operation of the wireless networking device, feeds information regarding the bandwidth availabilities of the first and second wireless transceivers back to the at least one virtual MAC interface;

wherein the processing interface is configured to, when the wireless networking device is being used, and in a manner transparent to any layer of the wireless networking device above the processing interface,

'564 EX1001 at 12:12-34 (claim 1).

Section 101



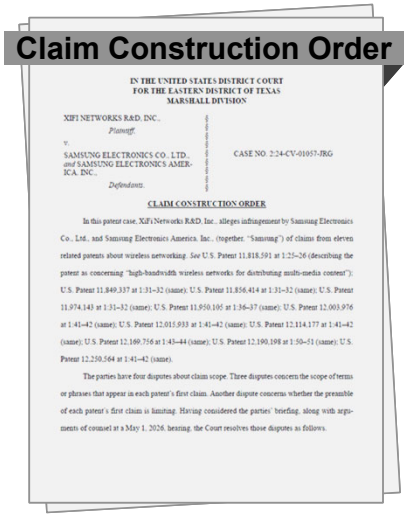
1. Chincholi discloses the "virtual MAC interface"

The Petition demonstrates that Chincholi's OMMA layer contains a "virtual MAC interface" under the stipulated construction—*i.e.*, "a software- or logical-based interface that is separately addressable from the recited actual MAC interfaces and that obscures the recited actual MAC interfaces from higher protocol stack layers." Pet. 25-28.

'564 Reply at 5-6.

Section 101

Claim Construction Order



IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

XIFI NETWORKS R&D, INC.,
Plaintiff,
v.
SAMSUNG ELECTRONICS CO., LTD., *and* SAMSUNG ELECTRONICS AMERICA, INC.,
Defendants.

CASE NO. 2:24-CV-01057-JRG

CLAIM CONSTRUCTION ORDER

In this patent case, XiFi Networks R&D, Inc., alleges infringement by Samsung Electronics Co., Ltd., and Samsung Electronics America, Inc., (together, "Samsung") of claims from eleven related patents about wireless networking. *See* U.S. Patent 11,818,591 at 1:25–26 (describing the patent as concerning "high-bandwidth wireless networks for distributing multi-media content"); U.S. Patent 11,849,337 at 1:31–32 (same); U.S. Patent 11,856,414 at 1:31–32 (same); U.S. Patent 11,974,143 at 1:31–32 (same); U.S. Patent 11,950,105 at 1:36–37 (same); U.S. Patent 12,003,976 at 1:41–42 (same); U.S. Patent 12,015,933 at 1:41–42 (same); U.S. Patent 12,114,177 at 1:41–42 (same); U.S. Patent 12,169,756 at 1:43–44 (same); U.S. Patent 12,190,198 at 1:50–51 (same); U.S. Patent 12,250,564 at 1:41–42 (same).

The parties have four disputes about claim scope. Three disputes concern the scope of terms or phrases that appear in each patent's first claim. Another dispute concerns whether the preamble of each patent's first claim is limiting. Having considered the parties' briefing, along with arguments of counsel at a May 1, 2026, hearing, the Court resolves those disputes as follows.

For this term, based on the foregoing, the Court adopts Samsung's construction of "information regarding current bandwidth availabilities of each of the wireless transceivers."

'564 EX1027 (E.D. Tex. Claim Construction Order) at 16.

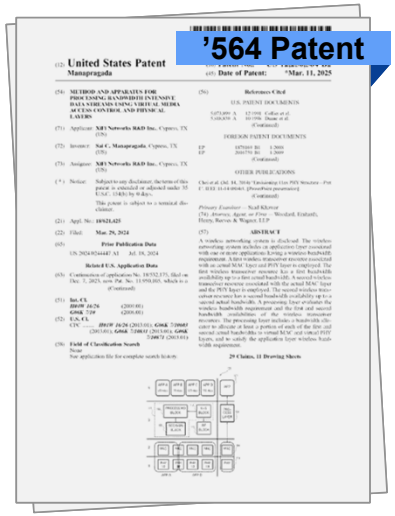
Section 101



"Likewise, Microsoft urges the court to view the claims as being directed to 'the concepts of organizing data into a logical table with identified columns and rows where one or more rows are used to store an index or information defining columns.' However, describing the claims at such a high level of abstraction and untethered from the language of the claims all but ensures that the exceptions to § 101 swallow the rule."

Enfish, LLC v. Microsoft Corp., 822 F.3d 1327, 1337 (Fed. Cir. 2016) (internal citation omitted).
('564 POR at 68)

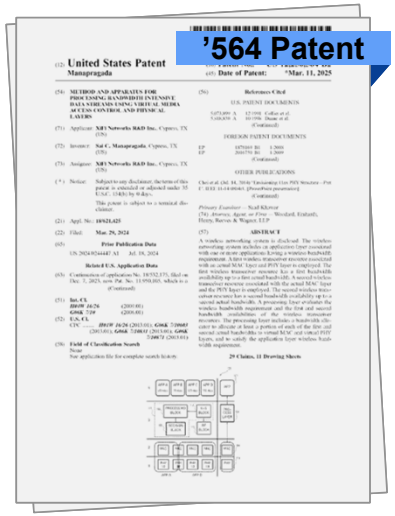
Section 101



With the proliferation of multi-media content over wireless networks comes an insatiable demand for more bandwidth over the networks. Conventional wireless networking architectures fail to provide adequate resources to efficiently provide optimum range and coverage for wireless network users, and fail to take full advantage of the resources available to satisfy the desire for more bandwidth.

'564 EX1001 at 1:54-60; '564 POR at 70; '564 Sur-reply at 20.

Section 101



In a further embodiment, a method of a method of operating a wireless transceiver system is disclosed. The wireless transceiver system includes an application layer, actual MAC and PHY layers, and a processing layer between the actual MAC and PHY layers. The method includes evaluating, with processing logic, application bandwidth requirements of applications associated with the applications layer. A virtual MAC layer and a virtual PHY layer are defined between the processing layer and the actual MAC and PHY layers. A bandwidth allocator allocates multiple wireless transceiver resources in the actual MAC and PHY layer to be controlled by the virtual MAC and PHY layer to satisfy the application bandwidth requirements. A stream of processed data is transferred via a wireless link with the allocated wireless transceiver resources.

'564 EX1001 at 2:56-3:3; '564 Sur-reply at 21-22, 23-24.

Section 101

The decision block **106**, processing block **108** and ultra-streaming block **110** together form a virtual MAC layer **111**. The RF block **112** forms a virtual PHY layer. As more fully described below, the virtual MAC and PHY layers enable simultaneous allocation of multiple PHY resources for different signal types associated with different applications. As a result, the wireless networking system **100** exhibits significant performance improvements and efficiency advantages.

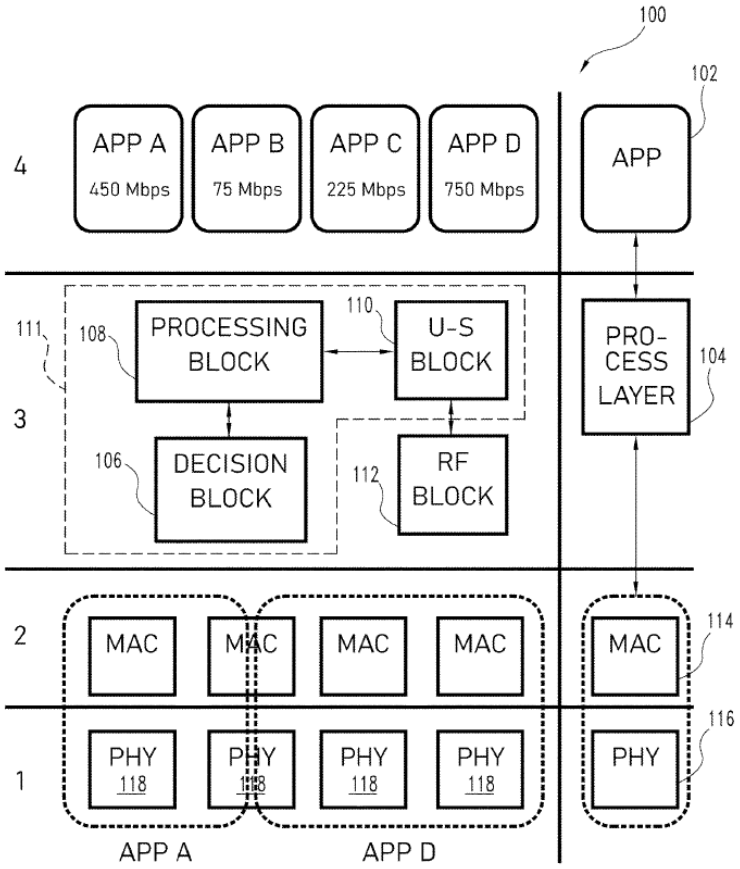


Fig. 1

'564 EX1001 at 3:49-57; '564 POR at 70; '564 Sur-reply at 21.

Section 101

With continued reference to FIG. **1**, the wireless networking system **100** includes an actual media access control (MAC) layer, at **114**, and an actual physical (PHY) layer, at **116**. The actual MAC layer **114** generally includes software resources capable of controlling one or more transceiver resources **118** that are at the actual PHY layer, such as various radios and receivers. The actual PHY layer **116** may include multiple transceiver resources corresponding to multiple radios, each with an actual data transfer capability, or bandwidth.

