

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

AT&T SERVICES, INC., AND NOKIA OF AMERICA CORP.;
Petitioner,
v.

ADAPTIVE SPECTRUM AND SIGNAL ALIGNMENT, INC.,
Patent Owner.

Case: IPR2025-00451

U.S. Patent No. 9,954,631

PETITION FOR *INTER PARTES* REVIEW
UNDER 35 U.S.C. §312 AND 37 C.F.R. §42.104

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TABLE OF EXHIBITS

Exhibit	Short Name	Description
Ex-1001	'631 patent	U.S. Patent No. 9,954,631
Ex-1002	'631 File History	File History of U.S. Patent No. 9,954,631
Ex-1003	Gitlin Declaration	Declaration of Dr. Richard D. Gitlin
Ex-1004	Bingham	U.S. Patent No. 5,680,394 to Bingham
Ex-1005	Strobel	U.S. Patent No. 9,531,491 to Strobel
Ex-1006	Strobel '943 Provisional	U.S. Provisional Patent Application No.61/601,943
Ex-1007	Strobel '270 Provisional	U.S. Provisional Patent Application No. 61/598,270
Ex-1008	Kuipers	ITU Temporary Document 2012-06-4A-061 by ADTRAN, titled "G.fast: A flexible framing structure"
Ex-1009	Wei	ITU Temporary Document 2012-06-4A-040 by Wei
Ex-1010	Cioffi	U.S. Patent No. 5,887,032 patent to Cioffi
Ex-1011	Liu	U.S. Patent No. 6,754,261
Ex-1012	Joint Claim Construction Statement	Joint Claim Construction Statement, Exhibit A, <i>Adaptive Spectrum and Signal Alignment, Inc. v. AT&T Inc. et al.</i> , No. 24-cv-00029-JRG-RSP, Dkt. 105-1 (E.D. Tex. July 22, 2024)
Ex-1013	Lantq Contribution	ITU Temporary Document 2012-02-4A-054 by Oksman
Ex-1014	CV	<i>Curriculum Vitae</i> of Richard Gitlin
Ex-1015	Grami	Grami, Introduction to Digital Communications, Academic Press, 2016. Chapter 11
Ex-1016	G.9701	Fast access to subscriber terminals (G.fast) – Physical layer specification
Ex-1017	Docket Control Order	Docket Control Order, <i>Adaptive Spectrum and Signal Alignment, Inc. v. AT&T Inc. et al.</i> , No. 24-cv-00029-JRG-RSP, Dkt. 84 (E.D. Tex. July 22, 2024)
Ex-1018	Order Focusing Claims	Order Focusing Patent Claims and Prior Art to Reduce Costs, <i>Adaptive Spectrum and Signal Alignment, Inc. v. AT&T Inc., et al.</i> , Case No. 2:24-

		cv-00029-JRG-RSP (E.D. Tex. Oct. 23, 2024), ECF No. 104.
Ex-1019	Motion to Transfer	Defendants’ Motion to Transfer Venue Based on the Parties’ Contractual Forum-Selection Clause, and Alternatively, Motion to Stay Case Pending Arbitration, <i>Adaptive Spectrum and Signal Alignment, Inc. v. AT&T Inc., et al.</i> , Case No. 2:24-cv-00029-JRG-RSP (E.D. Tex. Oct. 23, 2024), ECF No. 92 (<i>Redacted</i>).
Ex-1020	Gagnaire	Maurice Gagnaire, <i>Broadband Local Loops for High-Speed Internet Access</i> (Artech House, 2003).
Ex-1021	DSL Advances	Thomas Starr, et al., <i>DSL Advances</i> , (Prentice Hall, 2002).
Ex-1022	ISDN Architecture	Richard T. Roca, <i>ISDN architecture</i> (AT&T Technical Journal, 1986).
Ex-1023	Gitlin	U.S. Patent No. 4,924,492 to Gitlin
Ex-1024	Data Communication Principles	Richard D. Gitlin, Jeremiah F. Hayes and Stephen B. Weinstein, <i>Data Communication Principles</i> (Plenum Press, 1992).
Ex-1025	A Review of HDSL Progress	Joseph W. Lechleider, <i>High Bit Rate Digital Subscriber Lines: A Review of HDSL Progress</i> , Vol. 9, No. 6, IEEE Journal on Selected Areas in Comm. 769 (1991).
Ex-1026	Strobel Article	Strobel, <i>Channel Modeling and Physical Layer Optimization in Copper Line Networks</i> , (Springer, 2019).
Ex-1027	ITU Work Program	ITU Temporary Document 2012-06-4A-A20 titled “G.fast: Work programme for G.fast”
Ex-1028	Broadband Access Networks	Leif Aarthun Ims, <i>Broadband Access Networks</i> (Springer, 1998)
Ex-1029	Issues List	ITU Temporary Document 2012-06-4A-U20R1
Ex-1030	NF-085	ITU Temporary Document NF-085
Ex-1031	CI-075	ITU Temporary Document CI-075
Ex-1032	ITU Global Directory	ITU Global Directory from Wayback Machine, dated December 6, 2000
Ex-1033	ITU-T Guide	ITU-T Guide for Beginners, March 2005, International Telecommunication Union

AT&T Services, Inc. (“AT&T”) and Nokia of America Corp. (“Nokia”) (“Petitioners”) petition for IPR under 35 U.S.C. §§311–319 and 37 C.F.R. §42 of Claims 1, 3-6, 8-9, 11-16, 22-25, and 33-37 (the “Challenged Claims”) of Patent No. 9,954,631 (“’631 patent”). Petitioners request cancellation of the Challenged Claims.

I. STANDING UNDER 37 C.F.R. §41.104(A)

Petitioners certify that the ’631 patent is available for IPR, and that Petitioners are not barred or estopped from requesting IPR.

II. PAYMENT OF FEES

Petitioner authorizes Account No. 16-0605 to be charged for any fees.

III. OVERVIEW OF CHALLENGES AND RELIEF REQUESTED

Pursuant to §2.22(a)(1) and §42.104(b)(1)-(2), Petitioners request cancellation of the Challenged Claims pursuant to the grounds below. The Declaration of Dr. Richard D. Gitlin (Ex-1003) provides additional support.

Ground 1: Claims 1, 3-6, 34, and 37 are unpatentable under 35 U.S.C. §§102 and 103 in view of U.S. Patent No. 5,680,394 (“Bingham”).

Ground 2A: Claims 1, 3-6, 8-9, 11-16, 22-25, and 33-37 are unpatentable under 35 U.S.C. §103 over U.S. Patent No. 9,531,491 (“Strobel”).

Ground 2B: Claims 3, 15, and 16 are unpatentable under 35 U.S.C. §103 over Strobel in view of ITU Temporary Document 2012-06-4A-040 (“Wei”).

Ground 2C: Claims 5, 6, 9, 11-14, 35, 36 are unpatentable under 35 U.S.C. §103 over Strobel in view of ITU Temporary Document 2012-06-4A-061 (“Kuipers”).

Ground 2D: Claim 33 is unpatentable under 35 U.S.C. §103 over Strobel in view of Wei and Kuipers.

IV. **BACKGROUND**

A. Technical Background

The '631 patent issued on April 24, 2018 and claims priority to a PCT application filed on October 12, 2012, and U.S. Provisional Application No. 61/676,832, which was filed on July 27, 2012. Ex-1001, 1.

The '631 patent explains that known communication systems include “TDD (Time Division Duplex) systems [that] transmit downstream (network to subscriber) data and upstream (subscriber to network) data in distinct time slots of the same physical channel” and that “there is often a small guard-time between distinct time slots to ensure that data does not overlap.” Ex-1001, 1:24-29. It then explains that one “new TDD system is called ‘G.fast,’ which is currently in the process of standardization.” *Id.*, 1:29-30.

The '631 patent continues by explaining that “[i]n many TDD systems, there are multiple physical channels,” and “[i]f these channels are close together in location and overlap in frequency, then they may interfere with each other.” *Id.*, 2:1-

4. The '631 patent refers to Figure 3 to demonstrate this interference caused by two physical channels:

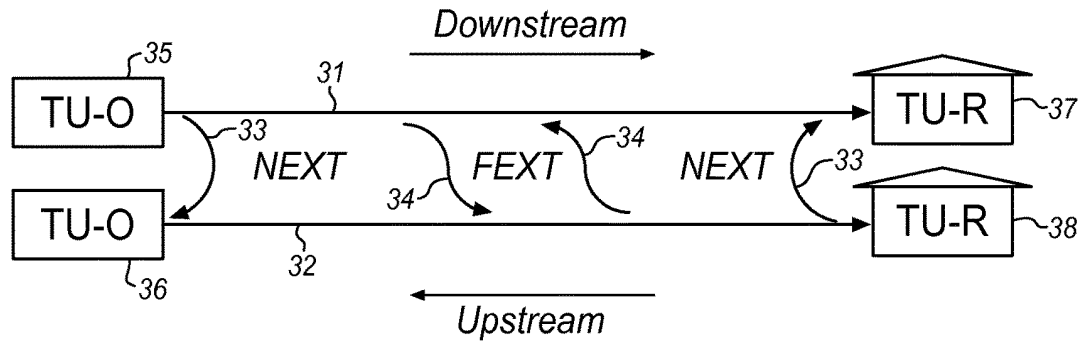


FIG. 3

Id., Fig. 3.

As a solution to the NEXT crosstalk problem, the '631 patent states that “[o]ne way to avoid self-NEXT is to synchronize the transmissions on the two lines so that one line does not transmit downstream while another line transmits upstream.” *Id.*, 3:31-33. When two or more lines are at issue, the '631 patent therefore contemplates arranging the time slots in such a way where one physical line does not transmit downstream while another different physical line transmits upstream, as shown in Figure 6 below. *Id.*, 5:62-63.

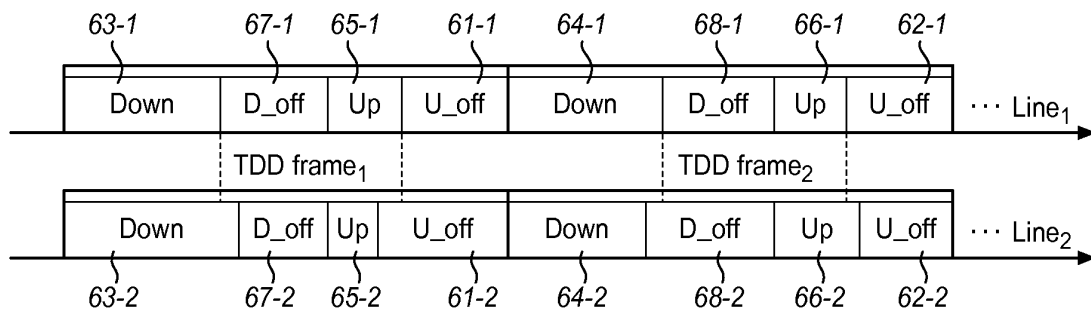


FIG. 6

Id., Fig. 6.

This solution—effectively applying the known concept of TDD to multiple physical lines (instead of just one)—did nothing to advance the state of the art. Using TDD across multiple physical lines was well-known prior to the '631 patent. *See* Ex-1004.

B. Prosecution History

The Examiner rejected claims 1-39 as being unpatentable over Williams (Pub. No. US20140003307) further in view of Cioffi (Patent No. 5,887,032). Ex. 1002, 358. The Examiner explained that Williams teaches managing upstream and downstream time slots and, although it does not teach doing so on multiple physical channels, Cioffi teaches a first physical channel for upstream and a second channel for downstream. *Id.*

In response, Applicant asserted that Williams in light of Cioffi did not render the proposed claim obvious because, in Williams, “there are no separate physical channels for downstream and upstream.” *Id.*, 390. Next addressing Cioffi, Applicant

asserted that “Cioffi does not disclose having separate channels for upstream and downstream.” *Id.* Rather, Applicant explained that the lines in Cioffi “appear to be bi-directional” and thus there was no “need for having separate channels for upstream and downstream.” *Id.*

Persuaded by this argument, the Examiner withdrew his rejection. *Id.*, 411. Instead, the Examiner rejected the claims over Williams in light of Liu (U.S. Patent No. 6,754,261). *Id.*, 411-412. Liu specifically discloses that “[t]he upstream channel and the downstream channel may share the same physical communication link or *occupy different physical communication links.*” Ex-1011, 1:52-55 (emphasis added).

In response, the Applicant asserted that because Williams disclosed multiplexing done by switches “any combination of a reference that teaches separate physical channels for downstream and upstream will change the principle of operation of Williams.” Ex-1002, 452.

A Notice of Allowance subsequently issued explicitly based on these arguments. *Id.*, 467, 473.

C. Priority Date

In this Petition, Petitioners assume without conceding that the earliest priority date for the ’631 patent is July 27, 2012 based on U.S. Provisional Application No.

61/676,832. Ex-1001; Ex-1003 ¶¶99. If Patent Owner disputes the prior art status of any cited references, Petitioners reserve the right to challenge the priority date.

D. Claim Construction

With the exception of the terms identified below, the terms should receive their respective plain and ordinary meaning as understood by a person of ordinary skill in the art under *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005); Ex-1003, ¶¶124-136.

1. “physical channel”

The scope of the term “physical channel” was expressly disclaimed during prosecution to exclude *bidirectional* physical channels. Prosecution disclaimer “preclud[es] patentees from recapturing through claim interpretation specific meanings disclaimed during prosecution.” *Omega Eng'g, Inc. v. Raytek Corp.*, 334 F.3d 1314, 1323 (Fed. Cir. 2003). “Thus, when the patentee unequivocally and unambiguously disavows a certain meaning to obtain a patent, the doctrine of prosecution history disclaimer narrows the meaning of the claim consistent with the scope of the claim surrendered.” *Biogen Idec, Inc. v. GlaxoSmithKline LLC*, 713 F.3d 1090, 1095 (Fed. Cir. 2013).

In this case, the Applicant first overcame the combination of Williams and Cioffi by asserting that “Cioffi does not disclose having separate channels for upstream and downstream” and instead the lines disclosed in Cioffi “appear to be bi-

directional,” which means there was “no need for having separate channels for upstream and downstream.” Ex. 1002, 358. The Applicant thus unequivocally and unambiguously disavowed a claim scope that would include bidirectional physical channels.

Much like the claims of the ’631 patent, Cioffi discloses synchronizing “wires that share a binder” using TDD “such that downstream communications are not transmitted at times that overlap with the transmission of upstream communications.” Ex-1010, 2:28-35. Applicant’s statements in view of Cioffi therefore must mean that the twisted-pair wires of Cioffi did not meet the limitation because they allowed both upstream and downstream communication on a single wire, which was not in the scope of the claims of the ’631 patent.

Confirming this understanding, the Examiner provided an additional reference (Liu) that expressly filled this gap, disclosing that the “upstream channel and the downstream channel may . . . *occupy different physical communication links*.” Ex-1002, 411-412. Applicant likewise overcame this reference by acknowledging that Liu did indeed teach upstream and downstream on different physical channels but that a “combination of a reference that teaches separate physical channels for downstream and upstream will change the principle of operation of Williams.” *Id.*, 452.

In view of this clear disclaimer, the term “physical channel” should be construed to mean “a physical channel that transmits in only the upstream or the downstream, not both.” Ex-1003, ¶135.

In the related district court litigation, ASSIA has taken the position that the claim does not need to be construed (plain and ordinary) and that there was no disclaimer. Ex-1012. Regardless of the construction adopted by the Board, Grounds 1 and 2 disclose every Challenged Claim of the ’631 patent and an IPR should be instituted.

2. “Means for” Limitations

Independent claim 37 recites several “means for” limitations. To comply with 37 C.F.R. §42.104(b)(3), Petitioner identifies the following non-limiting structures.

Claim Term	Citation to Specification
“means for scheduling upstream time slots...”	Structure includes a TDD management system, which “includes a memory 1295 coupled
“means for scheduling downstream time slots...”	directly or through a bus to a processor or processors 1296...includes one or more communications buses 1215 to connect the various illustrated components...includes a management interface 1225 coupled to the bus and to external management devices...includes a

	LAN (Local Area Network) interface 1230 coupled to the bus...includes a WAN (Wide Area Network) interface 1235 coupled to the bus and to an external WAN...includes stored historical information 1250 which may be stored within the memory 1295 or as a separate component coupled to the memory or to the bus.” Ex-1001, 14:47-15:13.
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Even if any of these claim limitations are deemed indefinite, review is still appropriate because a determination of unpatentability is not impossible given that the prior art references disclose at least the same structure for performing the same functions. *Samsung Electronics America v. Prism Engineering*, 948 F.3d 1342, 1355 (Fed. Cir. 2020).

V. PRIOR ART REFERENCES

A. Bingham (Ex-1004)

U.S. Patent No. 5,680,394 to Bingham *et al.*, titled “Time division duplexed high speed data transmission system and method” was filed on July 11, 1995 and issued on October 21, 1997. Bingham is prior art under at least pre-AIA 35 U.S.C. §102(b), based on its issuance date.

B. Strobel (Ex-1005)

U.S. Patent No. 9,531,491 to Strobel *et al.*, titled “Communication method, apparatus and system,” was filed on February 13, 2013 and issued on December 27, 2016. Strobel claims priority to a U.S. Provisional Application No. 61/598,270 filed on February 13, 2012 (“Strobel Provisional”). Strobel qualifies as prior art under at least pre-AIA 35 U.S.C. §102(e) for the reasons explained below.

1. Strobel Qualifies as Prior Art

Strobel claims priority to U.S. Provisional Nos. 61/598,270 (the “Strobel ’270 Provisional”) and 61/601,943 (the “Strobel ’943 Provisional”). Strobel should be afforded at least a filing date of February 22, 2012 (based on the later provisional – ’943) because the Strobel Provisionals provide adequate written disclosure under 35 U.S.C. §112 for at least Strobel’s Claim 4, and the Strobel Provisionals disclose and describe the subject matter relied on in Strobel. *See Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1380-81 (Fed. Cir. 2015).

The Strobel Provisionals provide §112, ¶1 support for at least Claim 4 of Strobel as shown in the table below (the below are non-limiting examples):

Claim 4 (Ex-1005)	Strobel ’943 Provisional (Ex-1006) and Strobel ’270 Provisional (Ex-1007)
A system operative to serve multiple electronic communication lines, comprising:	• “Solutions related to dynamic rate adaptation may operate on any system, including, without limitation, any cable, wireline telephony, other wireline, wireless system, or hybrids of any of the aforementioned kinds of systems.” Ex-1006, 24:9-11.