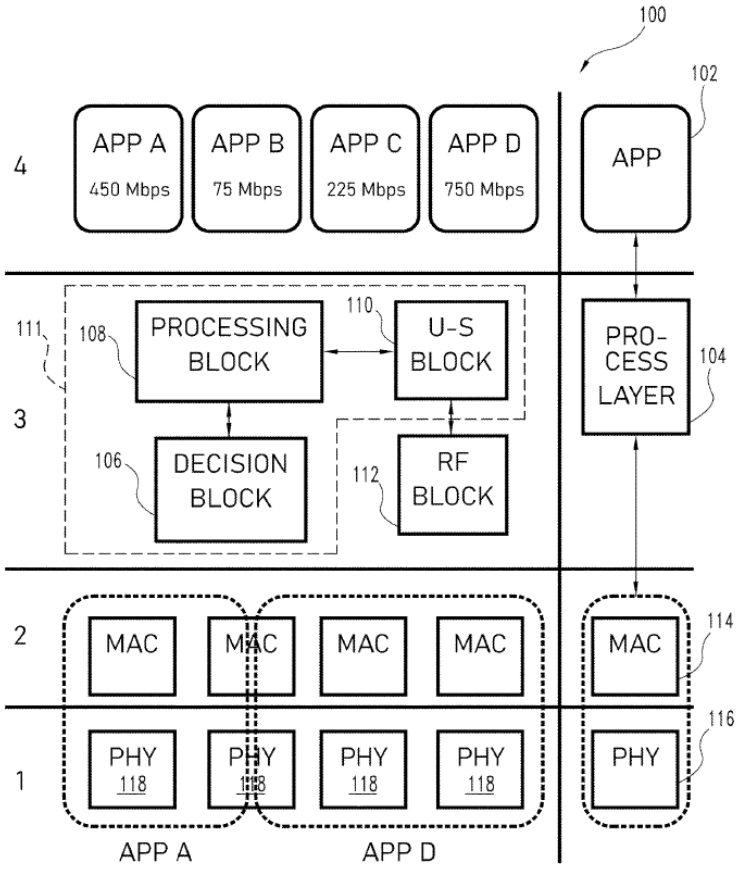


Fig. 1

'564 EX1001 at 3:58-67; '564 Sur-reply at 20.

Section 101

FIG. **1** illustrates one example, with Application A demanding a peak bandwidth of 450 Mbps, and Application D requiring a peak bandwidth of 750 Mbps. At **204**, the process layer **104** determines available resources in the actual MAC and PHY layers **114** and **116**, and allocates the available resources to satisfy the bandwidth demands, at **206**.

Using the same example shown in FIG. **1**, and assuming that all of the PHY transceivers are available, each PHY transceiver **118** is capable of providing a transmit/receive bandwidth of 300 Mbps. Grouping the entire bandwidth of one transceiver with half the bandwidth of a second satisfies the bandwidth demand for Application A. In a similar manner, allocating the bandwidths of two transceivers, and half the bandwidth of a third transceiver satisfies the bandwidth demand for Application D. The allocating is managed by defining the virtual MAC/PHY layers **111** and **112** with the allocated resources, at **208**.

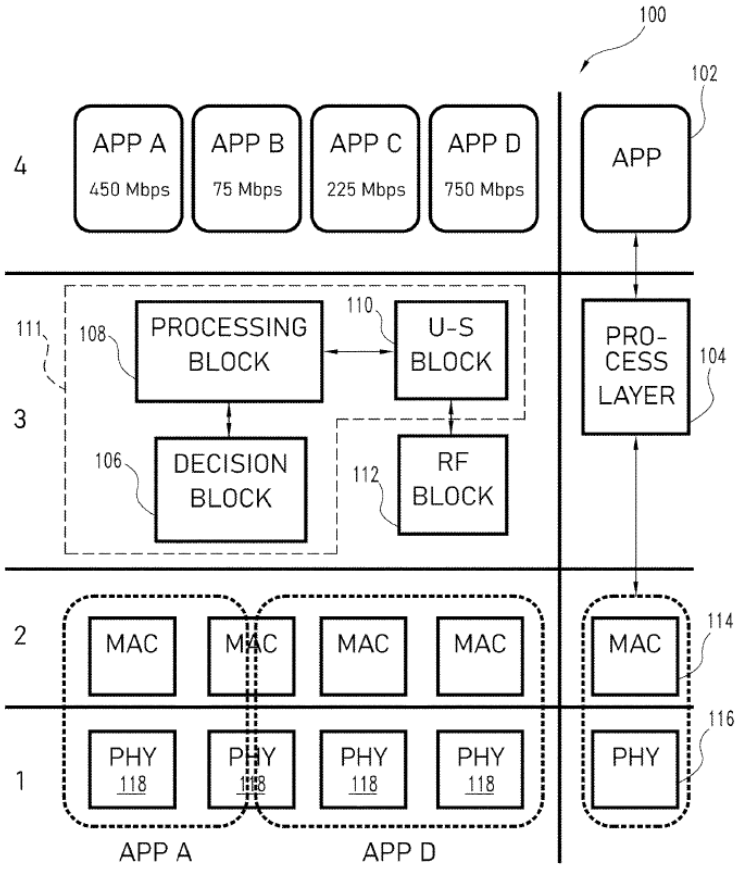


Fig. 1

'564 EX1001 at 4:24-40; '564 Sur-reply at 21.

Section 101

Referring now to FIG. **4**, defining the virtual MAC and PHY layers **302** and **304** involves an evaluation of available transceiver resources to meet peak bandwidth demands of applications running in the application layer. One or more applications, such as "Application A" and "Application B", may be initially supported with transceiver resources "Device **1**" and "Device **2**" through an initialization or training process at startup. The virtual MAC **302** interfaces with the virtual PHY **304** to determine device availability. This further involves a determination at the PHY layer as to the actual availability of the initially assigned transceiver resources. Should a given resource be unavailable, such as through insufficient bandwidth or having an existing assignment, a replacement resource may be identified and assigned. Availability monitoring may be carried out at initialization, as described above, or through periodic or continuous updating based on environmental conditions or through random on demand programming. Adaptively managing the actual resources provides efficient utilization of resources and power.

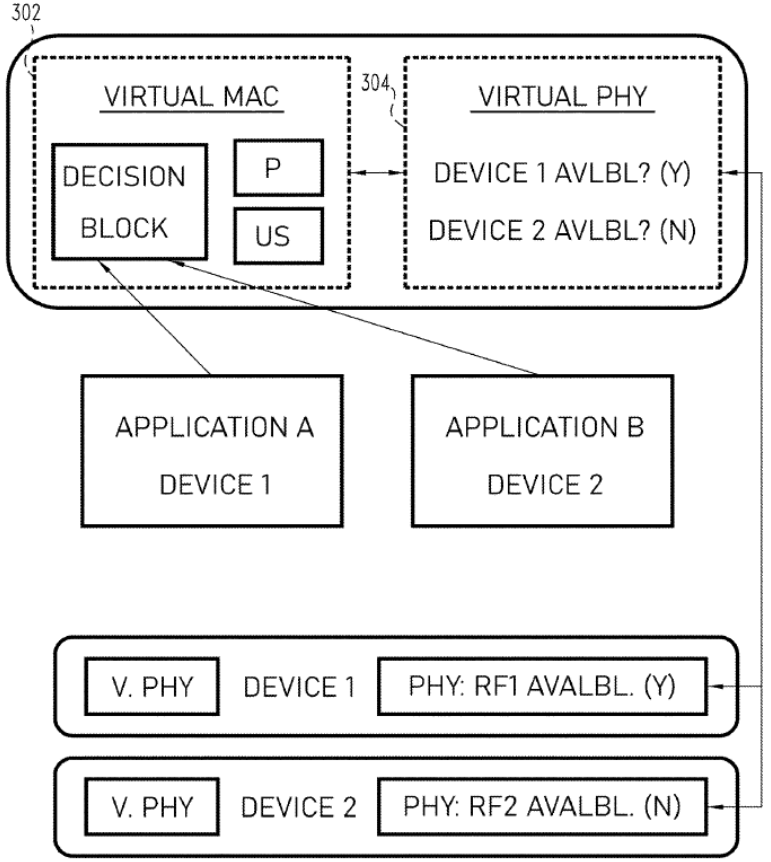
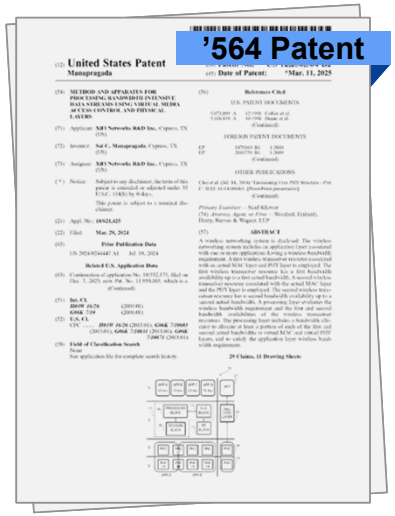


Fig. 4

'564 EX1001 at 4:61-5:13; '564 Sur-reply at 20.

Section 101



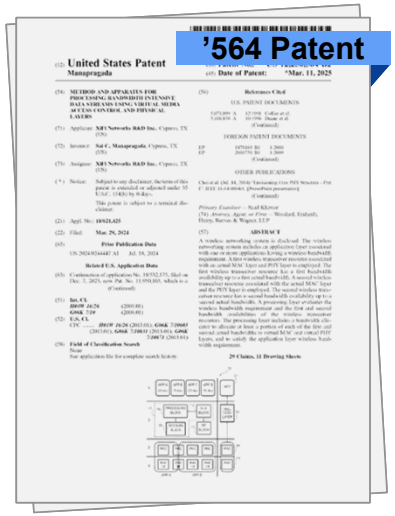
Those skilled in the art will appreciate that the embodiments described above enable wireless networking systems to operate at higher levels of performance and with better efficiencies. By employing a virtual MAC and virtual PHY between an application layer and an actual MAC and PHY layer, wireless transceiver resources may be allocated more efficiently to handle various data bandwidth requirements from different applications. Additionally, by selectively employing a variable duplex link, data transfers may be further optimized through finer control of link transmit and receive times.

'564 EX1001 at 6:1-11; '564 Sur-reply at 21 (citing '564 EX1001 at 6:4-8).

Written Description: “transparent”

’756, ’198, ’564 Patents
All Claims

Written Description: “transparent”



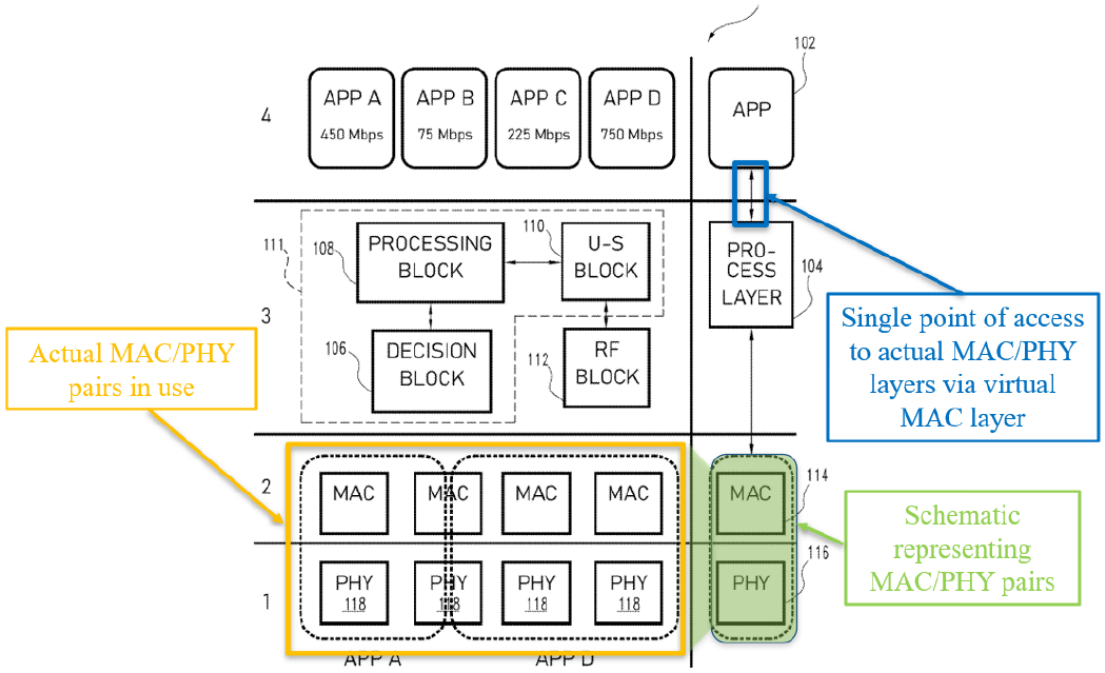
wherein the processing interface is configured to, when the wireless networking device is being used, and in a manner transparent to any layer of the wireless networking device above the processing interface,

’564 EX1001 at 12:31-34 (claim 1).

Written Description: “transparent”

130. This is because a POSITA would recognize that the single point of access between the upper layers and the actual MAC/PHY pairs below would represent transparent operations:

EX1001, Fig. 1 (annotations added). The double-headed arrow highlighted in blue above would convey to a POSITA that, by transmitting information from the MAC/PHY pairs in the lower layers through a single MAC service access point (rather than, for example, having direct communication between the network layer and each one of the MAC/PHY pairs), layers above the single MAC SAP would be indifferent to the manner of implementation by the processing layer or below, while all decision making is performed below the MAC SAP. This would demonstrate to a POSITA that these operations are transparent.



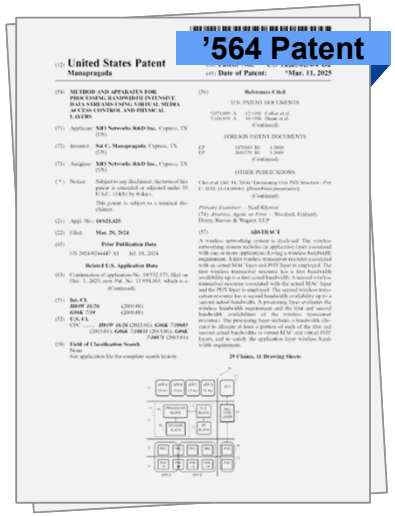
’564 EX2017 (Akl POR Decl.) at ¶¶ 96, 129-130 (citing ’564 EX1001 at Fig. 1).

Written Description: "evaluating data transfer characteristics"

'756, '198, '564 Patents

All Claims

Written Description: “evaluating data transfer characteristics”

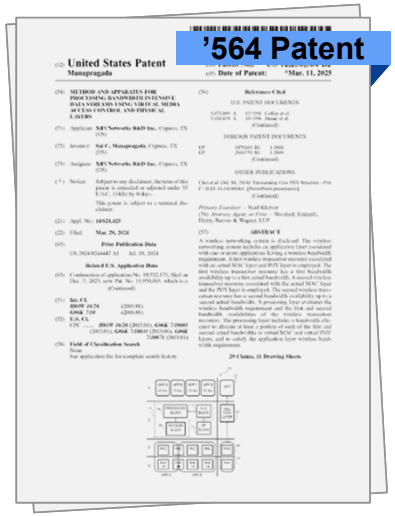


(c) evaluate the data transfer characteristics of the given resources of both the first and second identified bandwidth portions,

(d) if the data transfer characteristics of the first identified bandwidth portion are better than those of the second identified bandwidth portion, use the first wireless transceiver to transmit the first data stream to the recipient, without requiring disassociation of

’564 EX1001 at 12:45-52 (claim 1).

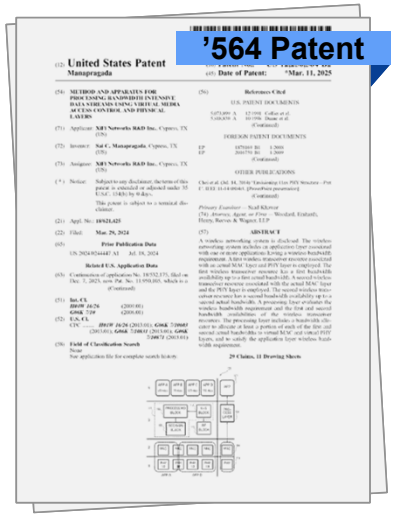
Written Description: “evaluating data transfer characteristics”



training process at startup. The virtual MAC **302** interfaces with the virtual PHY **304** to determine device availability. This further involves a determination at the PHY layer as to the actual availability of the initially assigned transceiver resources. Should a given resource be unavailable, such as through insufficient bandwidth or having an existing assign-ment, a replacement resource may be identified and assigned. Availability monitoring may be carried out at

’564 EX1001 at 5:1-8; ’564 POR at 78.

Written Description: “evaluating data transfer characteristics”



Referring now to FIG. **4**, defining the virtual MAC and PHY layers **302** and **304** involves an evaluation of available transceiver resources to meet peak bandwidth demands of applications running in the application layer. One or more applications, such as “Application A” and “Application B”, may be initially supported with transceiver resources “Device 1” and “Device 2” through an initialization or training process at startup. The virtual MAC **302** interfaces with the virtual PHY **304** to determine device availability. This further involves a determination at the PHY layer as to the actual availability of the initially assigned transceiver resources. Should a given resource be unavailable, such as through insufficient bandwidth or having an existing assignment, a replacement resource may be identified and assigned. Availability monitoring may be carried out at initialization, as described above, or through periodic or continuous updating based on environmental conditions or through random on demand programming. Adaptively managing the actual resources provides efficient utilization of resources and power.

’564 EX1001 at 4:61-5:13; ’564 POR at 18.

Written Description: “evaluating data transfer characteristics”

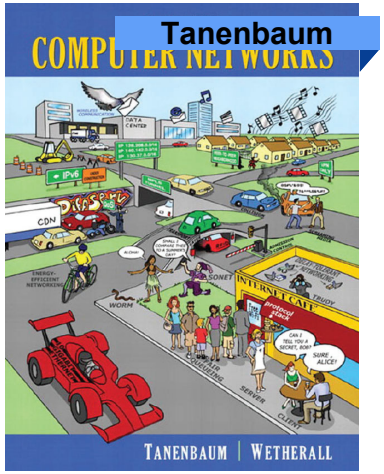
Dr. Akl
(Patent Owner’s Expert)



132. At the priority date of the ’564 Patent, a POSITA would have understood that data transfer characteristics refer to a known set of quality of service parameters, such as throughput, signal strength, bandwidth, delay, jitter, and loss. *See* EX2010 (Tanenbaum) at 405. A POSITA would know that these characteristics are present in any data transmission via a wireless networking system like that described in the ’564 Patent’s disclosure.

’564 EX2017 (Akl POR Decl.) at ¶ 132.