	• “One solution is a transceiver system that services multiple electronic communication lines.” Ex-1006, 24:21-22.
a distribution point, comprising a central unit and a plurality of transceivers;	• “This solution includes a distribution point, which itself may include a central unit and multiple transceivers.” Ex-1006, 24:22-23.
a crosstalk channel;	• “This solution also may include . . . a crosstalk channel, and multiple remote terminals.” Ex-1006, 24:23-24.
wherein the system is configured to compute a plurality of power level configurations, wherein the plurality of power level configurations corresponds to a non-zero data rate on the multiple electronic communication lines, store in memory data about said configurations, process said data into time sharing information comprised in a medium access plan,	• “[T]he system may be configured to compute locally optimal communication configurations, store in memory data about said configurations, process said data into time sharing information, convey such time sharing information to the transceivers and the remote terminals.” Ex-1006, 24:24-25. • “‘Local optimization’ is the process of finding transmission power levels for two communication units, and the corresponding data rate for each such unit.” Ex-1006, 6:1-6. • “One solution is a transceiver system that services multiple electronic communication lines.” Ex-1006, 24:30-31. • “A media access plan message contains the information about what configuration is to be used at which particular time.” Ex-1006, 15:10-11.
the time sharing information specifying, for each one of the multiple electronic	• “The time sharing information allows the communication units to transmit at times and power levels,” Ex-1006, Abstract. • “The time sharing information is later used by the transceivers and remote terminals to transmit in

communication lines, when to switch between the respective plurality of power level configurations,	accordance with such time sharing information.” Ex-1006, 24:28-29. • “One solution is the central unit that may be part of a communication system operative to serve multiple electronic communication lines, wherein the media access plan includes information about time slots, about when transceivers should transmit, and about the power levels at which transceivers should transmit.” Ex-1006, 29:23-26.
and to convey the medium access plan to the transceivers,	• “The central unit may include ... a unit that conveys the media access plan to transceivers that will transmit in accordance with the plan.” Ex-1006, 29:8-15.
wherein the medium access plan includes all downstream and upstream transmissions over all active transmission media.	• “A media access plan message contains the information about what configuration is to be used at which particular time.” Ex-1006, 15:10-11. • “The dynamic assignment of TS is by broadcasting a special control message called Medium Access Plan (MAP). This message includes the list of TS assigned to both the DP and all CPEs for transmitting and receiving data symbols, respectively.” Ex-1007, 7. • “providing a medium access plan that includes all downstream and upstream transmissions over all active lines;” Ex-1007, 17.

As this chart shows, Strobel has support for Claim 4 via at least a combination of both disclosures of the Strobel Provisionals (though the '943 Provisional itself discloses the claim). As an additional example to what is provided in the chart, claim 1 disclosed in the '943 Provisional almost entirely discloses claim 4 word for word.

Additionally, the Strobel Provisionals support the disclosures of Strobel relied on in this Petition. Support to the Strobel Provisionals is provided throughout the Petition in conjunction with cites to Strobel. Both Strobel Provisionals were

incorporated into Strobel. Accordingly, Strobel should be afforded the priority date of at least the Strobel '943 Provisional, February 22, 2012.

C. Wei

Wei is an ITU contribution submitted by Huawei titled “G.fast: Discontinuous Mode Power Saving” that was distributed and made available prior to the June 2012 meeting of the ITU. Wei would have been publicly available to a POSITA prior to the July 27, 2012 priority date. Ex-1003, ¶¶181-212. Wei is prior art under at least pre-AIA 35 U.S.C. §102(a), based on its publication date.

D. Kuipers

Kuipers is an ITU contribution submitted by ADTRAN titled “G.fast: A flexible framing structure” that was distributed and made available prior to the June 2012 meeting of the ITU. Kuipers would have been publicly available to a POSITA prior to the July 27, 2012 priority date. Ex-1003, ¶¶181-212. Kuipers is prior art under at least pre-AIA 35 U.S.C. §102(a), based on its publication date.

E. Wei and Kuipers Were Publicly Accessible Printed Publications Before the Priority Date

Wei and Kuipers qualify as “printed publications” because they were “disseminated or otherwise made available to the extent that persons interested and ordinarily skilled in the subject matter or art exercising reasonable diligence [could] locate it” at least by June 18, 2012. *SRI Int’l, Inc. v. Internet Sec. Sys.*, 511 F.3d 1186, 1194 (Fed. Cir. 2008); *see also* 35 U.S.C. §102(a); Ex. 1003, ¶¶181-212.

Wei and Kuipers were made available, presented, and disseminated to members of ITU-T Study Group 15 / Question 4. Ex. 1003, ¶¶181-182. As explained below, and as supported by Dr. Gitlin and various corroborating references, both Wei and Kuipers were shared with and/or otherwise available to hundreds of people having ordinary skill and expertise in the art, comprising the members of the most interested public, without any expectation or legal requirement of confidentiality and in such a manner such that copying the material was simple, easy, and in fact recommended. *See, e.g., M & K Holdings, Inc. v. Samsung Electronics Co., Ltd.*, 985 F.3d 1376 (Fed. Cir. 2021) (holding that printed publications were publicly accessible even behind a password-protected website where “interested users...could have located [the references] through reasonable diligence”); *In re Klopfenstein*, 380 F.3d 1345, 1350-52 (Fed. Cir. 2004) (finding public availability of reference presented to a target audience of chemists without confidentiality restriction); *see generally*, Ex. 1003, §IX.E.

Before the June 18-22, 2012 ITU meeting, Wei and Kuipers were made available via an ITU server and through email distribution. Ex-1003, ¶¶187-189, 204, 212; Ex-1008; Ex-1009; Ex-1030; Ex-1031. Although the server required a user to have a login credential (a username and password), as Dr. Gitlin explains, those credentials were freely available to people who worked for the many ITU-T member

companies, even if they never attended meetings. Ex. 1003, ¶¶190-196. There was no expectation of confidentiality with respect to these documents. Ex-1003, ¶195.

The ITU-T had guidelines that required all contributions to be both uploaded to a server and emailed via a “document announcement” to an email listserv that included all interested POSITAs. Ex-1003, ¶¶187-189; Ex-1031. Additionally, the ITU published “issues lists” before the meeting identifying those contributions that had been uploaded to a server and emailed to POSITAs, where both Wei and Kuipers were listed. Ex-1003, ¶186, 192; Ex-1029. Further, the ITU circulated meeting work programs that identified contributions indexed by type of contribution. Ex-1003, ¶¶200-201, 208-209; Ex-1027. For example, Wei was categorized into a category called “Low power modes” and Kuipers was categorized into a category called “Frame Structure.” *Id.*

A “dispositive question is whether interested users of the [ITU] website could have located [Wei] and [Kuipers] through reasonable diligence.” *M&K Holdings*, 985 F.3d at 1381. “A factor relevant to public accessibility is whether a repository indexes its documents or otherwise categorizes them by subject matter.” *Id.* Much like the Board found that the documents in *M&K Holdings* “were effectively indexed by subject matter,” here Wei and Kuipers were effectively indexed by subject matter. The ITU work program specifically categorized Wei into the “Low power modes” category, where it was one of only five documents, and Kuipers into the “Frame

Structure” category, where it was one of only eight documents. Ex-1027, 2. ITU contributions were also made available via the ITU website, and organized by meeting (here G.fast meeting). Ex-1003, ¶192; Ex-1033. As such, a POSITA reading the ’631 patent (which discloses using low power modes and flexible frame formats as it relates to G.fast) would have looked to the “low power mode” and “frame structure” categories of G.fast ITU contributions from G.fast meetings and would have found Wei and Kuipers. Ex-1003, ¶¶192, 202-204, 210-212. Thus, Wei and Kuipers are published documents available to the interested public no later than the earliest possible priority date of the ’631 patent.

VI. LEVEL OF ORDINARY SKILL IN THE ART

A person of ordinary skill in the art pertinent to the ’631 patent would have had at least a Bachelor’s Degree in electrical engineering, computer engineering, or similar discipline and had approximately two years of experience with electronic communication systems and familiarity with standards governing DSL systems. A person with a different degree but with additional relevant experience could still qualify if the additional experience compensates for the different educational background.

VII. THE CHALLENGED CLAIMS ARE UNPATENTABLE

A. Ground 1: Claims 1, 3–6, 34, and 37 are Unpatentable Under 35 U.S.C. §§102 and 103 over Bingham.

Much like the '631 patent, Bingham discloses “a time division, duplexed data transmission scheme that is well adapted for transmissions over bundled transmission wires such as subscriber lines.” Ex-1004, 1:8-10. Bingham explains that, at the time of its invention, one of the standards bodies (ANSI) was “just beginning work on the next generation subscriber line based transmission system, which is referred to as the VDSL (Very High Digital Subscriber Line) standard.” *Id.*, 1:62-65. Bingham proposed a time division duplexing approach for VDSL, much like the '631 patent discloses that the ITU had adopted a time division duplexing approach for G.fast.

1. Overview of Ground 1

Even a cursory comparison of the Abstract of Bingham to claim 1 of the '631 patent demonstrates the lack of inventiveness of the '631 patent:

Claim 1, '631 Patent

1. A method in a data communications system for managing multiple time division physical channels that are subject to crosstalk, the method comprising:
scheduling upstream time slots for upstream transmission in a first physical channel; and
scheduling downstream time slots for downstream transmission in a second physical channel, wherein transmission in the upstream time slots is substantially not simultaneous with transmission in the downstream time slots.

Bingham

A method of coordinating very high speed bi-directional data transmissions between a central unit and a plurality of remote units over distinct twisted pair transmission lines that share a binder is described. Specifically, periodic synchronized upstream and downstream communication periods are provided that do not overlap with one another. The upstream and downstream communication periods for all of the wires that share a binder are synchronized. With this arrangement, all of the very high speed transmissions within the same binder are synchronized and time division duplexed such that downstream communications are not transmitted at times that overlap with the transmission of upstream communications. In some embodiments, quiet periods are provided to separate the upstream and downstream communication periods. The described invention may be used in conjunction with a wide variety of modulation schemes, including both multi-carrier and single carrier transmission schemes. It is backwards compatible with existing systems and has particular advantages in very high performance systems.

Under the plain and ordinary meaning of the term “physical channel,” Bingham discloses the challenged claims. If the Board construes the claims to exclude bidirectional channels based on ASSIA’s disclaimer, Bingham still renders obvious the challenged claims.

Although a unidirectional system (where data is sent either in just the upstream or the downstream direction on a single physical channel) would be less efficient than a bidirectional system, the system would be less complex from a management perspective. Ex-1003, ¶219. For example, one of the considerations in a bidirectional channel is having to switchover between receiving and transmitting signals, something commonly referred to as a turnaround time. *Id.* Turnaround time generally refers to the time it takes for a transceiver to switch from transmitting mode

to receiving mode, and vice versa, within a single frequency channel. *Id.*; *see also* Ex-1005 at 21:6-9. A faster turnaround time correlates to more efficient data transfer. *Id.* A POSITA would have been motivated to use Bingham with unidirectional channels to eliminate this turnaround time. Ex-1003, ¶220. Given that this was a known solution to reduce turnaround time, *see* Ex-1005 at 21:6-9, a POSITA would have had a reasonable expectation of success in doing so.

a. Claim 1

- i. 1[pre]: A method in a data communications system for managing multiple time division physical channels that are subject to crosstalk, the method comprising:**

Bingham teaches the preamble of claim 1, to the extent it is determined to be limiting.

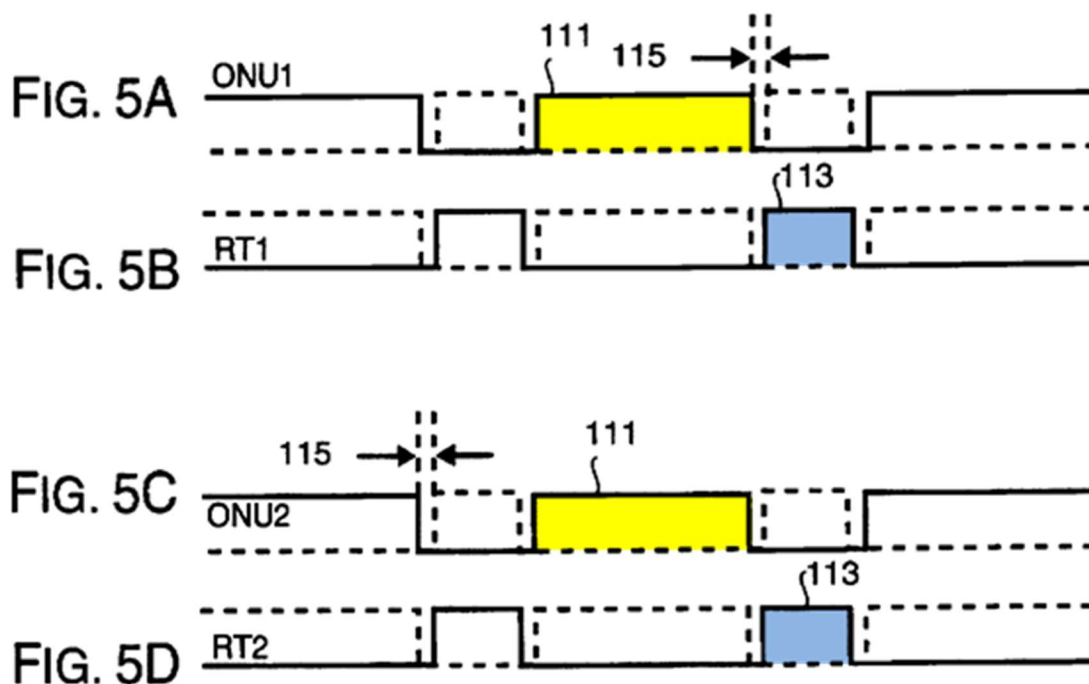
Bingham discloses “A method of coordinating very high speed bi-directional data transmissions between a central unit and a plurality of remote units over distinct twisted pair transmission lines that share a binder.” Ex-1004, Abstract. Bingham teaches a method that uses “a time division duplexed (i.e. “ping pong”) based data transmission scheme.” *Id.*, 4:18-20. Bingham confirms that this method is for managing crosstalk across multiple time division physical channels by explaining that “[t]he present invention overcomes the near end crosstalk problem by synchronizing time division duplexed transmissions for very high speed data transmissions that share a binder,” where a binder is a group of multiple physical

channels or lines. *Id.*, 4:34-37, 8:65-66 (“lines that share the same binder”); Ex-1003, ¶¶221-224.

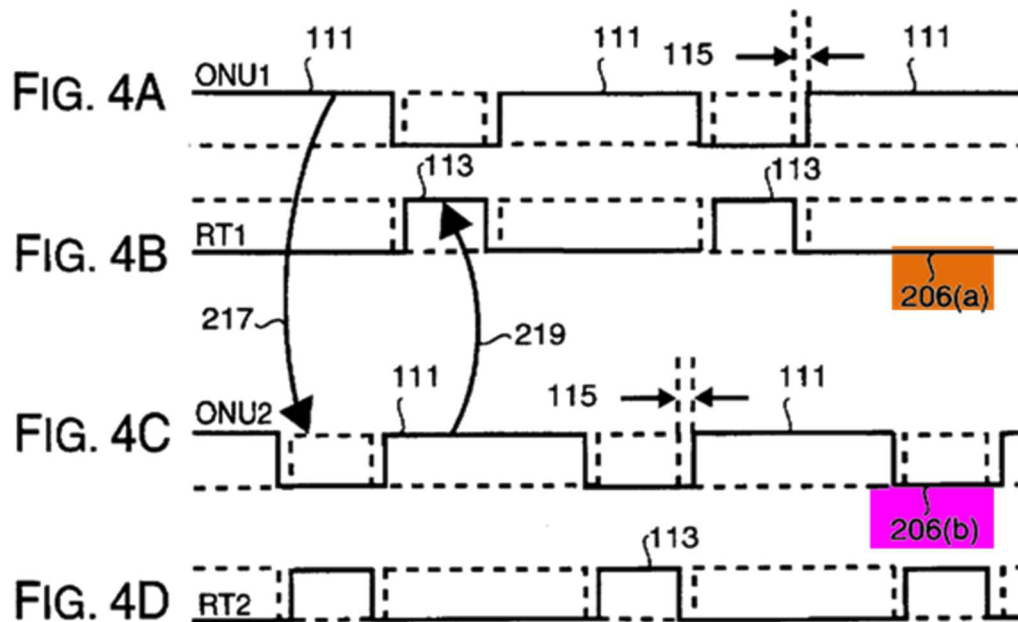
ii. 1[a] scheduling upstream time slots for upstream transmission in a first physical channel; and

Bingham teaches limitation 1[a].

Referring to Figures 5A-5D (annotated below), Bingham explains that in a “synchronized system, the downstream communication periods 111 [(shown in yellow)] all begin and end at the same times, and the upstream communication periods 113 [(shown in blue)] all begin and end at the same time.” Ex-1004 at 7:16-21.



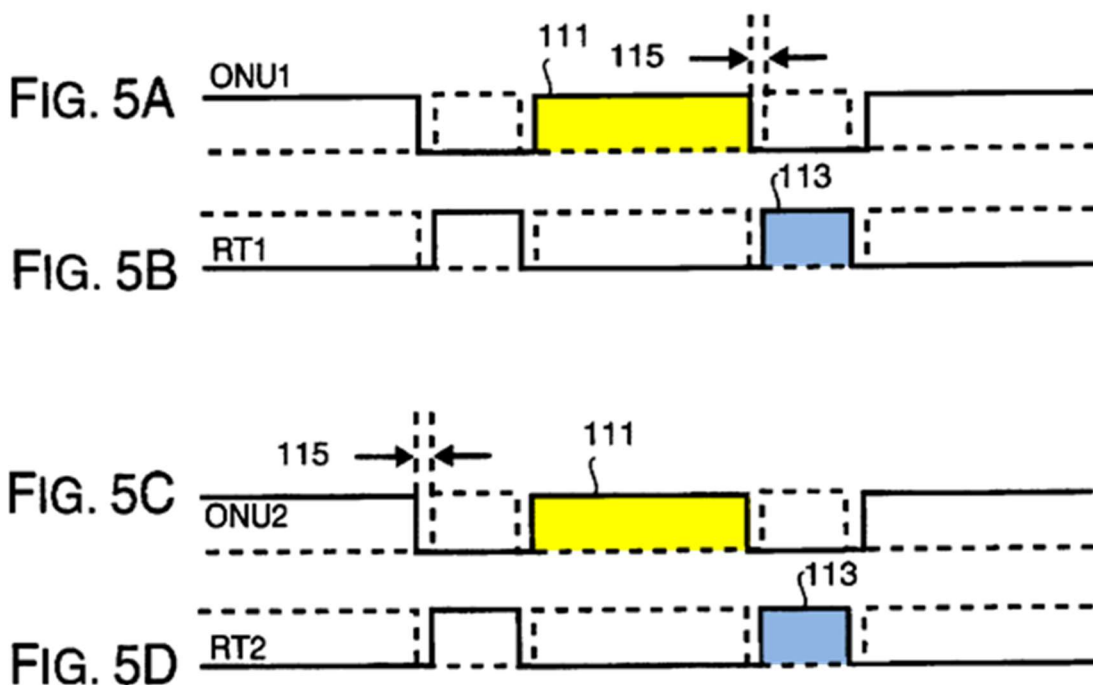
Here, Bingham discloses scheduling upstream time slot (113 in blue) in a first physical channel (shown in Figure 5B). As depicted in Figure 5B, the transmission comes from RT1, which Bingham explains is a first “upstream transmitter” or “receiver.” *Id.*, 7:8-13. A POSITA would have understood that Figure 5B depicts a first physical channel and Figure 5C depicts a second physical channel. Ex-1003, ¶¶227-230. To be sure, Bingham discloses, with respect to Figure 4 (annotated below), that “*twisted pair transmission lines* 206(a) [(in orange)] and 206(b) [(in purple)] both transmit time division duplexed discrete multi tone signals.” Ex-1004, 6:65-7:1. A POSITA would have understood those same separate physical channels carry over to Figure 5.



iii. **1[b] scheduling downstream time slots for downstream transmission in a second physical channel,**

Bingham teaches limitation 1[b].

As explained with respect to limitation 1[a], Bingham teaches that in a “synchronized system, the downstream communication periods 111 [(yellow)] all begin and end at the same times, and the upstream communication periods 113 [(blue)] all begin and end at the same time.” Ex-1004, 7:16-21.