Written Description: “evaluating data transfer characteristics”



5.4.1 Application Requirements

A stream of packets from a source to a destination is called a **flow** (Clark, 1988). A flow might be all the packets of a connection in a connection-oriented network, or all the packets sent from one process to another process in a connectionless network. The needs of each flow can be characterized by four primary parameters: bandwidth, delay, jitter, and loss. Together, these determine the **QoS** (**Quality of Service**) the flow requires.

’564 EX2010 at 357 (Tanenbaum at 405).

Written Description: “evaluating data transfer characteristics”

Dr. Akl
(Patent Owner’s Expert)



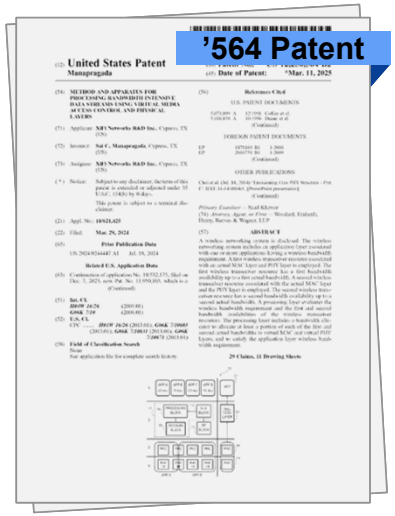
133. For example, both the ’216 provisional application and the ’564 Patent’s specification discusses the evaluation of data transfer characteristics, including as related to discussion of determination of “insufficient bandwidth” (such that the bandwidth was evaluated). EX1001, 5:1-8; EX1017 (’591 Patent File History) at 557-58 (describing evaluation of bandwidth in ’216 provisional). The specification further discusses “continuous updating based on environmental conditions,” where a POSITA would consider “environmental conditions” in the area where the wireless networking device is used like interference from other sources and physical obstructions that have effects on such data transfer characteristics as delay/latency, jitter, packet loss, bandwidth, reliability, and throughput. EX1001, 5:8-11. Further, references to “enabl[ing] efficient wireless access … by users that might be outside the range of a single wireless access point” would also indicate to a POSITA that the invention of the ’564 Patent includes evaluation of data transfer characteristics, such as received signal strength. EX1001, 10:49-52; *see also id.* at 6:65-7:44, 9:9-35, Figs. 7 & 11 (also demonstrating evaluation of signal strength).

’564 EX2017 (Akl POR Decl.) at ¶ 133.

Written Description: “resource monitoring interface”

’756, ’198, ’564 Patents
All Claims

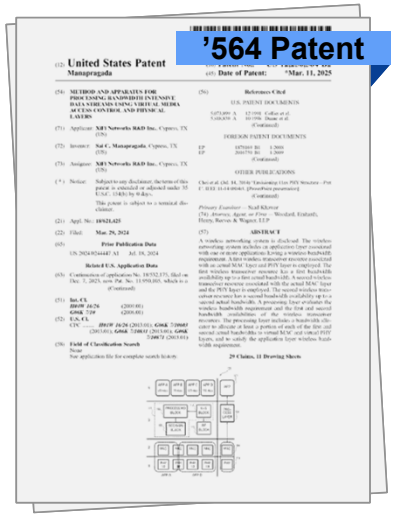
Written Description: “resource monitoring interface”



at least one virtual MAC interface and at least one resource monitoring interface formed in the processing interface that, during operation of the wireless networking device, feeds information regarding the bandwidth availabilities of the first and second wireless transceivers back to the at least one virtual MAC interface;

’564 EX1001 at 12:25-30 (claim 1).

Written Description: “resource monitoring interface”



resources. For one embodiment, the RF block(s) communicate directly with the ultra-streaming block about actual resource availability, and the ultra-streaming block sends the information back to the decision block in the virtual MAC layer. Alternatively, the virtual PHY RF block may directly communicate with the virtual MAC decision block and/or the processing block.

’564 EX1001 at 4:54-60; ’564 POR at 80.

Written Description: “resource monitoring interface”

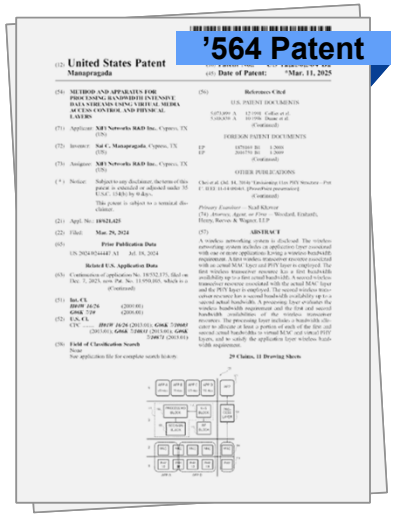
Dr. Akl
(Patent Owner’s Expert)



136. Indeed, the ’564 Patent specification discloses a resource monitoring interface that “feeds information regarding the bandwidth availabilities of the first and second wireless transceivers back to the at least one virtual MAC interface,” as recited in the claim, through several alternative embodiments that describe how the RF block forms a virtual layer that communicates with the ultra-streaming block about actual resource availability in order to perform the monitoring role. As one example, the specification describes that “[f]or one embodiment, the RF block(s) communicate directly with the ultra-streaming block about actual resource availability, and the ultra-streaming block sends information back to the decision block in the virtual MAC layer.” EX1001, 4:54-58. As an alternative embodiment, the specification further describes, “[a]lternatively, the virtual PHY RF block may directly communicate with the virtual MAC decision block and/or the processing block.” EX1001, 4:58-60. The specification also describes that, in some

’564 EX2017 (Akl POR Decl.) at ¶ 136.

Written Description: “resource monitoring interface”



While not explicitly shown in FIG. **1**, the ultra-streaming block carries out a monitoring function, more fully described below, that feeds back wireless resource availability to the decision block **106**. Various ways for determining availability of resources include common memory, host interfaces, common threads, and/or queues or other data structures.

The decision block **106**, processing block **108** and ultra-streaming block **110** together form a virtual MAC layer **111**. The RF block **112** forms a virtual PHY layer. As more fully

’564 EX1001 at 3:40-51; ’564 POR at 15, 17, 80.

Written Description: "resource monitoring interface"

Dr. Akl
(Patent Owner's Expert)



block." EX1001, 4:58-60. The specification also describes that, in some embodiments, the ultra-streaming block works with the RF block in carrying out the monitoring operation: "While not explicitly shown in FIG. 1, the ultra-streaming block carries out a monitoring function, more fully described below, that feeds back wireless resource availability to the decision block 106." EX1001, 3:41-45; *accord id*, 8:29-32. Considering these examples, a POSITA would understand that the specification discloses alternate components/pathways for gathering information about bandwidth availability and feeding it to the decision block of the virtual MAC, performed in all of these embodiments by the RF block, and in some embodiments, together with the ultra-streaming block.

'564 EX2017 (Akl POR Decl.) at ¶ 136; '564 POR at 80.

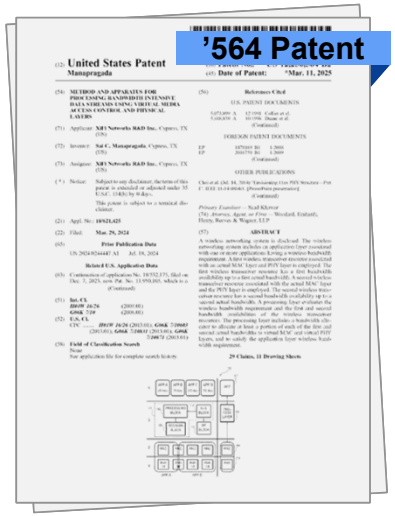
Written Description:

“adapted to . . . emit radio waves in . . . different bands of frequencies”

’756, ’198, ’564 Patents

All Claims

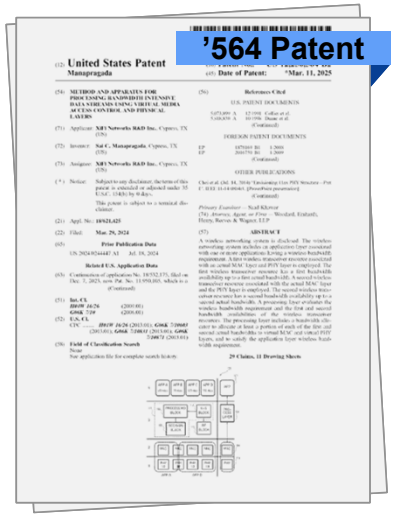
Written Description: “adapted to . . . emit radio waves in . . . different bands of frequencies”



first and second wireless transceivers respectively associated with the first and second actual PHY interfaces, wherein each of the first and second wireless transceivers is suitable for use in a wireless local area network, and the first and second wireless transceivers, respectively, (i) have a first and second bandwidth availability up to first and second actual bandwidths, and (ii) are adapted to emit radio waves in first and second different bands of frequencies;

’564 EX1001 at 12:16-24 (claim 1).