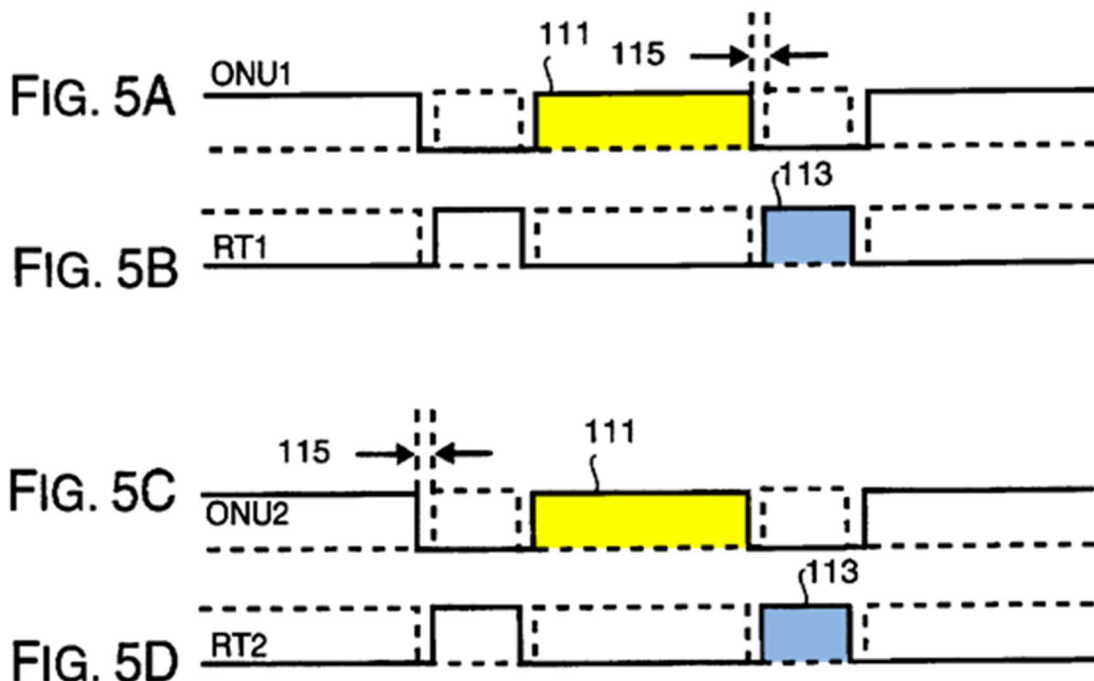
Here, Bingham discloses scheduling downstream time slots (111 in yellow) in a second physical channel (shown in annotated Figure 5C). As depicted in Figure 5C, the transmission comes from ONU2, which Bingham explains is the “central unit.” *Id.*, 7:28. For the same reasons explained with respect to limitation 1[a], a

POSITA would have understood that Figure 5C shows downstream transmission from the “central unit” on the second physical channel, while Figure 5B shows upstream transmission on the first physical channel. Ex-1003, ¶¶232-235.

iv. 1[c] wherein transmission in the upstream time slots is substantially not simultaneous with transmission in the downstream time slots.

Bingham teaches limitation 1[c].

As shown in annotated Figure 5, Bingham discloses that transmission in the upstream time slots is substantially not simultaneous with transmission in the downstream time slots. Ex-1003, ¶237. When comparing 111 (downstream in yellow) to 113 (upstream in blue), it is apparent that the transmissions are not simultaneous.



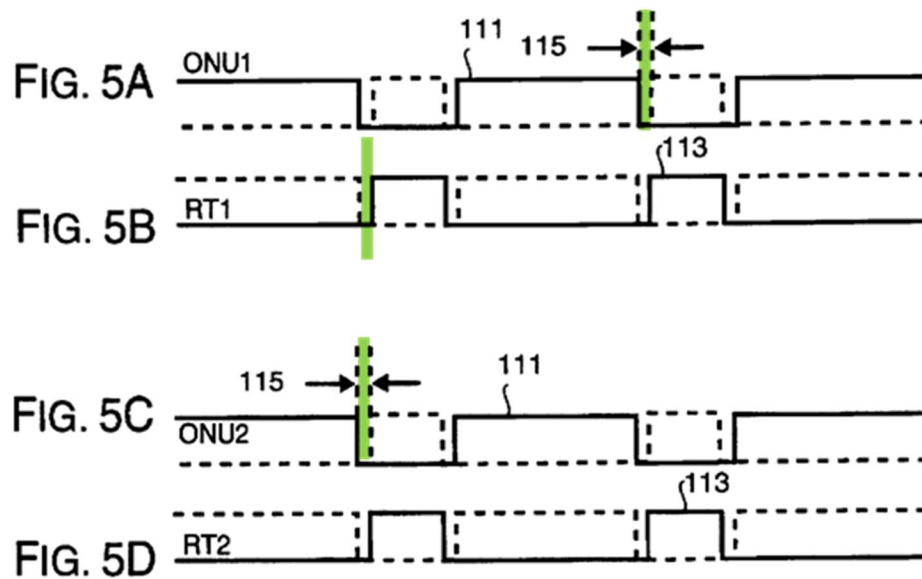
To be sure, Bingham explains that “[w]ith this arrangement, all of the very high speed transmissions within the same binder are synchronized and time division duplexed such that *downstream communications are not transmitted at times that overlap with the transmission of upstream communications.*” Ex-1004, Abstract (emphasis added).

Though the claim language does specify “substantially not simultaneous,” rather than just “not simultaneous,” if the times are entirely not simultaneous that falls within the claim scope of “substantially not simultaneous.” Ex-1003, ¶240.

b. Claim 3: The method of claim 1, wherein the upstream and downstream time slots have an active portion during which signals are transmitted and an off portion during which no signals are transmitted, and wherein the active portions of the upstream time slots are substantially not simultaneous with the active portions of the downstream time slots.

Bingham discloses claim 3.

As depicted in annotated Figure 5, both the upstream time slots 113 and downstream time slots 111 have “quiet periods 115 [(in green)] arranged therebetween.” Ex-1004, 7:3-4. The “quiet periods are provided to separate the upstream and downstream communication periods” and, during these quiet periods, “neither upstream nor downstream communications may be transmitted.” *Id.*, 2:59-62.



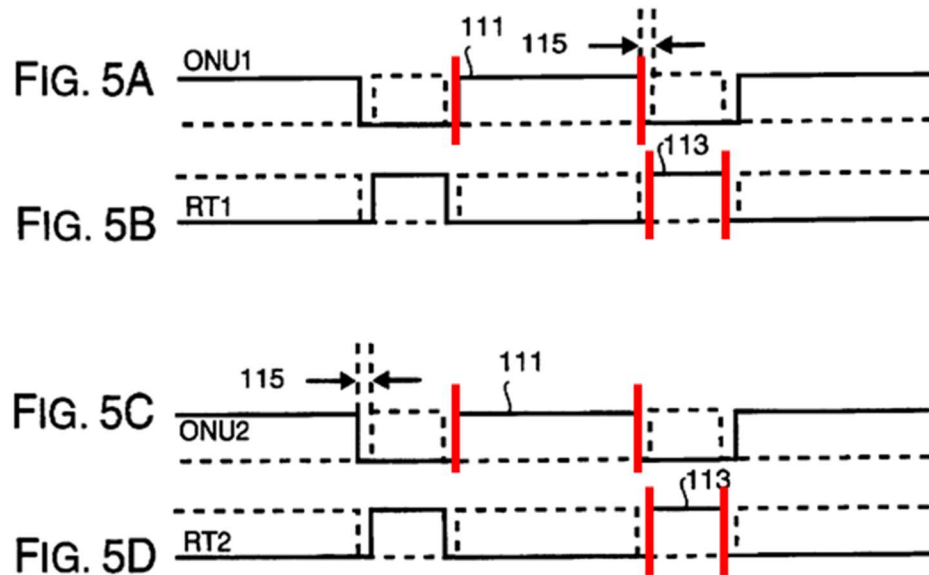
These quiet periods constitute the off portions of both the downstream and upstream time slots. Ex-1003, ¶¶244-245. For the same reasons explained with respect to limitation 1[b], the active portions of the upstream and downstream time slots are substantially not simultaneous.

c. Claim 4: The method of claim 1, wherein scheduling upstream and downstream time slots comprises scheduling upstream and downstream time slot boundaries.

Bingham discloses claim 4.

Figure 5 of Bingham (annotated below) shows scheduling upstream time slot boundaries for period 113 (in red) and downstream time slot boundaries for period 115 (also in red). As explained by Bingham, “the downstream communication periods 111 all begin and end at the same times, and the upstream communication periods 113 all begin and end at the same time,” where the beginning of the period

is one boundary and where the period ends is another boundary. Ex-1004, 7:19-21; Ex-1003, ¶¶247-249. A POSITA would have understood that the start and end of the upstream and downstream “periods” constitutes time slot boundaries. Ex-1003, ¶249.



d. Claim 5: The method of claim 4, wherein the time slot boundaries are flexible.

Bingham discloses claim 5.

With reference to Figure 3 (annotated below), Bingham explains that “downstream communication periods 111” (in yellow), “upstream communication periods 113” (in blue), and “quiet periods 115” (in green) may all be scheduled. Ex. 1004, 5:45-55.

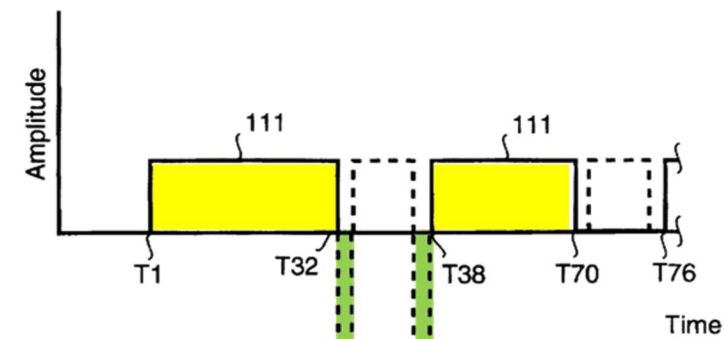


FIG. 3A

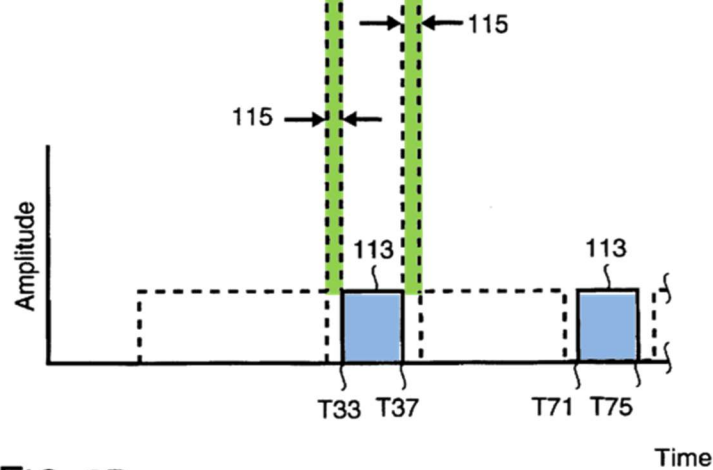


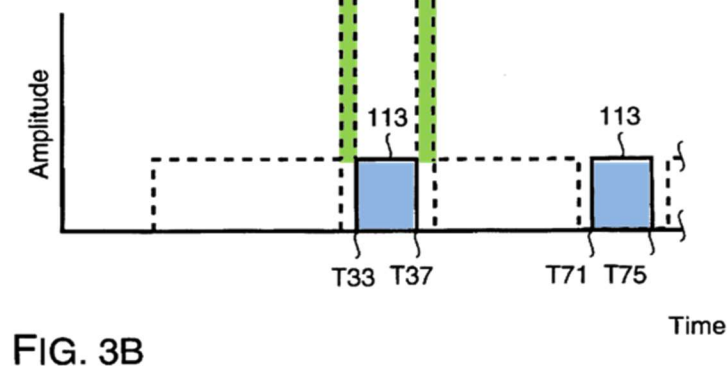
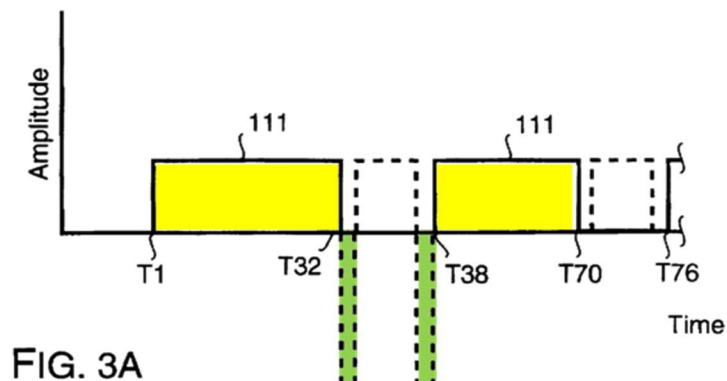
FIG. 3B

Bingham continues by explaining that the “actual duration of the upstream, downstream and quiet periods as well as the superframe may all be varied extensively within the scope of the present invention.” *Id.*, 5:57-61. A POSITA would have understood this to mean that the time slot boundaries of the upstream and downstream periods are flexible. Ex-1003, ¶¶251-252.

- e. **Claim 6: The method of claim 5, wherein the time slot boundaries have one or more of: variable-length frames; variable upstream time slot lengths; or variable downstream time slot-lengths.**

Bingham discloses claim 6.

Again looking to annotated Figure 3 of Bingham, Bingham explains that the “actual duration of the upstream, downstream and quiet periods as well as the superframe may all be varied extensively within the scope of the present invention.” *Id.*, 5:57-61. Because the duration of the upstream, downstream, and quiet periods can be varied, a POSITA would have understood that the actual time slot lengths for both the upstream and downstream could be variable. Ex-1003, ¶¶254-255.



f. Claim 34

- i. 34[pre]: A machine-readable medium having instructions that when operated on by the**

**machine cause the machine to perform
operations comprising:**

To the extent the preamble is limiting, Bingham discloses limitation 34[pre].

Bingham discloses that Figure 6 (below) “is a block diagram illustrating a central office and remote modem timing architecture suitable for implementing the synchronization of the present invention.” Ex-1004, 4:11-13. Bingham further explains that “the invention can be implemented using a wide variety of modem constructions at both the central and remote station locations.” *Id.*, 9:12-14. A POSITA would have understood the central office and modem (or remote location) disclosed by Bingham would have included a memory with software for implementing the usual processes of a central office and modem. Ex-1003, ¶¶257-260. Thus, a POSITA would have recognized that Bingham discloses a machine-readable medium that includes instructions to perform certain operations, including time-division duplexing operations. Ex-1003, ¶257.

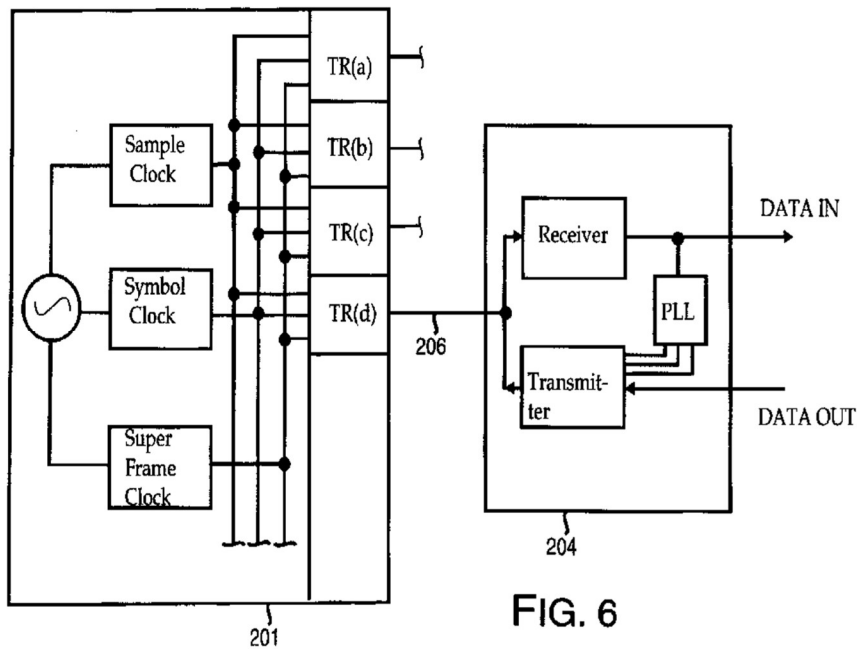


FIG. 6

- ii. **34[a] scheduling upstream time slots for upstream transmission in a first physical channel of multiple time division physical channels in a data communication system in which the physical channels are subject to crosstalk; and**

Bingham discloses limitation 34[a] for at least the same reasons discussed in limitations 1[pre] and 1[a]. Although the combination of both limitations 1[pre] and 1[a] are required to disclose limitation 34[a], the claimed scope is otherwise identical (except that claim 34 claims a “machine readable medium” while claim 1 claims a “method”).

- iii. **34[b]: scheduling downstream time slots for downstream transmission in a second physical channel subject to crosstalk from the upstream time slots,**

Bingham discloses limitation 34[b] for the same reasons discussed in limitation 1[b]. Limitation 34[b] recites “subject to crosstalk from the upstream time slots,” which is not recited in limitation 1[b]. But a POSITA would have understood that downstream transmissions are almost always subject to crosstalk from simultaneous upstream transmissions. Ex-1003, ¶263. For example, the ’631 patent discloses that “system transmitting in multi-pair copper cables can generate crosstalk into each other,” Ex-1001, 2:7-9, and Bingham discloses that “downstream communication transmission [that] occurs at the same time as upstream transmission . . . will result in near end crosstalk,” Ex-1004, 7:5-7.

iv. 34[c]: wherein transmission in the upstream time slots is substantially not simultaneous with transmission in the downstream time slots.

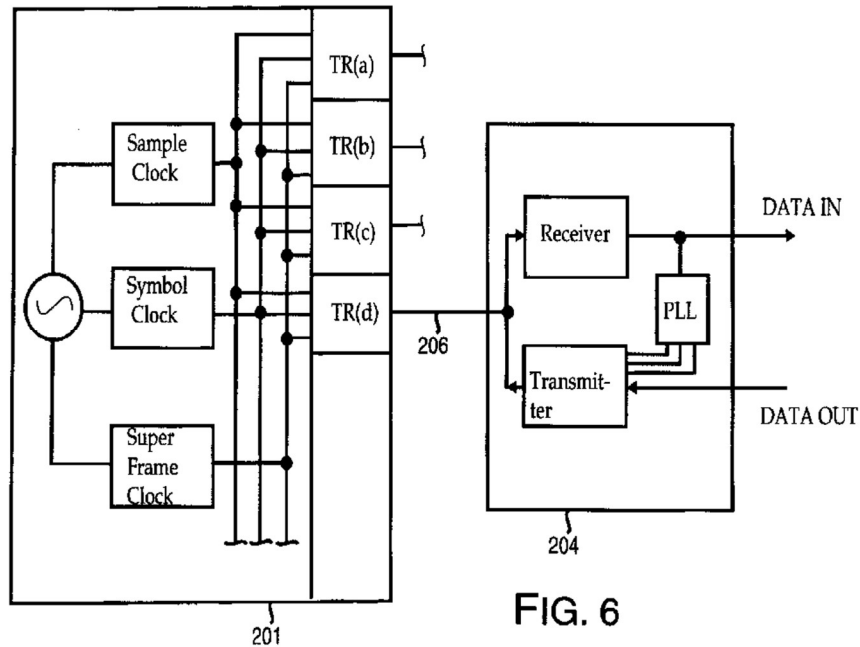
Bingham discloses limitation 34[c] for the same reasons discussed in limitation 1[c], which has identical language.

g. Claim 37

i. 37[pre]: An apparatus for managing multiple time division physical channels in a data communications system that are subject to crosstalk, the apparatus comprising:

Bingham discloses 37[pre] for the same reasons explained with respect to limitation 1[pre], which recites the same language (except as a method rather than apparatus). Bingham discloses an apparatus in Figure 6, which shows “a central

office and remote modem timing architecture” that are “suitable for implementing the synchronization of the present invention.” Ex-1004, 4:11-13.