Written Description: “adapted to . . . emit radio waves in . . . different bands of frequencies”



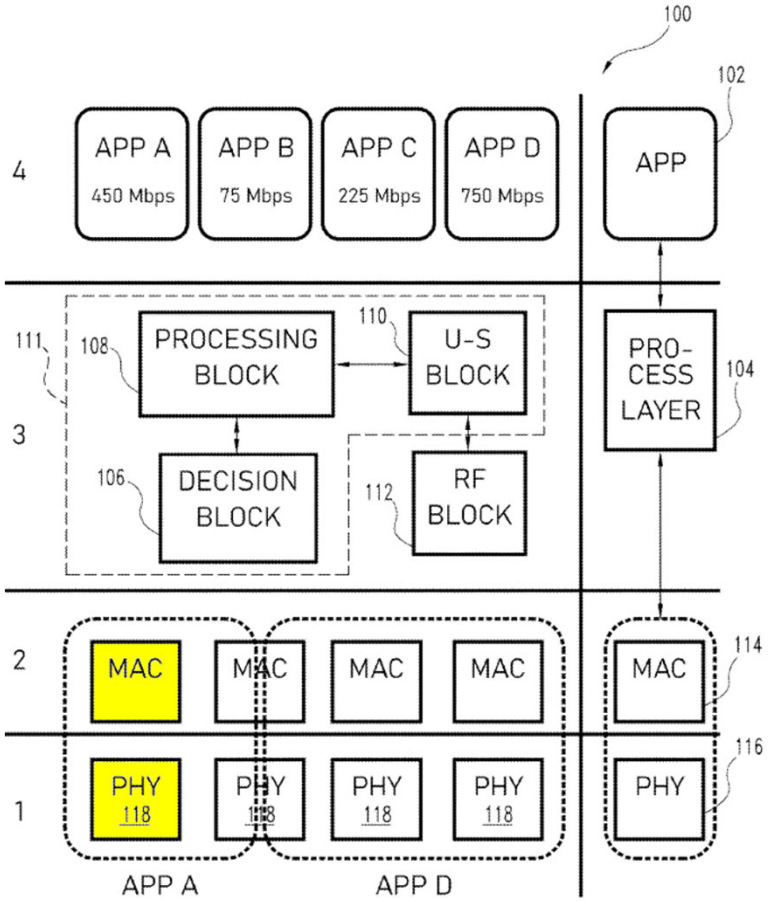
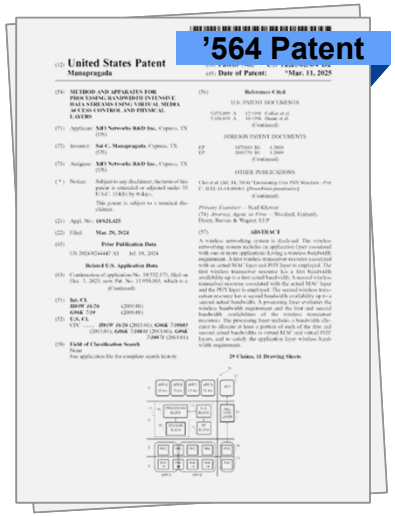


Fig. 1

’564 EX1001 at Fig. 1.

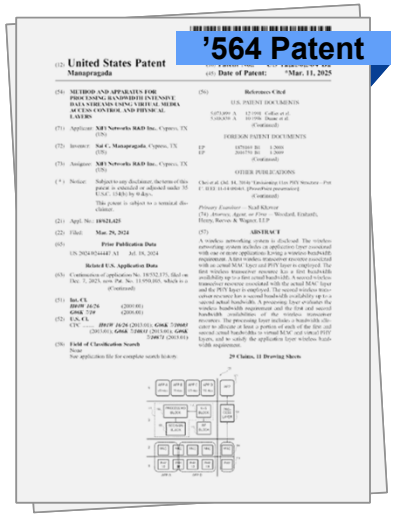
Written Description: “adapted to . . . emit radio waves in . . . different bands of frequencies”



The actual PHY layer transceivers may transmit and receive data consistent with a variety of signal protocols, such as High Definition Multimedia Interface (HDMI) consistent with the IEEE 802.11 Standard, Multiple-In Multiple-Out (MIMO), standard Wi-Fi physical control layer (PHY) and Media Access Control (MAC) layer, and existing IP protocols. Additionally, extremely high bandwidth appli-

’564 EX1001 at 4:1-7; EX2017 (Akl POR Decl.), ¶ 139 (citing ’564 EX1001 at 4:1-4).

Written Description: “adapted to . . . emit radio waves in . . . different bands of frequencies”



Referring to FIG. **1**, one embodiment of a wireless networking system, generally designated **100**, is shown in an abstract “layer” context. Generally speaking, the system may involve a WiFi network, a mobile wireless network, or a combination of the two. The network includes an appli-

’564 EX1001 (’564) at 3:15-18; EX2017 (Akl POR Decl.), ¶ 139 (citing ’564 EX1001 at 3:15-18).

Written Description: "adapted to . . . emit radio waves in . . . different bands of frequencies"

Dr. Akl
(Patent Owner's Expert)



139. Dr. Almeroth recognizes that WiFi 4 (IEEE 802.11n) was released in 2009. *Id.*, ¶180. A POSITA would understand that 802.11n, released several years prior to the priority date for the '756 Patent, included the ability for Wi-Fi radios to emit radio waves on different bands of frequencies, such as 2.4 GHz and 5GHz. The specification of the '756 Patent makes multiple references to WiFi standards and multiple WiFi radios. *See* EX1001, 3:18-21 ("Referring to FIG. 1, one embodiment

'564 EX2017 (Akl POR Decl.) at ¶ 139.

Written Description: “adapted to . . . emit radio waves in . . . different bands of frequencies”

140. A POSITA would further understand that the “multiple radios” of the ’564 Patent, as shown by the multiple MAC/PHY pairs in Figure 1 and as disclosed at the citations above, represent an ability to “emit radio waves to different bands of frequencies.” This is consistent with what Patent Owner expressed to the Office in

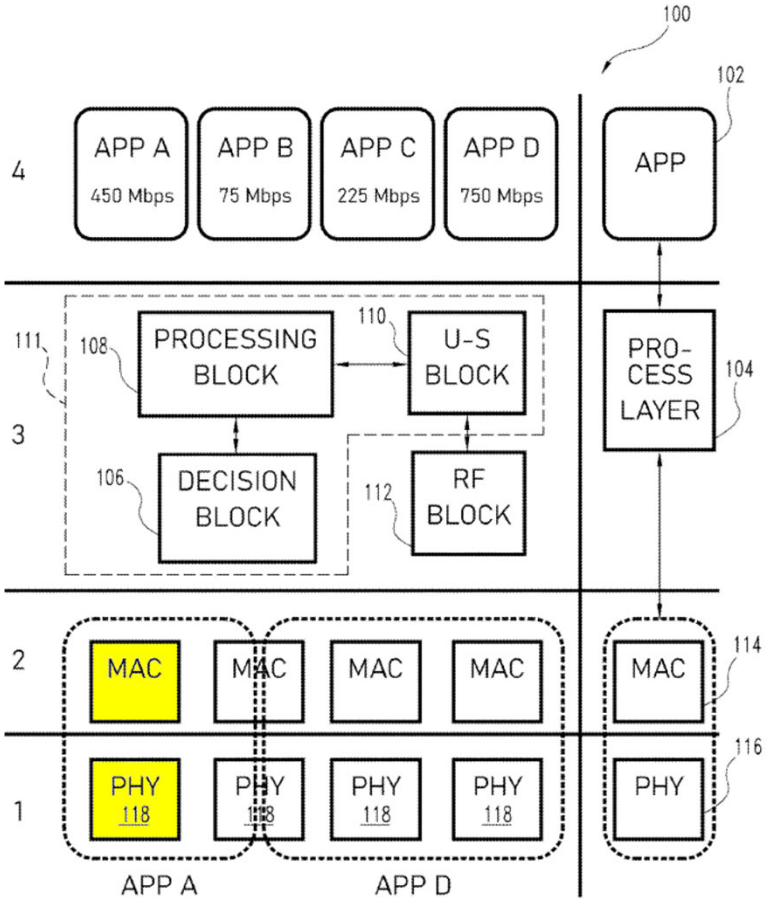


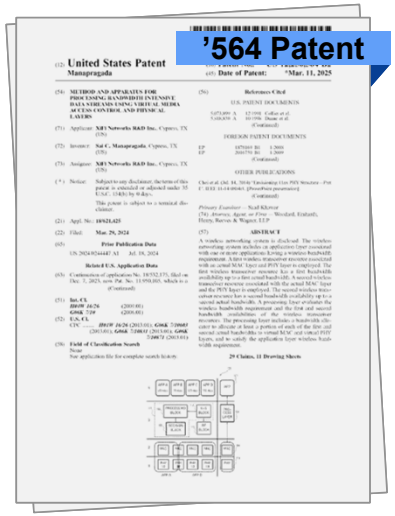
Fig. 1

’564 EX2017 (Akl POR Decl.) at ¶ 140; ’564 EX1001 at Fig. 1.

Written Description: “creating associations”

’756, ’198, ’564 Patents
All Claims

Written Description: “creating associations”



(a) request or create (i) a first association between a recipient and the first actual MAC and PHY interfaces and (ii) a second association between the recipient and the second actual MAC and PHY interfaces,

’564 EX1001 at 12:35-39 (claim 1).

Written Description: “creating associations”

142. As Dr. Almeroth recognizes (*id.*, ¶223), the ’216 provisional explains that “the RF block in the virtual PHY layer communicates directly with the Ultra-Streaming Block about actual resource availability and the Ultra-Streaming Block sends the information back to the Decision Block in the virtual MAC layer,” and also that “Figure 1 of that application shows four actual PHY layers each of which contains a radio.” EX1017 (’591 Patent File History) at 557-558; EX1001 at Fig. 1. From this disclosure, a POSITA would understand that the actual MAC and PHY interfaces create associations with the recipient.