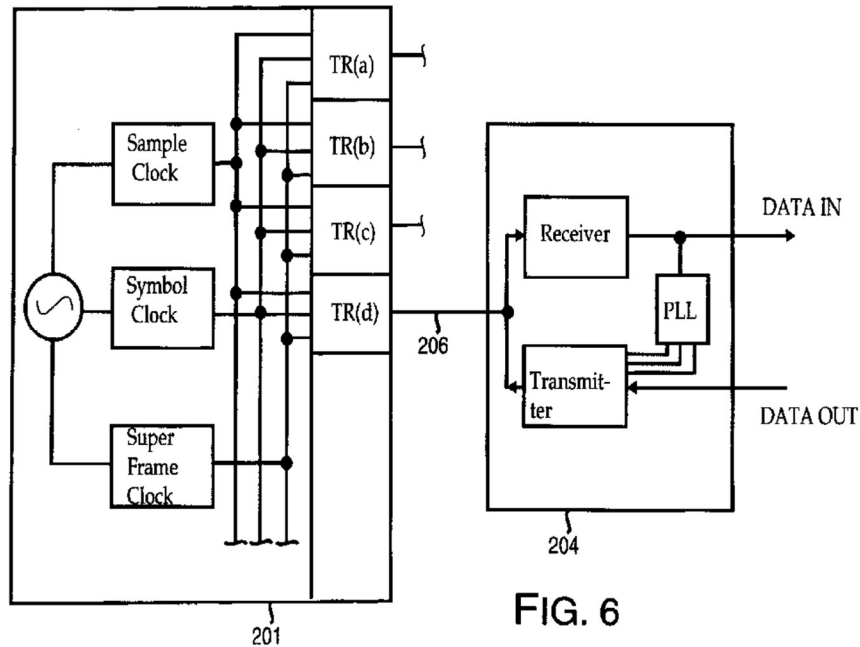


ii. 37[a]: means for scheduling upstream time slots for upstream transmission in a first physical channel; and

Bingham discloses limitation 37[a] for the same reasons explained with respect to limitation 1[a], incorporated herein. The claim additionally claims a “means,” which includes the structure described in the above claim construction section IV.D.2, also incorporated herein.

Bingham discloses this structure. Bingham discloses that the invention may be implemented by “a central office and remote modem timing architecture,” as shown in Figure 6 (below). Ex-1004, 4:11-13. Bingham explains that the “central

unit . . . may include a transceiver . . . that is functionally broken into a transmitter 209 and a receiver 210.” *Id.*, 4:49-51.



A POSITA would have understood that the transceiver disclosed by Bingham would have included both processors and memory connected at least within the transmitter and receiver, that the transceiver would include communication buses (as shown in Figure 6), that it would include a management interface (as shown by 201 in Figure 6), as well as buses for LAN and WAN, and that the memory could store historical data. Ex-1003, ¶¶269-274.

- iii. **37[b]: means for scheduling downstream time slots for downstream transmission in a second physical channel subject to crosstalk from the upstream time slots,**

Bingham discloses limitation 37[b] for the same reasons explained with respect to limitation 1[b]. As to the “means,” the structure disclosed in limitation 37[a] is the same for limitation 37[b].

iv. 37[c]: wherein transmission in the upstream time slots is substantially not simultaneous with transmission in the downstream time slots.

Bingham discloses limitation 37[c] for the same reasons explained with respect to limitation 1[c], which shares the same language.

B. Ground 2A: Claims 1, 3-6, 8-9, 11-16, 22-25, and 33-37 Are Unpatentable Under §103 Over Strobel.

Ground 2B: Claims 3, 15, and 16 Are Unpatentable Under §103 Over Strobel in View of Wei.

Ground 2C: Claims 5, 6, 9, 11-14, 35, and 36 Are Unpatentable Under §103 Over Strobel in View of Kuipers.

Ground 2D: Claim 33 Is Unpatentable Under §103 Over Strobel in View of Kuipers and Wei.

a. Overview of Ground 2

Under the plain and ordinary meaning of the term “physical channel,” Strobel, Wei, and Kuipers disclose the challenged claims. If the Board construes the claims to exclude bidirectional channels based on ASSIA’s disclaimer, these references still render obvious the challenged claims.

As explained in Ground 1 (incorporated herein), while a unidirectional system has its disadvantages, the fact that it eliminates turnaround time would have been a motivating factor for a POSITA to implement it into Strobel. Strobel confirms that

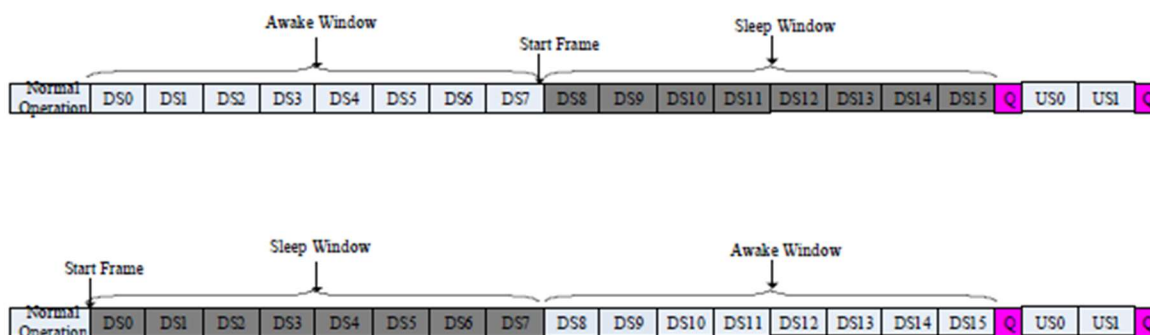
bidirectional channels have “a disadvantage in that turnaround time is required to switch between uplink and downlink, and vice versa,” and this “[t]urnaround time reduces the rate efficiency.” Ex-1005, 21:6-9. A POSITA thus would have been motivated to use unidirectional channels to increase rate efficiency in Strobel and, given that this was a known solution to reduce turnaround time, would have had a reasonable expectation of success in doing so. Ex-1003, ¶¶280-281.

1. Strobel

Strobel discloses a configuration (using twisted pairs in implementations as short as 100-200m) that is the exact configuration considered in G.fast, which was the emerging DSL standard to which the '631 patent pertains. *Compare* Ex-1001, 1:29-34, *with* Ex-1005, 2:17-25; Ex-1007, 1 (same); *see also* Ex-1003, ¶143. Just as the '631 patent explained that G.fast is a “TDD system,” Strobel explains that “[t]wo solutions were recently proposed for a DP: a first approach that uses time division duplexing between upstream and downstream [(i.e., a TDD system)]; and a second approach that uses Synchronized Time Division Multiple Access (STDMA).” Ex-1005, 2:43-47; Ex-1007, 1 (same). Strobel’s disclosure of the first approach that uses “time division duplexing between upstream and downstream” teaches the challenged claims of the '631 patent.

2. Wei

Wei is an ITU contribution submitted around the same time as the provisional applications of Strobel. Wei is directed to a particular issue contemplated in G.fast called “discontinuous mode power saving (DMPS) method for G.fast.” Ex-1009, 1. Specifically, “[i]t describes how DMPS can significantly reduce the power consumption of a G.fast transceiver when traffic is in a low level” by turning “the entire transmission and reception path off during some DMT symbols within a TDD frame to save power on DFE, aFE, and LD.” *Id.*, 2. Wei proposes possible methods for turning off these transmission paths, including turning off portions of the downstream and upstream paths (as shown in the below figure).



3. Kuipers

Like Wei, Kuipers is an ITU contribution submitted around the same time as the provisional applications of Strobel. Kuipers is directed to a particular issue contemplated in G.fast related to a “flexible frame structure for G.fast that will enable dynamic adaptation to the actual needs and offered traffic load.” Ex-1008, 1.

Kuipers explains that a “regular framing structure is of the utmost importance for a communication system” because it “provides synchronization, schedules time intervals for US and DS transmission, and gives implementers guidance in their design.” *Id.* As an example, it is imperative to “the provision of the required data rates, US/DS asymmetry ratio, latency, and the ability to save power.” *Id.* Kuipers therefore proposes a flexible frame format that allows for dynamically altering time slots of upstream and downstream transmissions, as shown in the figure below.

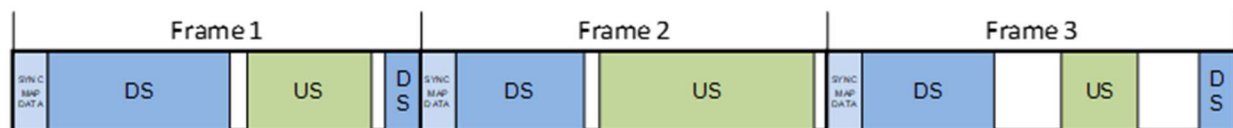


Figure 2: Frame format examples

4. Motivation to Combine Strobel and Wei, Strobel and Kuipers, and Strobel, Wei, and Kuipers

Though Strobel discloses all of the limitations of the challenged claims, Wei and Kuipers provide (1) context that informs how a POSITA would have understood Strobel and (2) alternative embodiments that could have been combined with Strobel. Ex-1003, ¶¶282-293. For example, while Strobel discloses guard times, it does not expressly disclose that those guard times are off times of a downstream or upstream time slot. Wei, however, does make this explicit disclosure, disclosing both guard times and an alternative “discontinuous mode power save (DMPS) method” that includes “Awake Windows” and “Sleep Windows.” Ex-1009, 2. Similarly, with respect to Kuipers, while Strobel discloses “programmable” time slots, it does not

expressly provide that those time slots are “flexible.” Kuipers, however, specifically “presents a flexible frame structure for G.fast that will enable dynamic adaptation to the actual needs and offered traffic load.” Ex-1008, 1.

Each of Strobel, Wei, and Kuipers is analogous art at least because each reference discloses solving problems related to G.fast. Ex-1005, 2:17-21; Ex-1008, 1; Ex-1009, 1; Ex-1003, ¶284. Strobel explains that one approach for distribution points “uses time division duplexing between the upstream and downstream,” but that approach “requires higher power consumption and is more complex.” Ex-1005, 2:43-52. Strobel continues by explaining that “[t]he task of finding transceiver settings in a communication system that lead to a desired rate configuration, typically requires very complex optimization.” *Id.*, 2:63-65. Wei and Kuipers contemplate varying transceiver settings such a flexible frame format and discontinuous mode power save that could be incorporated in a TDD system. Ex-1008; Ex-1009.

Importantly, as explained above, Wei and Kuipers are ITU contributions submitted to the topic related to “G.fast” submitted prior to the same meeting. Ex-1008; Ex-1009. While Strobel is a patent, much of its disclosure derives from an ITU contribution by Lantiq that was also submitted to the topic related to G.fast shortly before Wei and Kuipers. *See* Ex-1013; Ex-1003 ¶285. Given that the ITU ultimately agreed that the duplexing method for G.fast would be TDD, a POSITA

would have known to review the TDD embodiments disclosed in Strobel, along with the more detailed parameters disclosed by Wei and Kuipers. *See* Ex-1009; Ex-1003 ¶285.

More specifically, a POSITA would have been motivated to combine the TDD embodiments of Strobel with the power-saving proposal of Wei because Strobel admits that the TDD approach “requires higher power consumption” and Wei contemplates an alternative solution to reduce power within the same TDD system. *Compare* Ex-1005, 2:43-52, *with* Ex-1009, 1. For example, Strobel explains that in one embodiment its system may include “information about time slots, about when transceivers should transmit, and/or about the power levels at which transceivers should transmit.” Ex-1005, 6:53-63. Wei proposes an alternative approach to reducing power wherein, “when user traffic is lower than channel capacity, the entire transmission and reception path can be turned off during some DMT symbols within a TDD frame to save power.” Ex-1009, 2. A POSITA would have had a reasonable expectation of success in combining Strobel and Wei because Strobel discusses a time-division duplexing system conscious of reducing power and Wei discloses a power reduction technique for a time-division duplexed system. Ex-1005, 2:43-52; Ex-1009, 1; Ex-1003, ¶¶287-289.

A POSITA also would have been motivated to combine the TDD embodiments of Strobel with the flexible frame proposal of Kuipers because Strobel

admits that the TDD approach “is more complex” and Kuipers contemplates a proposed flexible frame format that addresses this complexity. *Compare* Ex-1005, 2:43-52, *with* Ex-1008, 1. For example, Strobel contemplates something called “[d]ynamic rate adaptation,” where “local optimizations” of a system are reprogrammed in response to “an event [that] happens to change the local optimizations.” Ex-1005, 12:44-50. Kuipers offers “a flexible frame structure for G.fast” that “enable[s] [this] dynamic adaptation.” Ex-1008, 1. A POSITA would have had a reasonable expectation of success in combining Strobel and Kuipers because Strobel discusses a time-division duplexing system for G.fast that uses dynamic rate adaptation and Kuipers discloses a flexible frame format that enables this same dynamic rate adaptation in G.fast. Ex-1005, 12:44-50; Ex-1008, 1; Ex-1003, ¶¶290-292.

A POSITA further would have been motivated to combine each of Strobel, Wei, and Kuipers together to address an entire G.fast system. Ex-1003, ¶293. Wei and Kuipers each provide separate parameters for optimizing a G.fast system that complement each other. For example, while Wei is directed to power reduction, Kuipers explains that its “flexible framer can also be used to reduce power consumption.” Ex-1008, 5. A POSITA would have therefore been motivated to combine Wei with Kuipers into the implementation of Strobel, and had a reasonable

expectation of success in doing so, because the power saving framework of Wei could function within the flexible frame format of Kuipers. Ex-1003, ¶293.

a. Claim 1

i. 1[pre]

To the extent the preamble is limiting, Strobel teaches it. Ex-1003, ¶¶294-301. Strobel discloses “various methods for configuring and operating the elements of [a communication] system to enhance communication between communication units within the system.” Ex-1005, Abstract. One issue Strobel sought to address is “crosstalk between the lines” that occurs with “multiple parallel transmissions bound together.” *Id.*, 1:17-19; Ex-1006, 1 (same). Strobel discloses that crosstalk may occur in “[t]ransmissions in a cable binder,” such as that of DSL where multiple physical channels are in a single binder. Ex-1005, 1:17-23; Ex-1006, 1. As such, Strobel discloses a solution of reducing crosstalk that “uses time division duplexing between upstream and downstream.” Ex-1005, 2:44-45; Ex-1007, 1.

As an example, Strobel depicts reducing crosstalk by the TDD method of Figure 16, which discloses a method of managing two separate physical channels (US1 in green depicts upstream transmission on a first physical channel and DS2 depicts downstream transmission on a second physical channel) that would be subject to crosstalk. Ex-1005, Fig. 16; Ex-1007, 4.

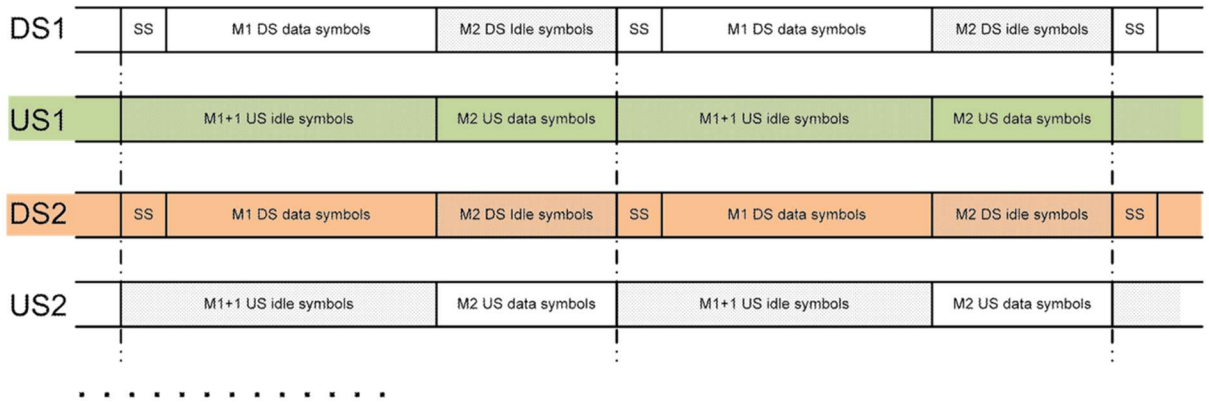


FIG. 16

ii. 1[a]

Strobel discloses limitation 1[a].

As seen in annotated Figure 16, Strobel discloses scheduling upstream time slots for upstream transmission in a first physical channel where, as an example, the M2 US transmitted upstream data symbols depicted in blue are scheduled in the time slots on the first physical channel. Ex-1005, Fig. 16; Ex-1007, 4.

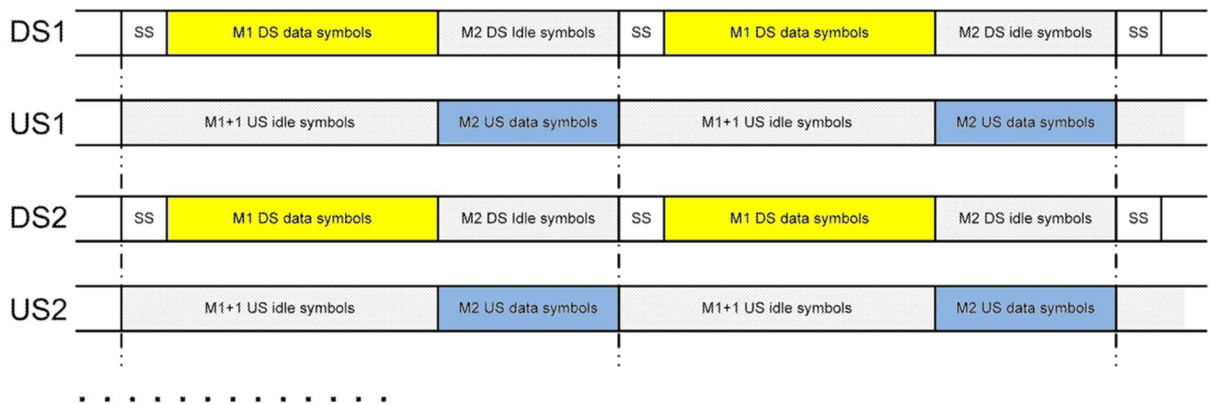


FIG. 16

Although Figure 16 depicts slot allocations based on data symbols as opposed to slot allocations based on time (i.e., time slots), Strobel explains that “all TS [(i.e., transmission time slots)] shall have duration that is an integer number of symbols.” Ex-1005, 31:45-46; Ex-1007, 7. This means that those data symbols represent the same time slots claimed by the ’631 patent. Ex-1003, ¶¶303-305.

To be sure, Strobel explains that “the symbols allocated for upstream transmission have an associated time position for actual upstream transmission” and the “the symbols allocated for downstream transmission have an associated time position for actual downstream transmission,” wherein “the two associated time positions are different.” Ex-1005, 8:43-49; Ex-1007, 6. In other words, the symbols are assigned actual time positions within time slots. Ex-1003, ¶306. These are the same time slots as in the ’631 patent. Strobel confirms that “transmission time slots (TS) are used to assign the particular transmission time (or transmission opportunity time) for a specific line in upstream and/or downstream direction.” Ex-1005, 31:40-43; Ex-1007, 6.

Showing the same concept a little differently, Strobel discloses annotated Figure 11 below, which it describes as “an illustration of a possible allocation of time slots 1110 for uplink and downlink transmission in a TDD system.” Ex-1007, 22:5-7.