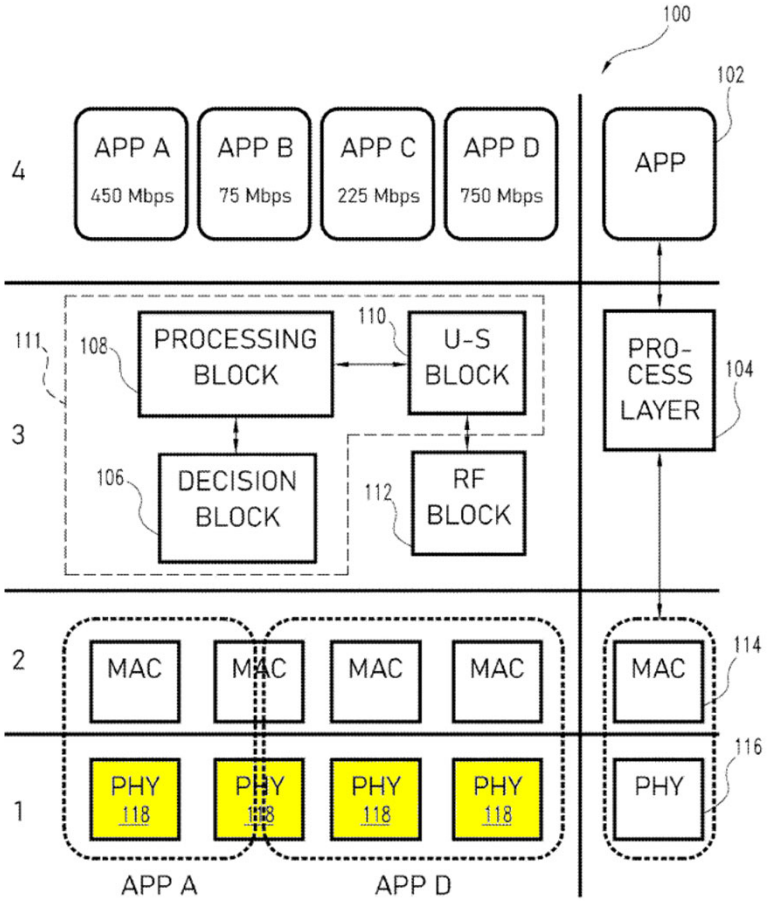
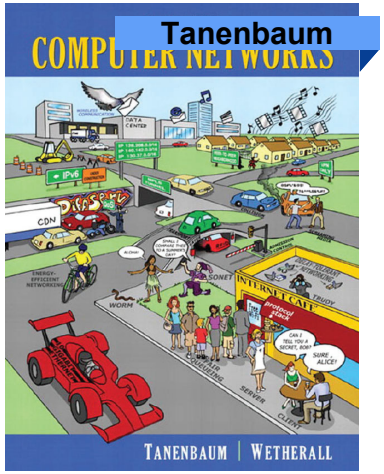


Fig. 1

’564 EX2017 (Akl POR Decl.) at ¶ 142; ’564 EX1001 at Fig. 1.

Written Description: “creating associations”



4.4.5 Services

The 802.11 standard defines the services that the clients, the access points, and the network connecting them must be a conformant wireless LAN. These services cluster into several groups.

The **association** service is used by mobile stations to connect themselves to APs. Typically, it is used just after a station moves within radio range of the AP. Upon arrival, the station learns the identity and capabilities of the AP, either from beacon frames or by directly asking the AP. The capabilities include the data rates supported, security arrangements, power-saving capabilities, quality of service support, and more. The station sends a request to associate with the AP. The AP may accept or reject the request.

’564 EX2010 at 263 (Tanenbaum at 311); ’564 EX2017 (Akl POR Decl.) at ¶ 143.

Written Description: “creating associations”

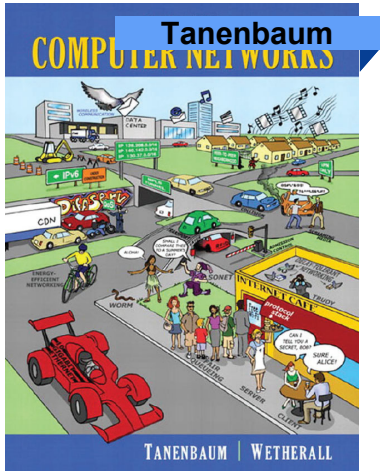
Dr. Akl
(Patent Owner’s Expert)



143. A POSITA would understand (as explained in the Tanenbaum textbook) that, in a Wi-Fi system like that of the ’564 Patent, “association” merely indicates that the two components are in radio range of each other and connect with each other. *See, e.g.*, EX2010 (Tanenbaum) at 311. As Patent Owner has explained to the Office, a POSITA would understand that a user or a device has an association with the actual MAC and PHY layers. *See* EX1017 (’591 Patent File History) at 557. Moreover, a POSITA would understand that a “recipient” is the entity that receives the data in a data transmission, which, in the case of the ’564 Patent’s wireless system, is a user or device engaging with that system. This understanding of “recipient” is reflected in the Tanenbaum textbook multiple times. EX2010 (Tanenbaum) at 390, 463 (textbook using “recipient” to refer to entity receiving data transmission in multiple contexts).

’564 EX2017 (Akl POR Decl.) at ¶ 143.

Written Description: “creating associations”



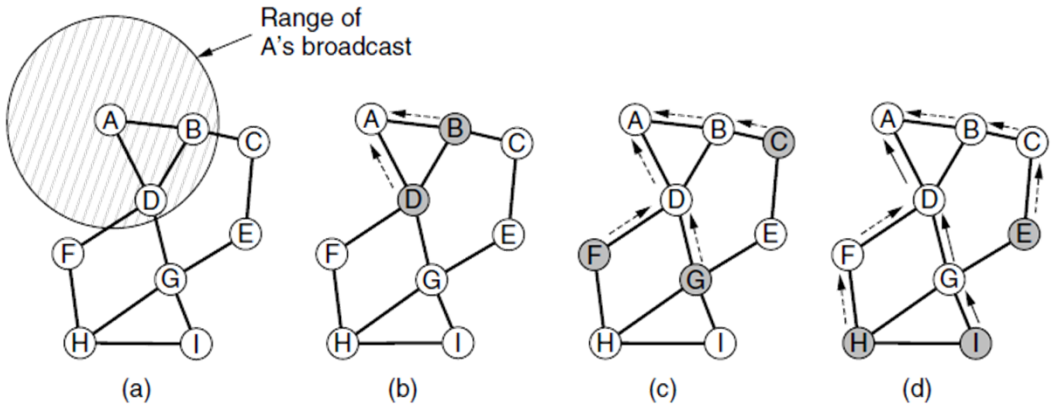


Figure 5-20. (a) Range of *A*'s broadcast. (b) After *B* and *D* receive it. (c) After *C*, *F*, and *G* receive it. (d) After *E*, *H*, and *I* receive it. The shaded nodes are new recipients. The dashed lines show possible reverse routes. The solid lines show the discovered route.

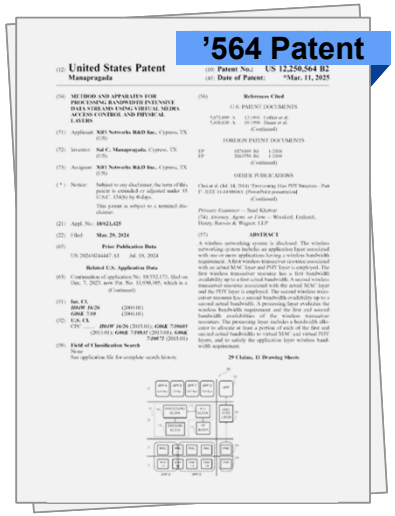
The authentication header provides a mechanism by which the receiver of a packet can be sure of who sent it. The encrypted security payload makes it possible to encrypt the contents of a packet so that only the intended recipient can read it. These headers use the cryptographic techniques that we will describe in Chap. 8 to accomplish their missions.

’564 EX2010 at 342, 415 (Tanenbaum at 390, 463); ’564 EX2017 (Akl POR Decl.) at ¶ 143.

Written Description:
"without requiring disassociation"

'564 Patent
All Claims

Written Description: “without requiring disassociation”

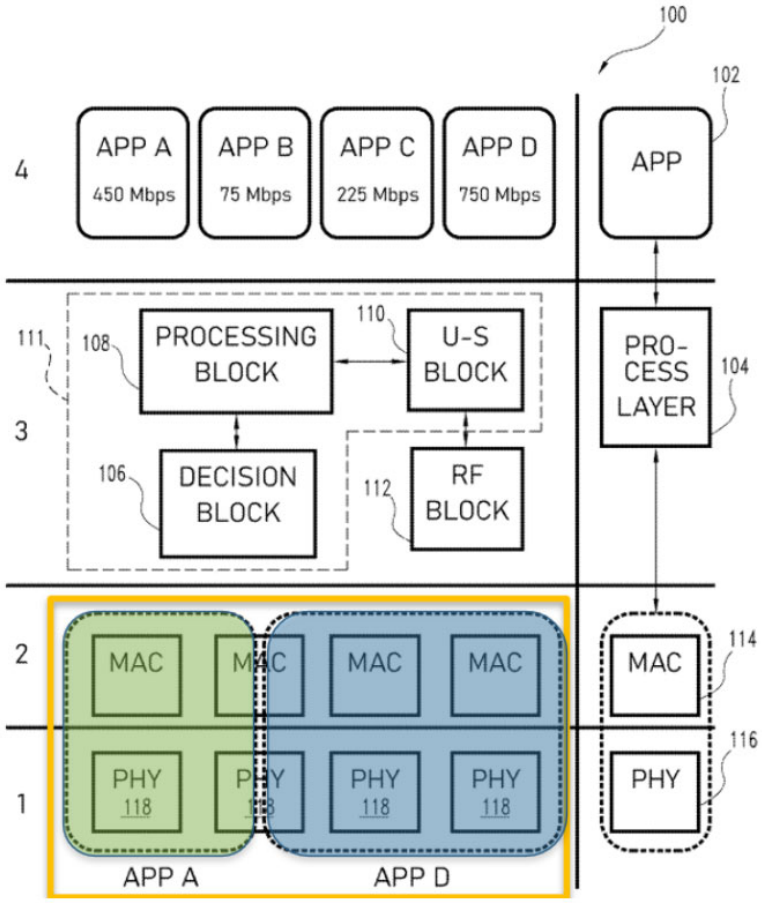


(d) if the data transfer characteristics of the first identified bandwidth portion are better than those of the second identified bandwidth portion, use the first wireless transceiver to transmit the first data stream to the recipient, without requiring disassociation of the recipient from either or both of the first and second actual MAC and PHY interfaces, using a subset of frequencies corresponding to only the given resources of the first identified bandwidth portion that are available for communication to thereby at least partially satisfy the first wireless bandwidth requirement of the first application, and

’564 EX1001 at 12:48-59 (claim 1).

Written Description: “without requiring disassociation”

EX1001, Fig. 1 (annotations added). From the fact that each application is using multiple radios/transceivers, a POSITA would understand that “make before break” is being employed. A POSITA would find this to be consistent with the ’564 Patent’s disclosure describing the functioning of the virtual MAC suggests make-before-break, because the virtual MAC allows for assignment of resources without needing a one-to-one correspondence, and without requiring channel lock-out. This

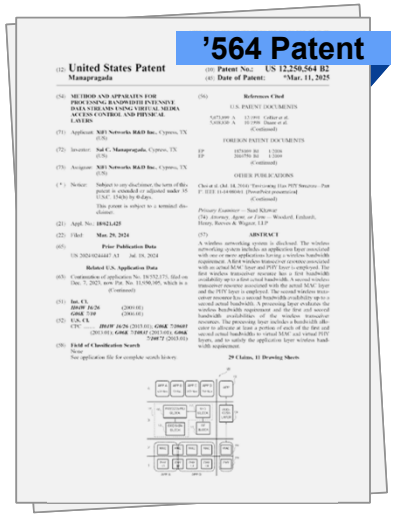


’564 EX1001 at Fig. 1; ’564 EX2017 (Akl POR Decl.), ¶ 145.

Written Description: “do not prevent”

’564 Patent
All Claims

Written Description: “do not prevent”

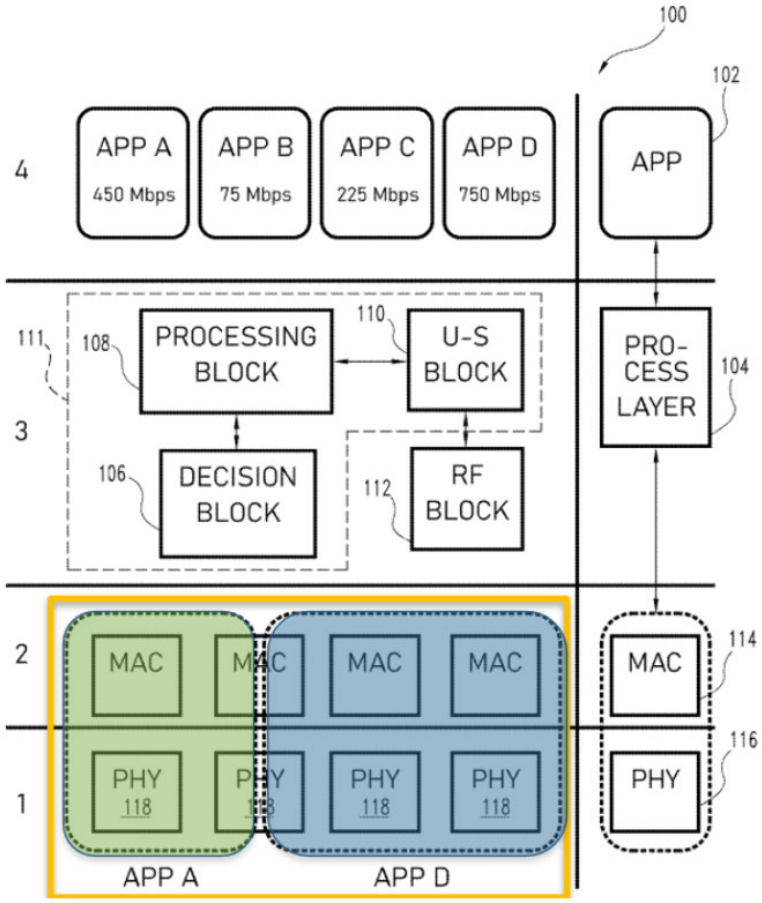


wherein, when the wireless networking is being used, the wireless networking device’s utilization of the first and second identified bandwidth portions do not prevent any wireless networking device from utilizing a range of frequencies corresponding to the remaining portion of the bandwidth availability of the first wireless transceiver for data transmission or reception purposes at the same time that the first or second identified bandwidth portions are being used for data transmission purposes.

’564 EX1001 at 13:5-13 (claim 1).

Written Description: “do not prevent”

148. The limitation recites in relevant part, “wherein … the wireless networking device’s utilization of the first and second identified bandwidth portions do not prevent any wireless networking device from utilizing a range of frequencies corresponding to the remaining portion of the bandwidth availability of the first wireless transceiver … .” EX1001, 13:5-13. A POSITA would understand this limitation to express the ability for resource sharing of the various actual PHY interfaces or the transceivers depicted in Figure 1—including as being shared by two applications:



’564 EX1001 at Fig. 1; EX2017 (Akl POR Decl.), ¶ 148.

Written Description: “do not prevent”

Dr. Akl
(Patent Owner’s Expert)



149. Similar to the “without requiring disassociation” limitation, a POSITA would understand that the operation of the virtual MAC interface of the ’564 Patent and its use of virtual (software-based) addressing allows for assignment of resources that is not a one-to-one correspondence with the manufacturer’s assigned address, and without any channel lock-out. For the same reasons described above with regard to “without requiring disassociation” and the fact that a POSITA would understand that the ’564 Patent’s system allows for “make-before-break” capability, a POSITA would also understand it also allows for resource sharing by multiple wireless networking devices. Also for the same reasons as above, I disagree that “this is a negative limitation” (EX1002, ¶239)—rather, it is a positive limitation that tells a POSITA that the system includes resource sharing and “make-before-break.”

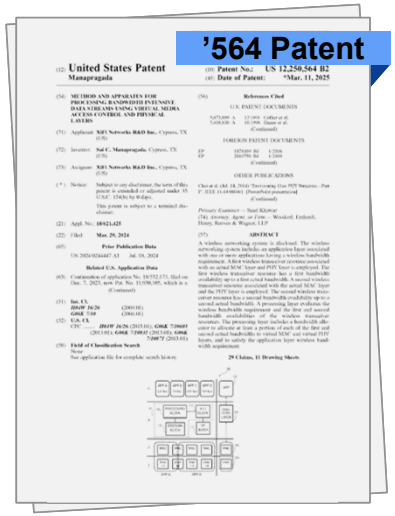
’564 EX1001 at Fig. 1; ’564 EX2017 (Akl POR Decl.), ¶ 149.

Definiteness:

“partially” or “substantially”
“simultaneous[ly]”

’756 Patent, Claims 27-30
’198 Patent, Claims 27-30
’564 Patent, Claims 15, 18-29

Definiteness: “partially” or “substantially” “simultaneous[ly]”

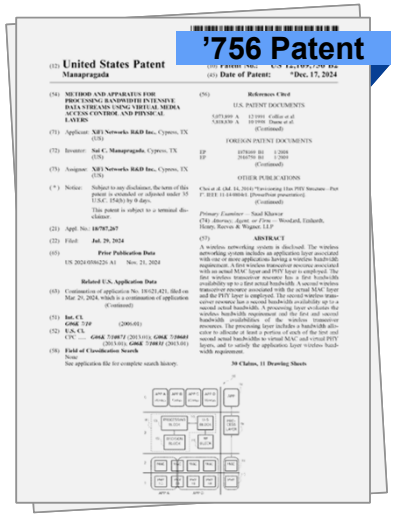


15. The wireless networking device of claim **1**, wherein the processing interface is configured to, when the wireless networking device is being used, in a manner transparent to any layer of the wireless networking device above the processing interface, aggregate the first and second identified actual bandwidth portions to at least partially simultaneously transmit the first data stream to the first recipient from the first wireless transceiver.

19. The wireless networking device of claim **18**, wherein the first data stream is substantially simultaneously transmitted to the recipient from both of the first and second wireless transceivers.

’564 EX1001 at 13:51-58 (claim 15), 15:11-14 (claim 19).

Definiteness: “partially” or “substantially” “simultaneous[ly]”



27. The wireless networking device of claim **26**, wherein the transmission of the data stream from the first wireless transceiver is at least partially simultaneous with the reception of the second data stream by the second wireless transceiver.

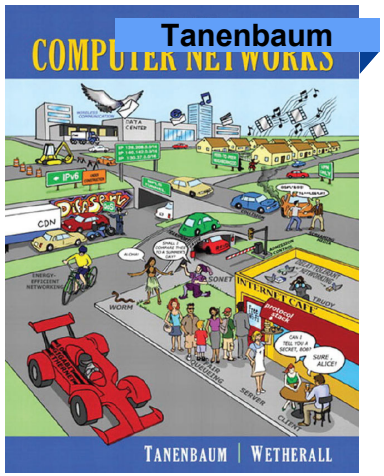
’756 EX1001 at 14:34-38 (claim 27);
’198 EX1001 at 14:40-43 (claim 27).