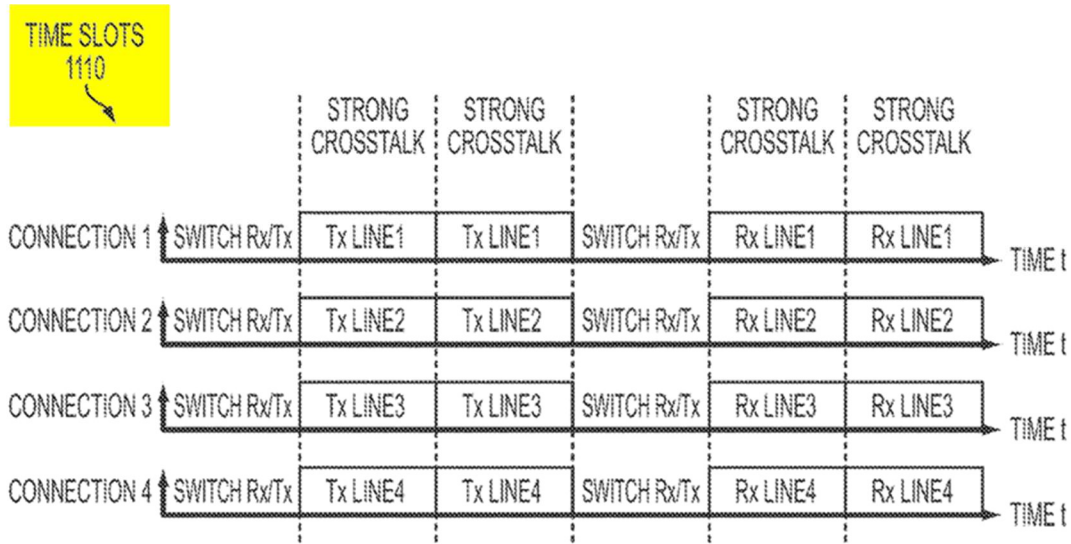


FIG. 11

iii. 1[b]

Strobel discloses limitation 1[b].

As seen in annotated Figure 16, Strobel discloses scheduling downstream time slots for downstream transmission in a second physical channel where, as an example, the M1 DS downstream data symbols depicted in yellow are scheduled in time slots in the second physical channel. Ex-1005, Fig. 16; Ex-1007, 4 (same). As explained with respect to limitation 1[a], the data symbols of Figure 16 represent actual time slots. Ex-100, ¶¶310-311.

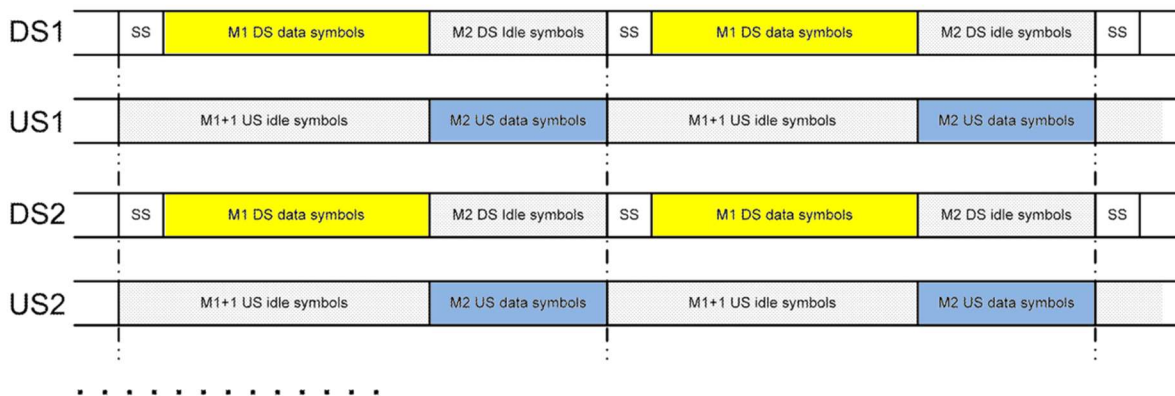


FIG. 16

Further, Strobel discloses time slots in annotated Figure 11 below.

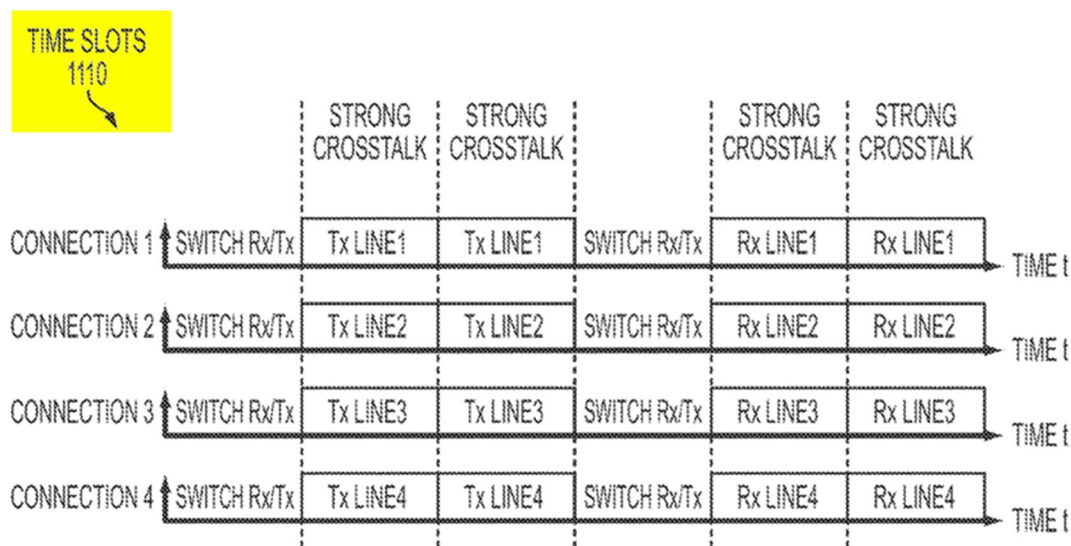


FIG. 11

iv. 1[c]

Strobel discloses limitation 1[c].

In annotated Figure 16, Strobel discloses scheduling upstream time slots (as depicted in blue) at times that are substantially not simultaneous with transmission in the downstream time slots (depicted in yellow). Ex-1005, Fig. 16; Ex-1007, 4.

While Figure 16 discloses data symbols, because Strobel explains that the symbols have an “associated time position,” a POSITA would have understood that the time slots of the upstream (in blue) and downstream (in yellow) are substantially not simultaneous. Ex-1003, ¶¶314-316.

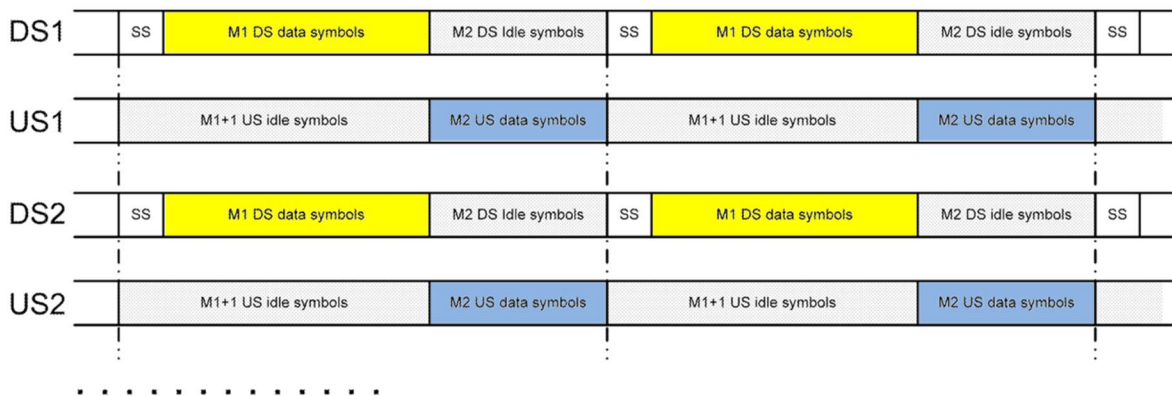


FIG. 16

Strobel confirms this, explaining that “the symbols allocated for upstream transmission have an associated time position for actual upstream transmission” while the “the symbols allocated for downstream transmission have an associated time position for actual downstream transmission,” wherein “*the two associated time positions are different.*” Ex-1005, 8:43-49; Ex-1007, 6 (emphasis added).

Additionally, although Strobel discloses upstream and downstream “idle symbols” that do overlap with the upstream and downstream time slot boundaries, Strobel explains that these idle symbols could be replaced with “quiet periods” where “symbols may not be transmitted at all.” *Id.*, 30:41-46; Ex-1007, 5. Thus, replacing the “idle symbols” shown in Figure 16 according to this alternative

embodiment with quiet periods, transmission in the upstream time slots is substantially not simultaneous with transmission in the downstream time slots. Ex-103, ¶¶317-318.

b. Claim 3

Strobel alone or in view of Wei discloses claim 3.

Looking to annotated Figure 16, Strobel discloses both the upstream and downstream having an active portion when it discloses time slots with “M2 US data symbols” (in blue) and “M1 DS data symbols” (in yellow). Strobel explains that “one upstream (US) and one downstream (DS) transmission are established during a superframe.” Ex-1005, 30:12-14. A POSITA would have understood that at least the M1 DS data symbols and M2 US data symbols are transmitted during an active portion. Ex-1003, ¶¶320-321. Moreover, because the M1 DS and M2 US symbols are already not transmitted at the same time, for the same reasons discussed with respect to limitation 1[c], the active portions of the upstream time slots are substantially not simultaneous with the active portions of the downstream time slots.

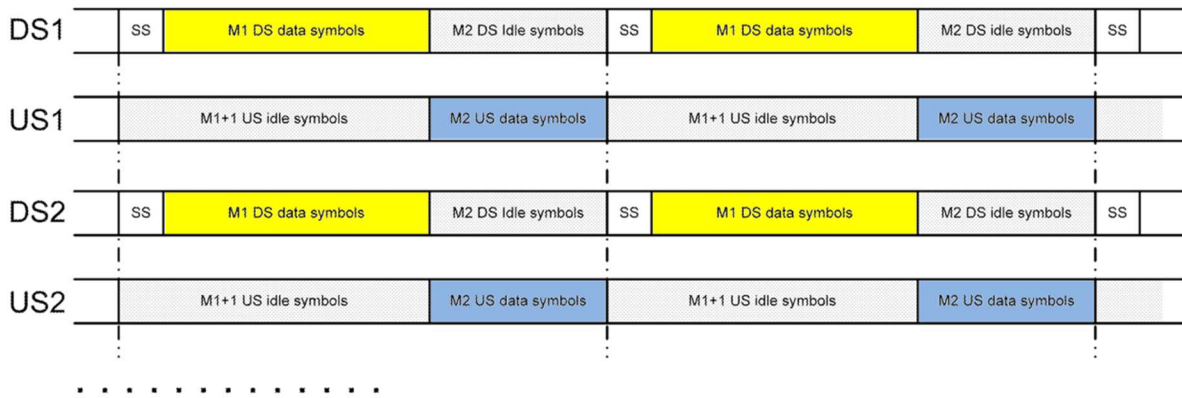


FIG. 16

Within each of the upstream and downstream portions, there also exists an active portion during which signals are transmitted and an off portion during which no signals are transmitted. Specifically, as shown in annotated Figure 20 (below), Strobel discloses guard times (T_{g1} and T_{g2}) shown in green:

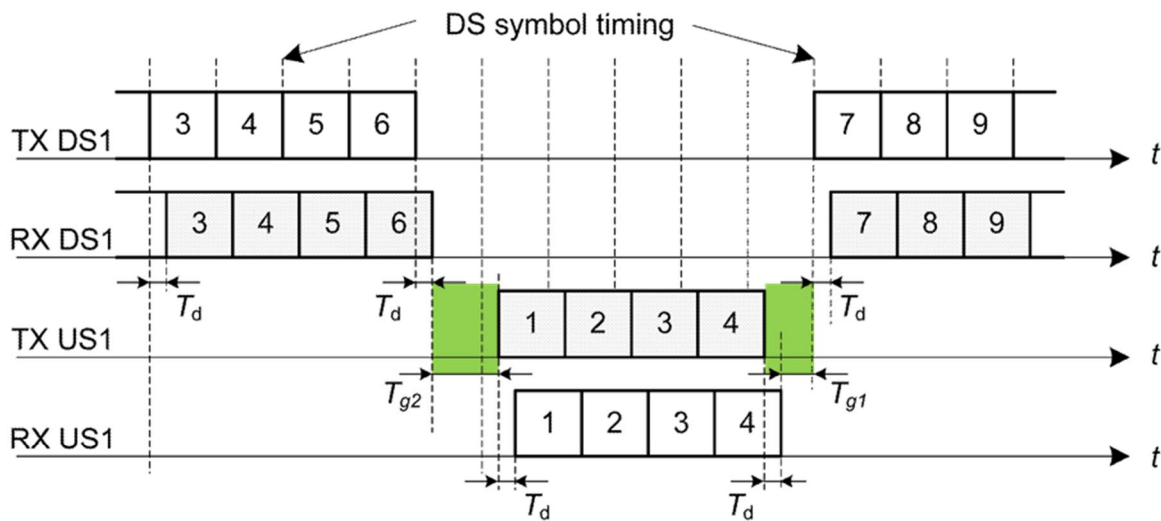


Fig. 20

The disclosed guard times constitute off periods during which no signals are transmitted. Strobel explains that in “an exemplary case of TDD, the guard time may be used, for example, to convert transmission circuitry from transmission mode to reception mode, and vice versa.” *Id.*, 33:23-26. It explains that “switching between transmission and reception . . . takes a turnaround time.” *Id.*, 33:27-33. A POSITA would have understood that these guard times apply to both the upstream and the downstream time slots. Ex-1003, ¶¶322-324. As an example, applying those guard times to Figure 16 would look like the below.

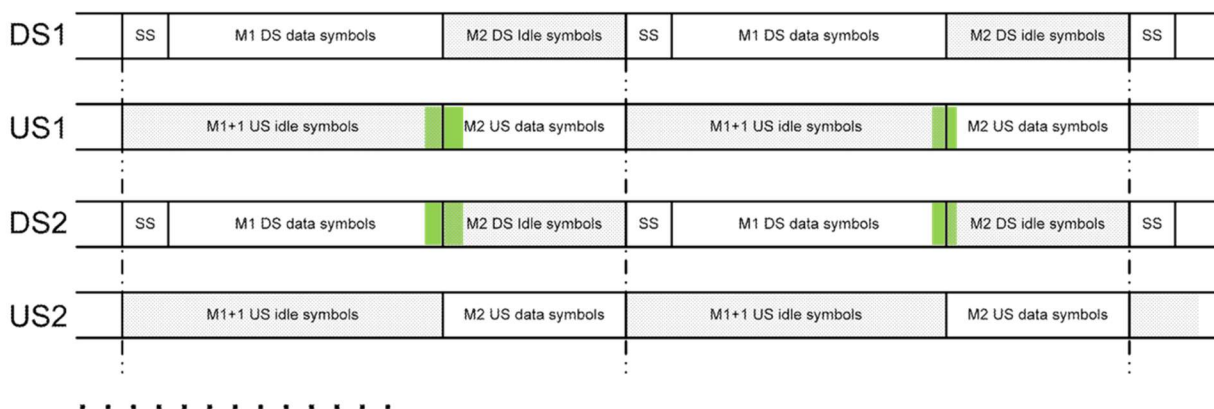


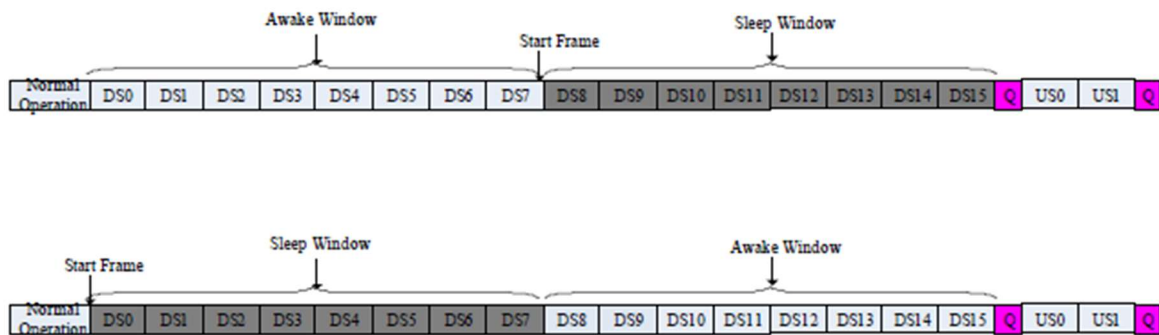
FIG. 16

To the extent the disclosure of guard times in Strobel is not explicit with respect to “off times,” Wei expressly discloses “(Quiet) intervals (i.e., guard time periods)” that are inserted during discontinuous operations and where no signals are transmitted. Ex-1009, 4. These quiet intervals (shown in pink in the disclosure below) constitute off portions during which no data is transmitted. EX-1003, ¶¶325-326.

The following figure shows a typical TDD frame with 16 DS and 2 US DMT symbol positions with 2 Q (Quiet) intervals (i.e., guard time periods) inserted in between:



Wei, however, goes a step further, and additionally discloses a “discontinuous mode power save (DMPS) method” whereby “the entire transmission and reception path can be turned off during some DMT symbols within a TDD frame.” Ex-1009, 2. An example of this discontinuous mode power save method is shown below, whereby Awake Windows and Sleep Windows are defined and where DMT symbols in the sleep window are off (meaning that no signals are transmitted). Ex-1009, 4-5; Ex-1003, ¶327. Although the sleep windows disclosed by Wei include only downstream time slots, a POSITA would have understood that the same sleep windows could be applied to upstream time slots. Ex-1003, ¶327.



Thus, either the guard times disclosed by Strobel disclose these off times, or the combination of Wei’s quiet periods and/or discontinuous mode power save method with the frame format of Strobel renders obvious this claim.

c. Claim 4

Strobel discloses claim 4.

Strobel explains that “transmission time slots (TS) are used to assign the particular transmission time (or transmission opportunity time) for a specific line in upstream and/or downstream direction.” Ex-1005, 31:40-43; Ex-1007, 6. Strobel continues that “all TS [(i.e., transmission time slots)] shall have duration that is an integer number of symbols” and that “when a particular transceiver is granted a transmission opportunity, it may use the granted TS starting from any symbol of the TS.” Ex-1005, 31:46-49; Ex-1007, 7. Strobel additionally discloses “aligning downstream transmissions over all transmission media by *boundaries*” and “aligning upstream transmissions over all lines by *boundaries*.” Ex-1005, 10:5-12. A POSITA would have understood that the start and end of the transmission time slot (TS) constitutes time slot boundaries, as shown in red below. Ex-1003, ¶¶330-332.

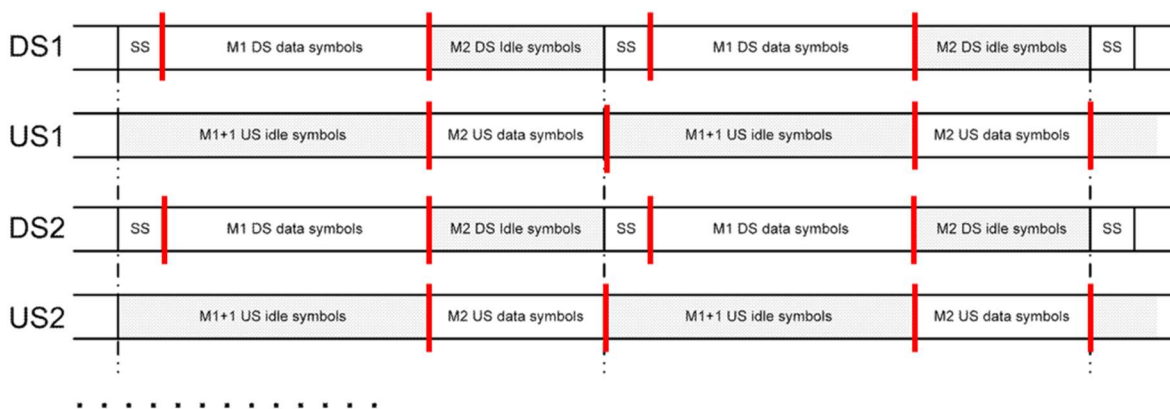


FIG. 16

d. Claim 5

Strobel alone or in view of Kuipers discloses claim 5.

Strobel discloses that in one embodiment, “other TS [time slots] may be programmable,” meaning that “their assignment and duration may depend, for example, on traffic requests from connected users.” Ex-1005, 31:55-58; Ex-1007, 7. Strobel also discloses that “dynamic rate adaption”—which allows for dynamically changing “optimizations”—“may be implemented in various embodiments, which may improve performance of the communication system.” Ex-1005, 12:44-54; Ex-1006, 6. A POSITA would have understood such programmable time slots with flexible assignments and duration to mean that the boundaries of the time slots are flexible. Ex-1003, ¶¶335-337.

To the extent Strobel’s disclosure of “programmable” time slots is not explicit that the time slots are flexible, Kuipers provides more detail. Kuipers is a contribution that “presents a flexible frame structure for G.fast that will enable dynamic adaptation to the actual needs and offered traffic load.” Ex-1008, 1. Discussing the flexible frame format, Kuipers explains that “a ‘symbol’ corresponds to an OFDM/DMT symbol, and a ‘timeslot’ corresponds to one or more consecutive symbols in a given upstream or downstream direction.” *Id.*, 2. Kuipers then goes on to explain that the flexible frame format utilizes a Media Access Plan (MAP) to “instruct the FTU-R at what time to listen to DS transmission and the interval to be

used for US transmission.” *Id.* Kuipers continues that this “MAP may change from frame to frame according to the needs.” *Id.*

As an example, Kuipers provides Figure 2 (below), which shows flexible time slot boundaries (in that at least the time slot boundaries differ from frame to frame). Ex-1003, ¶¶338-341.

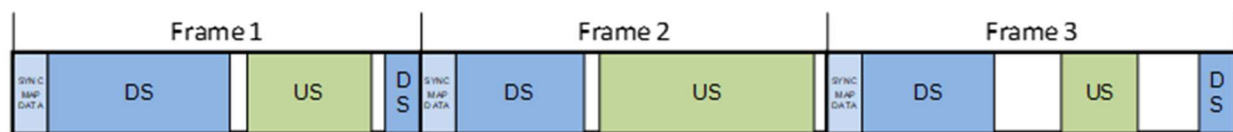


Figure 2: Frame format examples

A POSITA would have understood that the “programmable” time slots of Strobel could have such a flexible frame format as is disclosed by Kuipers. Ex-1003 ¶¶342-343.

e. Claim 6

Strobel alone or in view of Kuipers discloses claim 6.

Strobel discloses that “transmission time slots (TS) are used to assign the particular transmission time (or transmission opportunity time) for a specific line in upstream and/or downstream direction.” Ex-1005, 31:40-44; Ex-1007, 6. Strobel continues by explaining that “all TS [(time slots)] shall have a duration that is an integer number of symbols,” but that the “TS may be programmable” in that “their assignment and duration” can be changed. Ex-1005, 31:45-58; Ex-1007, 7. A POSITA would have understood the ability to program time slot lengths to mean

that the time slot boundaries may at least have variable upstream time slot lengths or variable downstream time slot lengths. Ex-1003, ¶¶345.

Strobel also discloses Figure 15 (below) where the superframe is made up of “M data symbols.” Ex-1005, 29:39-45; Ex-1007, 3-4. Because the time slots are defined by these “M data symbols,” *id.*, 31:45-46, if the time slots are altered the superframe itself will be altered, Ex-1003, ¶¶346-349. Strobel thus separately discloses time slot boundaries with variable length frames.

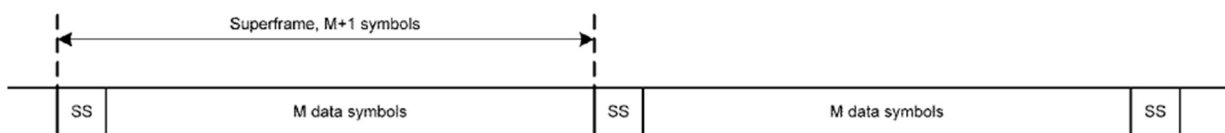


FIG. 15

Kuipers separately discloses at least variable upstream time slot lengths and variable downstream time slot-lengths. Kuipers explains that its flexible frame format utilizes a Media Access Plan (MAP) to “instruct the FTU-R at what time to listen to DS transmission and the interval to be used for US transmission.” Ex-1008, 1. Also, “MAP may change from frame to frame according to the needs.” *Id.* This is shown in Figure 2 (below), where the time slot lengths for both the downstream and upstream varies between each frame. Ex-1003, ¶¶350-351.

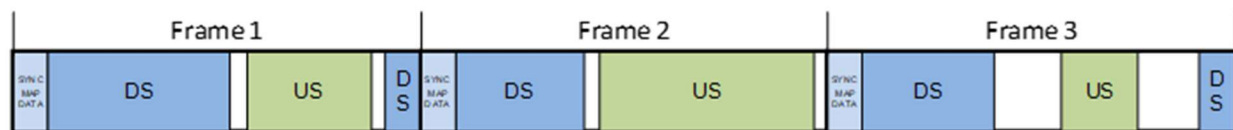


Figure 2: Frame format examples

Kuipers adds that “the allocation of symbols to DS or US can change from frame to frame.” *Id.*, 3. A POSITA would have understood this to mean that the upstream and downstream time slots may be variable. Ex-1003, 352. As with claim 5, a POSITA would have recognized that the programmable time slots of Strobel could use the variable upstream and downstream time slot format of Kuipers. *Id.*

f. Claim 8: The method of claim 1, further comprising adapting scheduling at least one of upstream and downstream time slots to accommodate delay requirements for the other of a downstream and upstream traffic source.

Strobel discloses claim 8.

Strobel discloses an embodiment where time slot “assignment and duration may depend, for example, on traffic requests from connected users.” Ex-1005 at 31:55-58. Strobel discloses a “guard time,” as shown in annotated Figure 20 below, that could be used to accommodate such traffic. Ex-1003, ¶355. In annotated Figure 20 (below), the delay, T_d , is shown in yellow, the guard time at the CPE (T_{g1}) is shown in green, and the guard time at the CO (T_{g2}) is shown in blue. A POSITA would have understood that this guard time could be used to accommodate delay requirements. Ex-1003, ¶355.

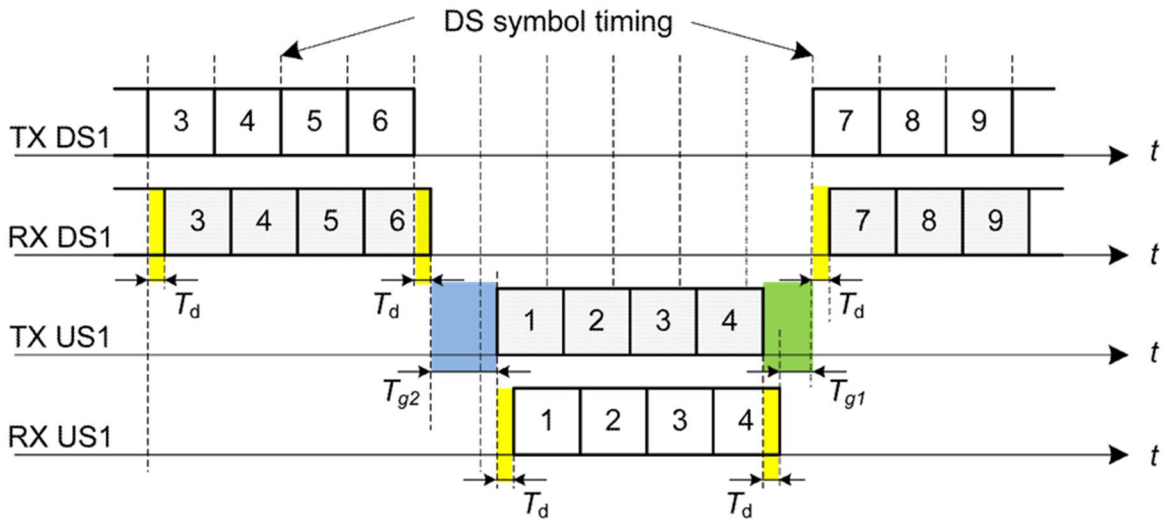


Fig. 20

Ex-1005, Fig. 20; Ex-1007, 9. Strobel explains that “downstream transmission timing is aligned with symbol timing and same for the upstream,” where “keep[ing] this alignment” requires “the sum of the guard time at the CPE (T_{g1}) and the CO (T_{g2})” to satisfy the below equation:

$$T_d + T_{g2} + T_d + T_{g1} = n \times T_{\text{OFDM}}, \text{ and } T_{g2} + T_{g1} = n \times T_{\text{OFDM}} - 2T_d$$

Ex-1005, 33:36-53; Ex-1007, 9. As such, the scheduling of the upstream and downstream time slots is dependent on this guard time, and Strobel therefore discloses claim 8. Ex-1003, ¶¶356-359.

- g. Claim 9: The method of claim 1, further comprising receiving input on desired traffic levels for the first and second physical channels, and wherein scheduling upstream and downstream time slots is performed based on the received input.**

Strobel alone or in view of Kuipers discloses claim 9.

Strobel discloses that in one embodiment, “other TS [(time slots)] may be programmable,” meaning that “their assignment and duration may depend, for example, on traffic requests from connected users.” Ex-1005, 31:55-58; Ex-1007, 7. Looking to annotated Figure 16 (below), a POSITA would have understood this disclosure of Strobel to mean that connected users may request access to either of the first or second physical channels (i.e., receiving input on desired traffic levels for the first and second physical channels), and then the upstream and downstream time slots (which are programmable) would have been scheduled based on these received traffic requests. Ex-1003 ¶361.

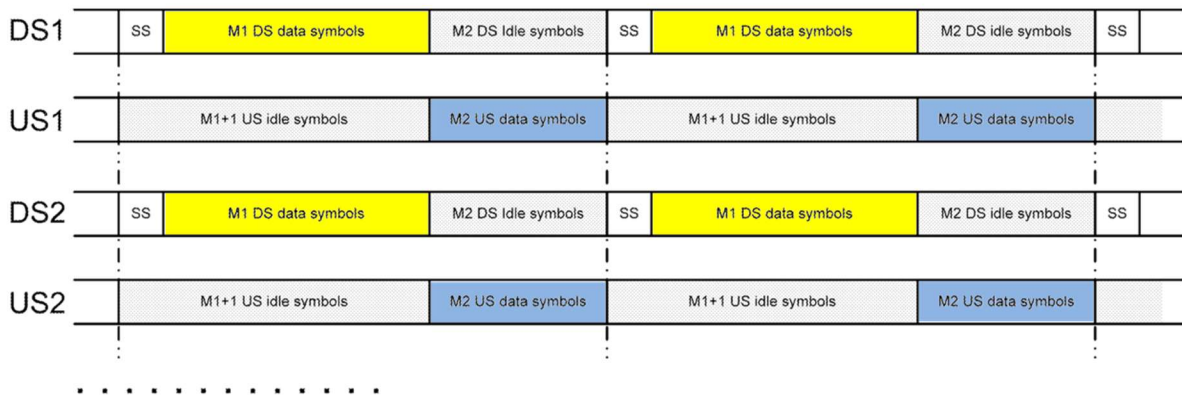


FIG. 16

Kuipers separately discloses this limitation. Ex-1003, ¶362. Kuipers discloses that the “flexible frame structure” it proposes “will enable dynamic adaptation to the actual needs and offered traffic load.” Ex-1008, 1. Kuipers explains that “[t]he portion of the frame required for US and DS transmission to fulfill these

requirements depends on the offered traffic load and the loop conditions.” *Id.*, 2. Continuing, Kuipers discloses that “the allocation of symbols to DS or US can change from frame to frame,” which “will require some knowledge about the actual offered traffic load in DS and US direction.” *Id.*, 3. Thus, a POSITA would have understood that scheduling the flexible frames of Kuipers would be based, in part, on receiving input on desired traffic levels. Ex-1003, ¶362.

A POSITA would have understood that the implementation used in Strobel would have benefitted from using additional parameters such as the actual traffic load disclosed in Kuipers. Ex-1003, ¶363.

h. Claim 11: The method of claim 9, wherein the received input comprises at least one of static subscription data, service layer information from a policy manager, behavior data for traffic types and users of the physical channels, long term traffic behavior data as a function of time, current traffic demands, queue lengths, traffic requests, upstream/downstream asymmetry, or traffic descriptors.

Strobel alone or in view of Kuipers discloses claim 11 for the same reasons discussed in claim 9.

As explained in claim 9, Strobel discloses that “other TS [(time slots)] may be programmable,” meaning that “their assignment and duration may depend, for example, on *traffic requests* from connected users.” Ex-1005, 31:55-58; Ex-1007, 7 (emphasis added). Similarly, Kuipers discloses the received input including “offered traffic load,” i.e., *current traffic demands*. Ex-1008, 1. Claim 11 requires that the

received input comprises at least *one of* “traffic requests” or “current traffic demands” and thus this claim is disclosed separately by Strobel and Kuipers (and this supports that both Strobel and Kuipers likewise teach claim 9). Ex-1003, ¶¶366-368.

i. Claim 12: The method of claim 9, wherein scheduling upstream and downstream time slots comprises assigning time slots to achieve a target upstream/downstream asymmetry ratio of data throughput.

Strobel alone or in view of Kuipers discloses claim 12.

Strobel discloses that in an embodiment of TDD, “each assigned TS is for all lines,” and that “the size of the TS determines the ratio between upstream and downstream and the duration of the upstream-downstream exchange cycle.” Ex-1005, 31:64-67; Ex-1007, 7. It continues by explaining that this “TS assignment may usually be permanent” or “may be changed” when, as an example under control by a “service provider.” Ex-1005, 32:1-5; Ex-1007, 7. A POSITA would have understood that selecting these time slots would therefore impact the upstream/downstream asymmetry ratio of data throughput, and so would have scheduled the upstream and downstream time slots to achieve a target ratio between upstream and downstream. Ex-1003, ¶¶370-371.

Although disclosed by Strobel, a POSITA would have looked to Kuipers to understand the benefits of setting a target asymmetry ratio. Ex-1003, ¶372. Kuipers

explains that “one of the objectives” of its flexible framing structures “is to ensure that the desired data rates and US/DS asymmetry ratio are provided to the subscribers.” Ex-1008, 2. Kuipers adds that “the operator will be able to provision a set of parameters that might include the min and max values of US/DS asymmetry ratio and defined data rates instead of just fixed values.” *Id.* This assignment of maximum and minimum values to the upstream and downstream asymmetry ratio represents the target upstream/downstream asymmetry ratio. Ex-1003 ¶¶372-373. A POSITA would have applied this target upstream/downstream asymmetry ratio as a parameter in the embodiment of Strobel, and picked a “size of the [time slot]” to achieve that target ratio of data throughput. Ex-1003, ¶373.

j. Claim 13: The method of claim 12, wherein the upstream/downstream asymmetry ratio is defined in numbers of discrete multi-tone symbol positions.

Strobel alone or in view of Kuipers discloses claim 13.

As explained with respect to claim 12, Strobel discloses that “the size of the TS determines the ratio between upstream and downstream” Ex-1005, 31:64-67; Ex-1007, 7. Prior to that, Strobel explains that “all TS [(i.e., transmission time slots)] shall have duration that is an integer number of symbols” (which Strobel contemplates is “M” symbols) and that “when a particular transceiver is granted a transmission opportunity, it may use the granted TS starting from any symbol of the TS.” Ex-1005, 31:46-49; Ex-1007, 7. Because Strobel’s “M” symbols dictate the

duration and assignment of the time slots, the “M” symbols ultimately determine the asymmetry ratio for upstream and downstream transmissions. Ex-1003, ¶¶376-377.

To the extent Strobel’s disclosure of defining the asymmetry ratio in terms of symbols is unclear, a POSITA would have looked to Kuipers to confirm its understanding. Ex-1003, ¶378. Just like Strobel, Kuipers expressly discloses that the “‘timeslot’ corresponds to one or more consecutive symbols in a given upstream or downstream direction.” Ex-1008, 2. Having confirmed its understanding with Kuipers, a POSITA would have known that the upstream/downstream asymmetry ratio defined by Strobel would be defined particularly in numbers of discrete multi-tone symbol positions. Ex-1003, ¶38.

k. Claim 14: The method of claim 12, wherein the measure of throughput is at least one of an average throughput across all lines, a traffic demand match, a minimum throughput for each physical channel, a perceived quality of experience, an average delay, or a minimum delay.

Strobel alone or in view of Kuipers discloses claim 14.

Strobel teaches the method of claim 12 wherein the measure of throughput is “a traffic demand match.” Strobel discloses that its proposed embodiments with “enhanced communication rates may result in higher throughput rates.” Ex-1005, 4:1-2. For one of those embodiments, it explains that “other TS [(time slots)] may be programmable,” meaning that “their assignment and duration may depend, for example, on traffic requests from connected users.” Ex-1005, 31:55-58; Ex-1007, 7

(emphasis added). A POSITA would have understood that once time slots are assigned (for a certain duration), that data would be transmitted, which therefore correlates to the data throughput. Ex-1003, ¶380. Because Strobel discloses that the assignment and duration of the time slots correlates to matching a traffic demand, the measure of throughput is based at least on a traffic demand match. *Id.*

Kuipers separately discloses that the measure of throughput is of an “average throughput across all lines.” Ex-1008, 1. Kuipers first explains that its proposal will provide “high throughput.” *Id.* It goes on to explain that “there is usually no need to fulfill the provisioned requirements on a frame level with a granularity of e.g. 1ms.” *Id.*, 2. Rather, “[i]t should be sufficient to ensure that the US/DS asymmetry ratio and the data rate objectives are fulfilled on average.” *Id.* A POSITA would have understood that ensuring the asymmetry ratio and data rates “on average” constitutes measuring an average throughput across all lines. Ex-1003, ¶381. A POSITA further would have understood that measuring throughput on average as disclosed in Kuipers could be applied to Strobel. *Id.*

1. Claim 15: The method of claim 1, wherein scheduling upstream and downstream time slots comprises assigning time slots based at least in part on power usage.

Strobel alone or in view of Wei discloses claim 15.

A key aspect of Strobel is contemplating the adjustment of both “transmission times and power levels to enhance the communication within the system.” Ex-1005,

Abstract. Strobel thus contemplates that in one embodiment, there exists a central unit that has “an optimizer adapted to operate an optimization routine to compute multiple locally optimal configurations.” Ex-1005, 6:43-46; Ex-1006, 3. Strobel explains that that central unit may comprise “a media access plan,” which in turn “comprises information about time slots, about when transceivers should transmit, and/or about the power levels at which transceivers should transmit.” Ex-1005, 6:53-63; Ex-1006, 29; *see also* Ex-1005, 27:56-61. Relying on this information—including time slots and power levels—Strobel explains that this allows the system “to achieve optimal system communication.” Ex-1005, 63-67. A POSITA would have understood that, in balancing the time slots and power levels, this “optimizer” would have scheduled the upstream and downstream time slots based at least in part of those power levels. Ex-1003, ¶¶384-387. To be sure, Strobel elsewhere explains that “[t]here is a mapping between the possible power allocation [] for each transmission line[...]...and the reachable data rate,” wherein that data rate is directly correlated to the time slots of the upstream and downstream physical channels. Ex-1005, 13:53-67.