Section 112

"It is well established that when the term 'substantially' serves reasonably to describe the subject matter so that its scope would be understood by persons in the field of the invention, and to distinguish the claimed subject matter from the prior art, it is not indefinite."

Verve, LLC v. Crane Cams, Inc., 311 F.3d 1116, 1120 (Fed. Cir. 2002).
(564 POR at 87-88)

Definiteness: “partially” or “substantially” “simultaneous[ly]”



A further part of the quality of service extensions is the notion of a **TXOP** or **transmission opportunity**. The original CSMA/CA mechanism let stations send one frame at a time. This design was fine until the range of rates increased. With 802.11a/g, one station might be sending at 6 Mbps and another station be sending at 54 Mbps. They each get to send one frame, but the 6-Mbps station takes nine times as long (ignoring fixed overheads) as the 54-Mbps station to send its frame. This disparity has the unfortunate side effect of slowing down a fast sender who is competing with a slow sender to roughly the rate of the slow sender. For example, again ignoring fixed overheads, when sending alone the 6-Mbps and 54-Mbps senders will get their own rates, but when sending together they will both get 5.4 Mbps on average. It is a stiff penalty for the fast sender. This issue is known as the **rate anomaly** (Heusse et al., 2003).

’564 EX2010 at 261 (Tanenbaum at 309); ’564 EX2017 (Akl POR Decl.) at ¶ 152.

Definiteness: “partially” or “substantially” “simultaneous[ly]”

Dr. Akl
(Patent Owner’s Expert)



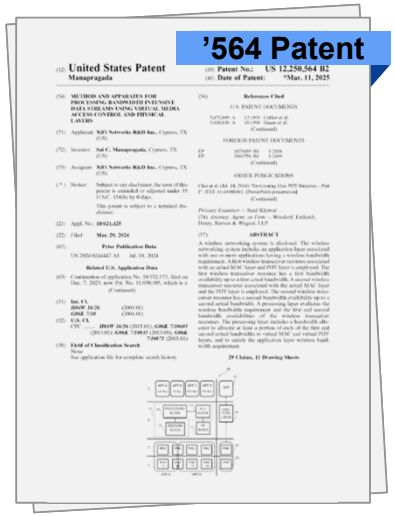
152. A POSITA would understand that transmission in a system such as that of the ’564 Patent takes place during set “transmission opportunities,” or TXOPs. *See* EX2010 at 309. A POSITA would further understand that, in parallel transmissions on two different bands, both transmissions would take place during a given TXOP. A POSITA would understand that two parallel transmissions could not be perfectly simultaneous as a matter of physical reality, but could be “substantially,” or essentially, simultaneous—where the two parallel transmissions were transmitting the same amount of frames during the TXOP span. *Id.* A POSITA would further understand that, if the two transmissions were of different data amounts, the one transmitting less data would finish first within the TXOP’s duration. *Id.* This would mean the transmissions were “partially simultaneous”—overlapping while both were transmitting, but not fully or substantially—because the larger transmission would take longer to finish.

’564 EX2017 (Akl POR Decl.) at ¶ 152.

Definiteness: “better than”

’564 Patent
All Claims

Definiteness: “better than”



(c) evaluate the data transfer characteristics of the given resources of both the first and second identified bandwidth portions,

(d) if the data transfer characteristics of the first identified bandwidth portion are better than those of the second identified bandwidth portion, use the first

(e) if the data transfer characteristics of the second identified bandwidth portion are better than those of the first identified bandwidth portion, use the first

’564 EX1001 at 12:48-13:4 (claim 1).

Definiteness: "better than"

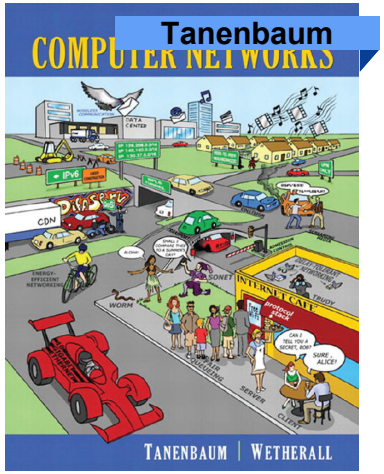
Dr. Akl
(Patent Owner's Expert)



156. As described above, there are many data transfer characteristics, such as throughput, signal strength, bandwidth, delay, jitter, and loss. Likewise, Dr. Almeroth lists "levels of bandwidth, received signal strength, frame packet error rate, frequency offset, and latency." EX1002, ¶246. A POSITA would understand that, for any single characteristic, a "better" result is that which more efficiently and effectively achieves the transmission.

'564 EX2017 (Akl POR Decl.) at ¶ 156.

Definiteness: “better than”



Shannon's major result is that the maximum data rate or **capacity** of a noisy channel whose bandwidth is B Hz and whose signal-to-noise ratio is S/N, is given by:

$$\text{maximum number of bits/sec} = B \log_2 (1 + S/N) \qquad (2\text{-}3)$$

This tells us the best capacities that real channels can have. For example, ADSL

’564 EX2010 at 110 (Tanenbaum at 94); ’564 EX2017 (Akl POR Decl.) at ¶ 157.

Definiteness: "better than"

Dr. Akl
(Patent Owner's Expert)



157. While each may have a different metric for evaluation, a POSITA would understand that a more effective transmission based on the characteristics listed above would almost always be more or less effective in concert. For example, a POSITA would understand that, generally, a transmission with greater throughput would also have a lower frame packet error rate. A POSITA would be familiar with Shannon's formula dating back to 1948, as reproduced in Tanenbaum:

$$\text{maximum number of bits/sec} = B \log_2 (1 + S/N)$$

EX2010 at 94. That formula shows that a higher bits/second rate is correlated with a higher bandwidth (B), higher signal power (S), and lower noise (N). *Id.* at 94-95. Therefore, a POSITA would understand that, that whatever metric was used or whatever data characteristic might be highlighted, the bandwidth portion with "better" characteristics would be the same.

'564 EX2017 (Akl POR Decl.) at ¶ 157.

Definiteness: "better than"

Dr. Akl
(Patent Owner's Expert)



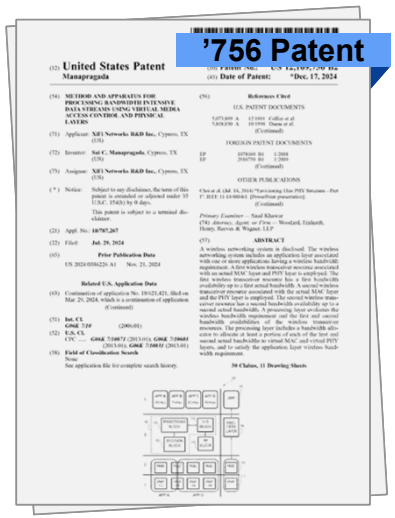
on link A, while the opposite was true on link B), would be quite rare. Second, even in the case of such a rare conflict, a POSITA would understand that certain data characteristics are more important to efficient transmission, and a POSITA would therefore have no trouble determining a hierarchy of characteristics in determining which link was "better." A POSITA would understand that the most important data characteristics are error rate, latency, and throughput, which all indicate the success of the transmission. Meanwhile, other characteristics such as signal strength are only a means to the end of the transmission. Therefore, in the case of Dr. Almeroth's hypothetical, a POSITA would have no trouble understanding that the lower packet error rate would be more important than the stronger received signal, and the bandwidth portion with the lower error rate (link B) would be "better." Therefore, a POSITA would be able to understand the scope of the claim term including "better than."

'564 EX2017 (Akl POR Decl.) at ¶ 158.

Definiteness: “partially satisfy”

’756, ’198 Patents
All Claims

Definiteness: “partially satisfy”



(ii) use the information provided to it by the resource monitoring interface to make allocation decisions with respect to first and second bandwidth availabilities to at least partially satisfy the bandwidth requirement of the data stream.

’756 EX1001 at 12:40-44 (claim 1).

Definiteness: "partially satisfy"

Dr. Akl
(Patent Owner's Expert)



160. A POSITA would easily understand that any bandwidth availability that measurably contributed to a bandwidth requirement would "at least partially satisfy" that bandwidth requirement—more than sufficient guidance to understand the scope of the term. I understand that Dr. Almeroth opines that "it is not clear whether aggregating bandwidth portions of two transceivers to allocate 1, 5, or 10 Mbps would qualify as 'partially' satisfying the bandwidth requirement of the data stream." *Id.* I disagree. A POSITA would understand that all three of these would qualify as "partially" satisfying the bandwidth requirement of 750 Mbps that Dr. Almeroth poses—because each would contribute to that requirement being met.

'756 EX2017 (Akl. POR Decl.) at ¶ 160.

Definiteness: "partially satisfy"

Dr. Akl
(Patent Owner's Expert)



161. To explain further, a POSITA would understand that, in order to meet quality of service requirements, an application would have a particular bandwidth requirement, for example, 225 Mbps, and that use of a bandwidth availability of 225 Mbps would satisfy that requirement. *See* EX1017 at 559. However, a bandwidth availability could be 75 Mbps (or any number less than 225), and a POSITA would understand that its use by that application could constitute "partial satisfaction" of the 225 Mbps bandwidth requirement.

'756 EX2017 (Akl. POR Decl.) at ¶ 161.