Though disclosed by Strobel, Wei confirms that time slots can be assigned based on power usage. Wei explains that when the traffic on a line becomes too low, “the number of transmitted DMT/OFDM symbols within a TDD frame can be reduced,” which “allows the entire transmission and reception path to be turned off

during some DMT/OFDM symbol periods to save power in DFE, AFE, and LD.” Ex-1009, 3. By turning off the transmission path to save power, Wei requires that the time slots of the upstream and downstream are scheduled to accommodate those power savings. Ex-1003, ¶388. A POSITA would have known it could implement this power savings method of Wei to achieve the optimized allocations disclosed by Strobel.

m. Claim 16: The method of claim 15, wherein assigning time slots based on power usage comprises assigning by scheduling entries, exits, and transitions between low-power link states and off states.

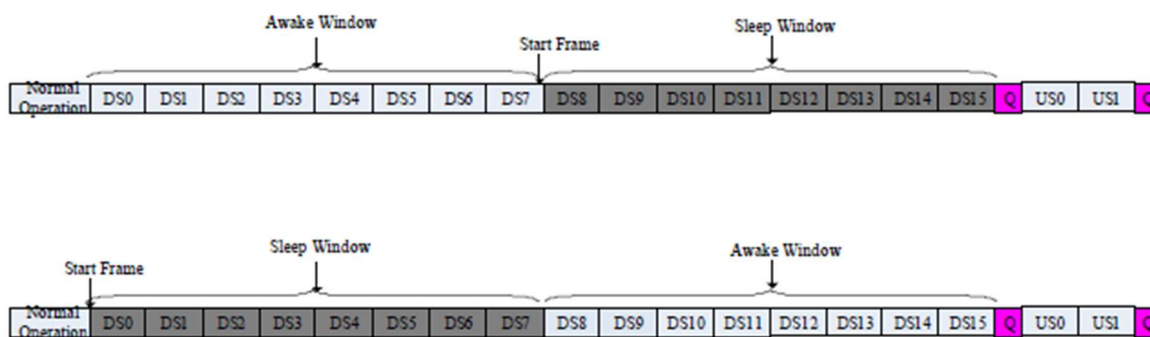
Strobel alone or in view of Wei discloses claim 16.

As explained in claim 15, Strobel explains that the central unit may comprise “a media access plan,” which in turn “comprises information about time slots, about when transceivers should transmit, and/or about the power levels at which transceivers should transmit.” Ex-1005, 6:53-63; Ex-1006, 29; *see also* Ex-1005, 27:56-61. Reviewing Wei in view of Strobel, a POSITA would have understood assigning time slots by scheduling entries, exits, and transitions between low-power link states and off states would be one way of controlling the power levels at which transceivers should transmit. Ex-1003 ¶¶391-392.

Wei discloses “(Quiet) intervals (i.e., guard time periods)” that are inserted during discontinuous operations as well as “Sleep Window[s]” where that entire transmission and reception path can be turned off. Ex-1009, 2. Wei explains that the

“Sleep Window[s]” are periods where “the entire transmission and reception path can be turned off.” Ex-1009, 2. A POSITA would have understood that the Quiet Intervals are low-power states because no data is transmitted but synchronization messages could still be sent. Ex-1003, ¶¶393-395.

As depicted below, Wei therefore discloses entry, transition, and exit into an Awake Window with a downstream time period (DS), followed by entry, transition, and exit to an off state (Sleep Window), followed by entry, transition, and exit into a low-power link state (the quiet period), followed by entry, transition, and exit to an upstream time period (US), again followed by a low-power link state (the quiet period). *Id.*



A POSITA would have recognized this as one way of optimizing power levels as disclosed by Strobel. Ex-1003, ¶¶396-397. For example, Strobel discloses that scheduling transmissions “at such times and such power levels as to achieve enhanced communication within the system according to some criterion”—one way of enhancing communication within this system would be to do it by scheduling

entries, exits, and transitions between low-power link states and off states as disclosed by Wei. Ex-1005, 39:5-16; Ex-1003, ¶396. Strobel’s claimed invention intends to maintain desired throughput levels via its time slot assignments, to minimize potential interference that would reduce throughput, and/or increase power levels (which effects throughput). Thus, a POSITA would have understood that Strobel’s time slot scheduling techniques that aim to minimize crosstalk and increase, or maintain, system throughput levels, would necessarily require assigning time slots based on scheduling transitions between low-power link states and off states. *Id.*

n. Claim 22: The method of claim 1, further comprising receiving requests for upstream and downstream transmission and wherein scheduling upstream time slots is based on the received upstream transmission requests.

Strobel discloses claim 22.

Strobel discloses that in one embodiment, “other TS [(time slots)] may be programmable,” meaning that “their assignment and duration may depend, for example, on *traffic requests* from connected users.” Ex-1005, 31:55-58; Ex-1007, 7 (emphasis added). In the context of Figure 16 (annotated below), a POSITA would have understood that the request could be for upstream (in blue) and/or downstream (in yellow) transmissions. Ex-1003, ¶¶400-401.

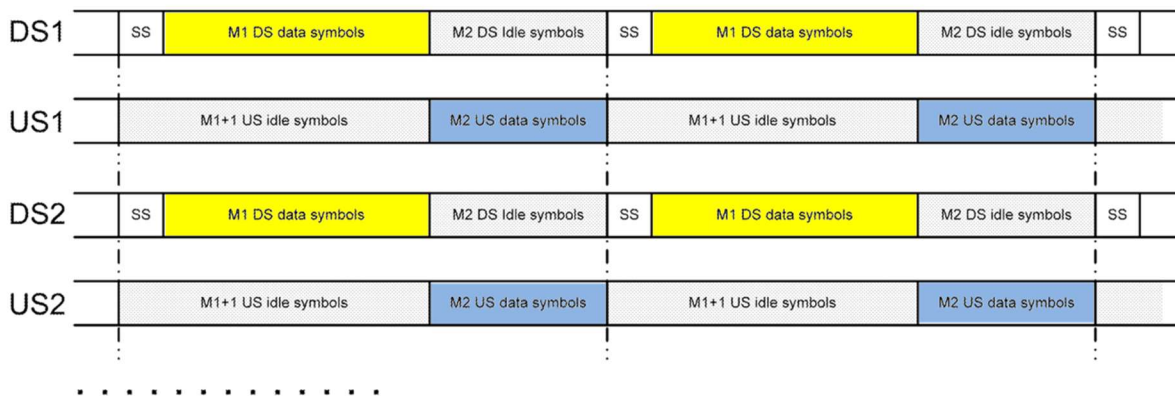


FIG. 16

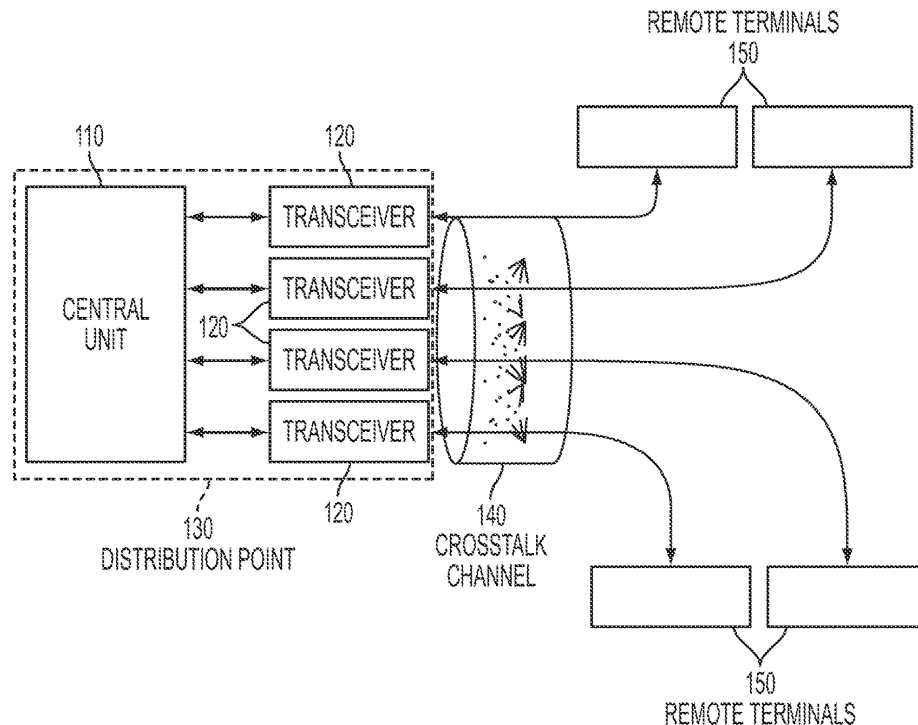
Because Strobel also explains that the time slots are “programmable” based on these “traffic requests,” a POSITA would have understood that the upstream time slots may be scheduled based on those traffic requests. Ex-1003, ¶¶402-403.

o. Claim 23: The method of claim 1, wherein the transmission in the upstream time slots is from a plurality of different network-end transmission sources.

Strobel discloses claim 23.

With reference to Figure 1 (below), Strobel discloses that there may be multiple “remote terminals” 150 that transmit data in the upstream time slots. Strobel explains that a “remote terminal” is “a radio unit outside the distribution point” that “may be a transmitter, a receiver, or a transceiver.” Ex-1005, 13:8-12; Ex-1006, 7. Strobel adds that “[t]he remote terminals 150 may transmit through the crosstalk channel 140 to the transceiver 120, in which case the remote terminals 150 are acting as transmitters.” Ex-1005, 13:46-52; Ex-1006, 8. A POSITA would have understood

that transmissions from the remote terminals 150 to the transceivers 120 constitutes an upstream transmission. Ex-1003, ¶¶406-407.



Ex-1005, Fig. 1; Ex-1006, Fig. 1.

p. Claim 24: The method of claim 23, further comprising synchronizing upstream transmission and downstream transmission among a plurality of different network-end transmission sources.

Strobel discloses claim 24.

As shown in annotated Figure 16 (below), the upstream time slots across a first physical channel (which goes to a first remote terminal) is synchronized with the upstream time slots in a second physical channel (which goes to a second remote terminal). Ex-1003, ¶¶410-411. Specifically, the downstream time slots (in yellow)

are synchronized between DS1 and DS2, and the upstream time slots (in blue) are synchronized between US1 and US2 (in blue). Ex-1005, Fig. 16.

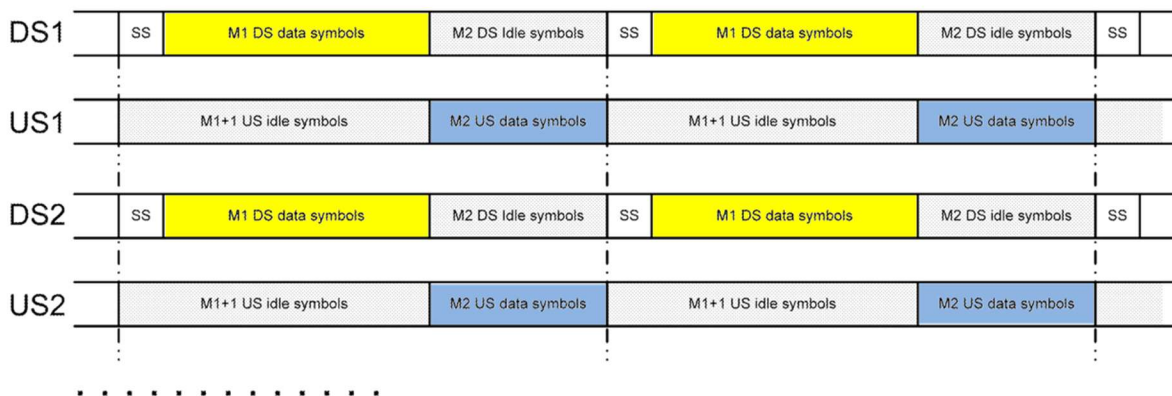


FIG. 16

Strobel confirms the same in the specification, explaining that with respect to Figure 16 “all DS and all US transmissions shall be synchronized in all lines.” Ex-1006, 30:14-18; Ex-1007, 4.

q. Claim 25: The method of claim 24, wherein synchronizing comprises sending synch symbols to a source of upstream transmissions.

Strobel discloses claim 25.

As shown in Figure 16 (annotated below), Strobel contemplates sending synch symbols (denoted by SS in green) in the downstream (i.e., to the source of upstream). Ex-1005, Fig. 16.

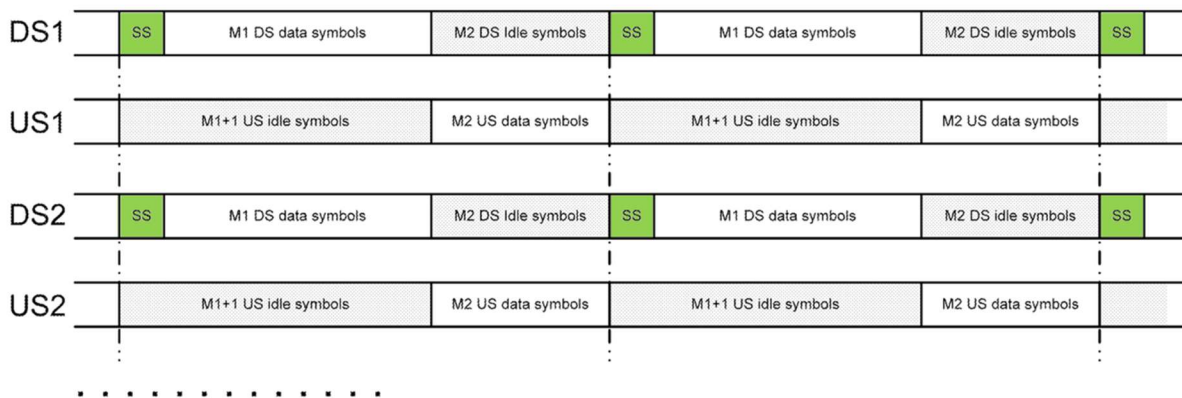


FIG. 16

Specifically, the synch symbols shown in Figure 16 are sent in the downstream towards a remote unit, which a POSITA would have understood is the source of the upstream transmissions. Ex-1003, ¶¶415-416. Regardless, Strobel confirms that the synch symbols may be sent in either direction, explaining that “the sync symbols (SS) are also sent only in the downstream direction, but in [another] embodiment SS may be also used in the upstream direction.” Ex-1005, 30:55-58.

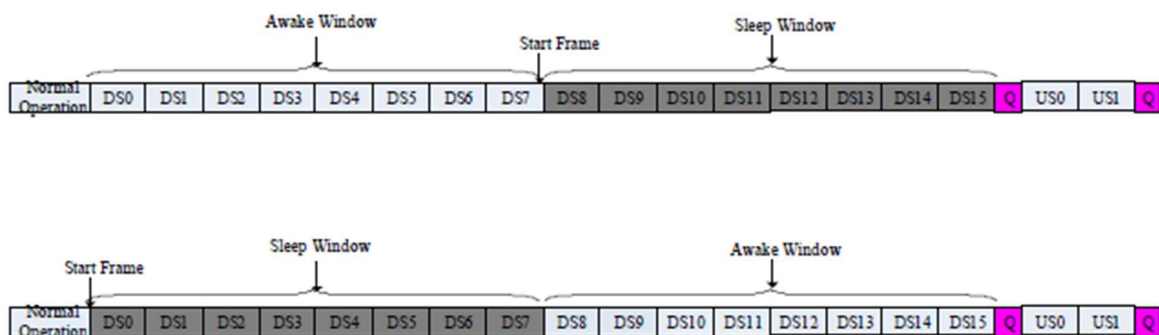
- r. Claim 33: The method of claim 1, further comprising receiving input on desired traffic levels for the first and second physical channels and wherein scheduling upstream and downstream time slots is performed based on the received input and at least in part on power usage.**

Strobel alone or in view of Kuipers and Wei discloses claim 33 for the same reasons explained with respect to claims 9 and 15.

Regarding scheduling time slots based on input on desired traffic levels, Strobel discloses that in one embodiment, “other TS [(time slots)] may be

programmable,” meaning that “their assignment and duration may depend, for example, on traffic requests from connected users.” Ex-1005, 31:55-58; Ex-1007, 7. Kuipers separately discloses that the “flexible frame structure” it proposes “will enable dynamic adaptation to the actual needs and offered traffic load.” Ex-1008, 1. As explained in claim 9 (and incorporated herein), either Strobel or Kuipers discloses receiving input on desired traffic levels for a first and second physical channel.

As explained with respect to claim 15 (incorporated herein), Strobel discloses that adjustment of “power levels” can be used to “enhance the communication within the system.” Ex-1005, Abstract. To balance time slot allocation with power usage, Strobel contemplates a central unit that has “an optimizer adapted to operate an optimization routine to compute multiple locally optimal configurations. Ex-1005, 6:43-46; Ex-1006, 3. Strobel explains that that central unit may comprise “a media access plan,” which in turn “comprises information about time slots, about when transceivers should transmit, and/or about the power levels at which transceivers should transmit.” Ex-1005, 6:53-63; Ex-1006, 29; *see also* Ex-1005, 27:56-61. Wei reinforces this concept, expressly disclosing adjusting upstream and downstream time slots to reduce power (shown in the Figure below).



A POSITA would have been motivated to use the additional parameters of Kuipers and Wei to further optimize the time slot scheduler in Strobel. Ex1003, ¶¶419-422.

s. Claim 34

i. 34[pre]

To the extent the preamble is limiting, Strobel discloses limitation 34[pre].

Strobel provides a “system...that is operative to serve multiple electronic communication lines,” that “includes a distribution point, which includes a central unit and multiple transceivers,” and that “is configured to compute locally optimal communication configurations, store in memory data about said configurations, process said data into time sharing information, and convey such time sharing information to the transceivers and the remote terminals.” *Id.* 4:8-19. A POSITA would have recognized that the memory of the system constitutes a machine-readable medium with instructions that when operated on would cause the system to

convey time-sharing information. Ex-1003, ¶¶424-426. Strobel thus discloses 34[pre].

ii. 34[a]

Strobel discloses limitation 34[a] for at least the same reasons discussed in limitations 1[pre] and 1[a]. Although the combination of both limitations 1[pre] and 1[a] are required to disclose limitation 34[a], the claimed scope is otherwise identical (except that claim 34 claims a “machine readable medium” while claim 1 claims a “method”).

iii. 34[b]

Strobel discloses limitation 34[b] for the same reasons discussed in limitation 1[b]. Limitation 34[b] recites “subject to crosstalk from the upstream time slots,” which is not recited in limitation 1[b]. But a POSITA would have understood that downstream transmissions are almost always subject to crosstalk from upstream transmissions. Ex-1003, ¶433. For example, the ’631 patent discloses that “system transmitting in multi-pair copper cables can generate crosstalk into each other,” Ex-1001, 2:7-9, and Strobel discloses that “[i]n many communication transmission systems, there are multiple parallel transmissions bound together which can cause crosstalk between the lines,” Ex-1005, 1:16-18.

iv. 34[c]

Strobel discloses limitation 34[c] for the same reasons discussed in limitation 1[c], which has identical language.

- t. Claim 35: The medium of claim 34, the operations further comprising receiving input on desired traffic levels for the first and second physical channels and wherein scheduling upstream and downstream time slots is performed based on the received input.**

Strobel alone or in view of Kuipers discloses Claim 35 for the same reasons explained with respect to claim 9, which recites identical language.

- u. Claim 36: The medium of claim 34, wherein scheduling upstream and downstream time slots comprises assigning time slots to achieve a target upstream/downstream asymmetry ratio of data throughput.**

Strobel alone or in view of Kuipers discloses Claim 36 for the same reasons explained with respect to claim 12, which recites identical language.

v. Claim 37

i. 37[pre]

Strobel discloses 37[pre] for the same reasons explained with respect to limitation 1[pre], which recites the same language (except as a method rather than apparatus).

ii. 37[a]

Strobel discloses limitation 37[a] for the same reasons explained with respect to limitation 1[a], incorporated herein. The claim additionally claims a “means,” which includes the structure described in the above claim construction section IV.D.2 , also incorporated herein.

Strobel discloses the structure in Figure 1, shown below:

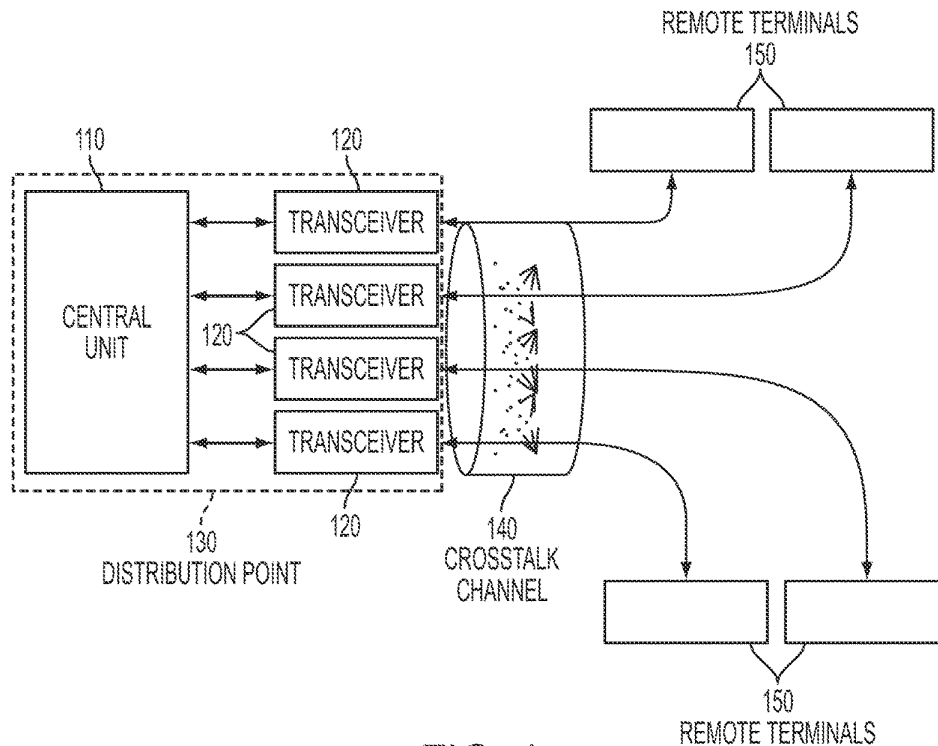


FIG. 1

Strobel discloses that this system “includes a distribution point, which includes a central unit and multiple transceivers,” that the “system is configured to compute locally optimal communication configurations, store in memory data about said configurations, process said data into time sharing information, and convey such time sharing information to the transceivers and the remote terminals. *Id.*, 4:8-19. A POSITA would have understood that this system includes both processors and memory connected at least in the distribution point, that the distribution point would include communication buses (as shown in Figure 1), that it would include a management interface (the distribution point itself), as well as buses for LAN and

WAN, and that the memory could store historical data (such as configuration data).
Ex-1003, ¶¶441-446.

iii. 37[b]

Strobel discloses limitation 37[b] for the same reasons explained with respect to limitation 1[b]. As to the “means,” Strobel discloses the same “means” embodied in the ’631 patent for the same reasons explained with respect to limitation 37[a], which shares the same structure here.

iv. 37[c]

Strobel discloses limitation 37[c] for the same reasons explained with respect to limitation 1[c], which shares the same language.

VIII. DISCRETIONARY ISSUES

A. The Petition Does Not Present the Same References Addressed in Prosecution.

The Board should not deny institution under §325(d). Under *Advanced Bionics*, the Board uses a two-part framework in determining whether to exercise its discretion under §325(d). *Advanced Bionics, LLC v. MED-EL Elektromedizinische Geräte GmbH*, No. IPR2019-01469, Paper 6 at 7-8 (P.T.A.B. Feb. 13, 2020) (precedential).

Where “neither [the combination references] nor similar prior art was before the examiner... the prosecution history does not include any overlapping arguments directed to this prior art,” the first prong of *Advanced Bionics* is not satisfied.

Godbersen-Smith Constr. Co. v. Guntert & Zimmerman Const. Div., Inc. No. IPR2021-00050, Paper 24 at 19-21 (P.T.A.B. May 7, 2021). In such a case, the Board “need not address part two of the analysis.” *Id.* at 21.

Under the first prong, this Petition does not include any prior art references previously cited during the original prosecution and therefore are not cumulative of the art considered by the Examiner during prosecution. Ex. 1003, ¶¶88-92. The only primary reference relied on during prosecution was Williams, which is directed to using switches and/or amplifiers for controlling signals in time domain duplex (not time division duplexing). None of the references included in this Petition are focused on using switches for controlling time domain duplexing. Instead, they contemplate parameters involved in time division duplexing. Thus, the Bingham, Strobel, Wei, and Kuipers references relied upon in this petition cannot be cumulative of the art and/or arguments raised during prosecution as there are material differences between the grounds herein and what was previously presented. *Tianma Microelectronics Co., v. Japan Display Inc.*, IPR2021-01058, Paper 16 at 31 (P.T.A.B. Jan. 5, 2022). Because the first prong is not met, the Board need not move to the second prong. *Id.* at 21; *Oticon Med. AB v. Cochlear Ltd.*, IPR2019-00975, Paper 15 at 20 (P.T.A.B. Oct. 16, 2019).

B. The Board Should Not Deny Institution Under *Fintiv*.

The claims of the '631 patent have never been tested in view of the most relevant prior art. In view of these strong and compelling challenges, the on-going district court litigation against AT&T, and the ongoing cloud over all of Nokia's customers, institution should not be discretionarily denied under §314(a). *See NHK Spring Co. v. Intri-Plex Techs., Inc.*, IPR2018-00752, Paper 8 at 19-20 (PTAB Sept. 12, 2018) (precedential); *Apple v. Fintiv, Inc.*, IPR2020-00019, Paper 11 at 13-14 (PTAB Mar. 20, 2020) (precedential).

Factor 1—a potential stay of the district court litigation—is neutral because no party has requested a stay in the action against AT&T. *VMWare, Inc. v. Intellectual Ventures I LLC*, IPR2020-00470, Paper 13 at 17 (PTAB Aug. 18, 2020) (finding in the absence of a stay motion that this factor “does not weigh for or against discretionary denial”).

Factor 2—the district court trial date and the Board's statutory deadline—weighs against discretionary denial because of the high likelihood of transfer to another forum that will significantly push back any potential trial date. This is a complex case with a complicated relationship between the Plaintiff and AT&T. Specifically, AT&T has a license to patents owned by the Plaintiff where the licenses include a choice of forum clause requiring litigation to be brought in N.D. California rather than E.D Texas (any disagreement about this clause must be decided through

arbitration). AT&T thus filed a motion to transfer the case to the Northern District of California or, in the alternative, arbitrate where the case should be brought. Given the strength of AT&T's motion, it is highly likely that trial will be pushed back (either because it is transferred or because arbitration is ordered) until well after the deadline for a final written decision. Ex-1019. Moreover, even if the motion is denied, because jury selection is far in the future and is not set to begin until at least September 22, 2025, with trial set to begin thereafter, discretionary denial is still not warranted. *See Dish Network v. Broadband iTV*, IPR2020-01280, Paper 17 at 16 (PTAB Feb. 4, 2021).

Altogether, this factor weighs against discretionary denial.

Factor 3—investment in the district court proceedings—weighs against discretionary denial. The district court case is in its early stage and the court has not issued any substantive rulings in either case with respect to the '631 patent. Specifically, invalidity contentions were served on October 7, 2024, the claim construction hearing is not scheduled until March 19, 2025, and opening expert reports are not due until April 29, 2025 with expert discovery extending into June. Ex-1017.

Altogether, there is much work to be done in the district court and most of the work will be well in the future. Accordingly, the district court will not invest significant resources related to the challenged patent prior to the issuance of an

institution decision. *See Fintiv*, IPR2020-00019, Paper 11 at 9-12; *DISH Network*, IPR2020-01280, Paper 17 at 18-21.

Factor 4—overlap between this proceeding and the district court proceedings—favors institution. Indeed, there will not be complete overlap between this IPR and the district court cases because there are twenty-two claims challenged in this case, whereas there are nineteen claims at issue in the district court case, and that number will be reduced to six total claims before trial. Ex-1018. This factor thus weighs against discretionary denial.

Factor 5—overlapping parties—strongly favors institution. Here, while the Petitioners include both AT&T and Nokia, currently only AT&T is a party in the underlying litigation. *Fintiv*, IPR2020-00019, Paper 11 at 13-14. As an initial matter, that means that if institution is denied and only the subset of claims raised at trial are rendered invalid at the district court, ASSIA may resort to gamesmanship and assert infringement of those claims not raised at trial (but challenged in this petition) against Nokia in a separate litigation. Additionally, in that underlying litigation, ASSIA has only accused AT&T of infringement (largely accusing Nokia products), but AT&T is just one of Nokia’s many U.S. customers using Nokia’s DSL products. Given ASSIA’s history of suing Nokia’s customers (including KPM in the Netherlands, Orange in France, and Fastweb in Italy), Nokia believes that ASSIA is likely to sue additional U.S.-based customers in the future, none of which are named

in the underlying litigation. What’s more, ASSIA has taken the position that the ’631 patent is essential to the G.fast standard. Given that the claims are directed to well-known TDD concepts, ASSIA’s allegations would implicate anyone using G.fast in the United States.

The final Fintiv factor—other considerations—weighs strongly against discretionary denial. As detailed herein, the merits of the Petition are strong. For example, looking at asserted claim 1, the claims seems to be directed to the well-known concept of time-division duplexing in DSL, which is expressly disclosed by both Bingham and Strobel. Indeed, even the abstract of Bingham alone discloses independent claim 1. Moreover, Bingham, Strobel, Wei, and Kuipers were not previously considered by either the Office or the district courts. *Cf. Comcast Cable Commn’s, LLC v. Rovi Guides, Inc.*, IPR2019-00231, Paper 14 at 11 (PTAB May 20, 2019).

C. The Board Should Not Deny Institution Under *General Plastic*

The *General Plastic* factors do not apply for several reasons. First, this is the first and only *inter partes* review (“IPR”) petition filed by Petitioner with respect to the ’631 patent. There are no other proceedings involving the ’631 patent, and therefore, there is no concern of serial petitions. Given the merits raised in this Petition have not been addressed to date, denial of institution under *General Plastic*

is unwarranted. *Code200, UAB v. Bright Data, Ltd.*, IPR2022-00861, Paper 18 at 5-6 (P.T.A.B. Aug. 23, 2022) (precedential).

IX. CONCLUSION

For the reasons set forth above, Petitioner respectfully requests cancellation of the Challenged Claims.

X. MANDATORY NOTICES UNDER 37 C.F.R. §42.8

A. Real Party in Interest Under 37 C.F.R. §42.8(b)(1)

The real parties in interest are AT&T Services, Inc., AT&T Enterprises, LLC, AT&T Mobility LLC, AT&T Mobility II LLC, and Nokia of America Corp.

Out of an abundance of caution, Petitioners have identified all current defendants in the below cases, as well as additional involved parties, as potential real parties in interest only for the purpose of this proceeding and only to the extent that Patent Owner contends that these separate legal entities should be named real parties in interest in this IPR. Petitioners do so to avoid the potential expenditure of resources to resolve such a challenge. Petitioners also acknowledge that each petitioner has a number of affiliates. No unnamed entity is funding, controlling, or otherwise has an opportunity to control or direct this Petition or Petitioners' participation in any resulting IPR. Petitioners are also not aware of any affiliate that would be barred from filing this Petition under 35 U.S.C. § 315(e).

B. Related Matters Under 37 C.F.R. §42.8(b)(2)

The '631 patent is the subject of the following litigation:

- *Adaptive Spectrum and Signal Alignment, Inc. v. AT&T Enterprises, LLC, AT&T Mobility LLC, AT&T Mobility II LLC, and AT&T Services, Inc.*, No. 2:24-cv-00029-JRG-RSP

Petitioners are not aware of any other judicial or administrative matter that would affect or be affected by a decision in this IPR.

C. Designation of Counsel Under 37 C.F.R. §42.8(b)(3)

Petitioners provide the following designation of counsel.

Lead Counsel	Backup Counsel
M. Scott Stevens Reg. No. 54,762 ALSTON & BIRD LLP Vantage South End 1120 S. Tryon Street, Suite 300 Charlotte, NC 28203 Phone: 704.444.1000 Fax: 704.444.1111 Email: scott.stevens@alston.com	Christopher TL Douglas Reg. No. 56,950 Nicholas C. Marais Reg. No. 77,181 ALSTON & BIRD LLP Vantage South End 1120 S. Tryon Street, Suite 300 Charlotte, NC 28203 Phone: 704.444.1000 Fax: 704.444.1111 Email: christopher.douglas@alston.com Email: nic.marais@alston.com

Pursuant to 37 C.F.R. § 42.8(b)(4), counsel agrees to service by mail as detailed above, and to electronic service by email as detailed above. Pursuant to 37 C.F.R §42.10(b), a Power of Attorney executed by Petitioners accompanies this Petition.

Service Information:

Please address all correspondence and service to the addresses listed above. Petitioners consent to electronic service at the addresses above.

Date: January 17, 2025

By: /M. Scott Stevens/

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TABLE OF CLAIMS

Reference	Claim Limitation
Claim 1	
1[pre]	A method in a data communications system for managing multiple time division physical channels that are subject to crosstalk, the method comprising:
1[a]	scheduling upstream time slots for upstream transmission in a first physical channel; and
1[b]	scheduling downstream time slots for downstream transmission in a second physical channel,
1[c]	wherein transmission in the upstream time slots is substantially not simultaneous with transmission in the downstream time slots.
Claim 3	
3[a]	The method of claim 1, wherein the upstream and downstream time slots have an active portion during which signals are transmitted and an off portion during which no signals are transmitted,
3[b]	and wherein the active portions of the upstream time slots are substantially not simultaneous with the active portions of the downstream time slots.
Claim 4	
Claim 4	The method of claim 1, wherein scheduling upstream and downstream time slot comprises scheduling upstream and downstream time slot boundaries.
Claim 5	
Claim 5	The method of claim 4, wherein the time slot boundaries are flexible.
Claim 6	
Claim 6	The method of claim 5, wherein the time slot boundaries have one or more of: variable-length frames; variable upstream time slot lengths; or variable downstream time slot-lengths.
Claim 8	
Claim 8	The method of claim 1, further comprising adapting scheduling at least one of upstream and downstream time slots to accommodate delay requirements for the other of a downstream and upstream traffic source.

Claim 9	
9[a]	The method of claim 1, further comprising receiving input on desired traffic levels for the first and second physical channels, and
9[b]	wherein scheduling upstream and downstream time slots is performed based on the received input.
Claim 11	
Claim 11	The method of claim 9, wherein the received input comprises at least one of static subscription data, service layer information from a policy manager, behavior data for traffic types and users of the physical channels, long term traffic types and users of the physical channels, long term traffic behavior data as a function of time, current traffic demands, queue lengths, traffic requests, upstream/downstream asymmetry, or traffic descriptors.
Claim 12	
Claim 12	The method of claim 9, wherein scheduling upstream and downstream time slots comprises assigning time slots to achieve a target upstream/downstream asymmetry ratio of data throughput.
Claim 13	
Claim 13	The method of claim 12, wherein the upstream/downstream asymmetry ratio is the defined in numbers of discrete multi-tone symbol positions.
Claim 14	
Claim 14	The method of claim 12, wherein the measure of throughput is at least one of an average throughput across all lines, a traffic demand match, a minimum throughput for each physical channel, a perceived quality of experience, an average delay, or a minimum delay.
Claim 15	
Claim 15	The method of claim 1, wherein scheduling upstream and downstream time slots comprises assigning time slots based at least in part on power usage.
Claim 16	
Claim 16	The method of claim 15, wherein assigning time slots based on power usage comprises assigning by scheduling entries, exits, and transitions between low-power link states and off states.

Claim 22	
Claim 22	The method of claim 1, further comprising receiving requests for upstream and downstream transmission and wherein scheduling upstream time slots is based on the received upstream transmission requests.
Claim 23	
Claim 23	The method of claim 1, wherein the transmission in the upstream time slots is from a plurality of different network-end transmission sources.
Claim 24	
Claim 24	The method of claim 23, further comprising synchronizing upstream transmission and downstream transmission among a plurality of different network-end transmission sources.
Claim 25	
Claim 25	The method of claim 24, wherein synchronizing comprises sending synch symbols to a source of upstream transmissions.
Claim 33	
33[a]	The method of claim 1, further comprising receiving input on desired traffic levels for the first and second physical channels and
33[b]	wherein scheduling upstream and downstream time slots is performed based on the received input and at least in part on power usage.
Claim 34	
34[pre]	A machine-readable medium having instructions that when operated on by the machine cause the machine to perform operations comprising:
34[a]	scheduling upstream time slots for upstream transmission in a first physical channel of multiple time division physical channels in a data communication system in which the physical channels are subject to crosstalk; and
34[b]	scheduling downstream time slots for downstream transmission in a second physical channel subject to crosstalk from the upstream time slots,
34[c]	Wherein transmission in the upstream time slots is substantially not simultaneous with transmissions in the downstream time slots.

Claim 35	
35[a]	The medium of claim 34, the operations further comprising receiving input on desired traffic levels for the first and second physical channels and
35[b]	wherein scheduling upstream and downstream time slots is performed based on the received input.
Claim 36	
Claim 36	The medium of claim 34, wherein scheduling upstream and downstream time slots comprises assigning time slots to achieve a target upstream/downstream asymmetry ratio of data throughput.
Claim 37	
37[a]	An apparatus for managing multiple time division physical channels in a data communications system that are subject to crosstalk, the apparatus comprising:
37[b]	means for scheduling upstream time slots for upstream transmission in a first physical channel; and
37[c]	means for scheduling downstream time slots for downstream transmission in a second physical channel subject to crosstalk from the upstream time slots,
37[d]	wherein transmission in the upstream time slots is substantially not simultaneous with transmission in the downstream time slots.

CERTIFICATION UNDER 37 C.F.R. § 42.24

Petitioner certifies that the word count in this Petition is 13,998, as counted by the word-processing program (Microsoft Word for Office 365) used to generate this Petition, where such word count excludes the table of contents, table of authorities, mandatory notices, certificate of service, appendix of exhibits, and this certificate of word count. This Petition is in compliance with the 14,000-word limit set in 37 C.F.R. §42.24(a)(1)(i).

Date: January 17, 2025

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CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. §§42.6(e), 42.105 and in view of the agreement between the Parties under 37 C.F.R. § 42.105(b), the undersigned hereby certifies that true and correct copies of the above-captioned PETITION FOR INTER PARTES REVIEW OF U.S. PATENT NO. 9,954,631, all associated exhibits, and Petitioner's Power of Attorney were served in their entirety on January 17, 2025, upon the Patent Owner at the following email addresses of Patent Owner's litigation counsel:

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