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Paper 13
Entered: October 14, 2016

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

LUMENTUM HOLDINGS, INC., LUMENTUM, INC., LUMENTUM OPERATIONS, LLC, CORIANT OPERATIONS, INC., CORIANT (USA) INC., CIENA CORPORATION, CISCO SYSTEMS, INC., and FUJITSU NETWORK COMMUNICATIONS, INC.,
Petitioner,

v.

CAPELLA PHOTONICS, INC.,
Patent Owner.

Case IPR2015-00739[1]
Patent RE42,678 E

Before JOSIAH C. COCKS, KALYAN K. DESHPANDE, and JAMES A. TARTAL, *Administrative Patent Judges*.

TARTAL, *Administrative Patent Judge*.

FINAL WRITTEN DECISION

35 U.S.C. § 318(a) and *37 C.F.R. § 42.73*

[1] IPR2015-01971 was joined with IPR2015-00739 on March 11, 2016, by Order in IPR2015-01971, Paper 12 (IPR2015-00739, Paper 41).

I. INTRODUCTION

Petitioner, Lumentum Holdings, Inc., Lumentum Inc., Lumentum Operations, LLC, Coriant Operations, Inc., Coriant (USA) Inc., Ciena Corporation, Cisco Systems, Inc., and Fujitsu Network Communications, Inc., filed petitions requesting an *inter partes* review of claims 1–4, 9, 10, 13, 17, 19–23, 27, 29, 44–46, 53, and 61–65 of U.S. Patent No. RE42,678 E (Ex. 1001, "the '678 patent"). Paper 1 ("Petition" or "Pet."); *see also* IPR2015-01971, Paper 6.

Claims 1–4, 9, 10, 13, 17, 19–23, 27, 29, 44–46, 53, and 61–65 of the '678 patent were previously held to be unpatentable in *Cisco Systems, Inc., Ciena Corporation, Coriant Operations, Inc., Coriant (USA) Inc., and Fujitsu Network Communications, Inc., v. Capella Photonics, Inc.*, IPR2014-01276, (PTAB Feb. 17, 2016) (Paper 40) (the '1276 case). Claims 1–4, 9, 10, 13, 17, 19–23, 27, 29, 44–46, 53, and 61–65 of the '678 patent also were previously held to be unpatentable in *Fujitsu Network Communications, Inc., Coriant Operations, Inc., Coriant (USA) Inc., and Ciena Corporation v. Capella Photonics, Inc.*, IPR2015-00727, (PTAB Sep. 28, 2016) (Paper 36) (the '727 case). The grounds of unpatentability asserted by Petitioner in this case rely on combinations of prior art, evidence, and arguments not asserted in either the '1276 case or the '727 case. Likewise, Patent Owner, Capella Photonics, Inc., advances arguments and evidence in response in this case that were not asserted by Patent Owner in either the '1276 case or the '727 case.

Based on the information provided in the Petition, and in consideration of the Preliminary Response (Paper 6) of Patent Owner, we

instituted a trial pursuant to 35 U.S.C. § 314(a) of: (1) claims 1–4, 9, 10, 13, 19–23, 27, 44–46, and 61–65 as obvious over Bouevitch,[2] Sparks[3], and Lin[4] under 35 U.S.C. § 103(a); and, (2) claims 17, 29, and 53 as obvious over Bouevitch, Sparks, Lin, and Dueck[5] under 35 U.S.C. § 103(a). Paper 7 ("Institution Decision"); *see also* IPR2015-01971, Paper 12.

After institution of trial, Patent Owner filed a Response (Paper 16, "Response" or "PO Resp.") and Petitioner filed a Reply (Paper 36, "Pet. Reply"). The Petition is supported by the Declaration of Sheldon McLaughlin (Ex. 1028). The Response is supported by the Declaration of Dr. Alexander V. Sergienko (Ex. 2022).

A transcript of the Oral Hearing conducted on May 24, 2016, is entered as Paper 49 ("Tr.").

We issue this Final Written Decision pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. For the reasons that follow, Petitioner has shown by a preponderance of the evidence that claims 1–4, 9, 10, 13, 17, 19–23, 27, 29, 44–46, 53, and 61–65 of the '678 patent are unpatentable.

II. BACKGROUND

A. The '678 patent (Ex. 1001)

The '678 patent, titled "Reconfigurable Optical Add-Drop Multiplexers with Servo Control and Dynamic Spectral Power Management

[2] U.S. Patent No. 6,498,872 B2, issued December 24, 2002 (Ex. 1003, "Bouevitch")
[3] U.S. Patent No. 6,625,340 B1, issued September 23, 2003 (Ex. 1004, "Sparks").
[4] U.S. Patent No. 5,661,591, issued August 26, 1997 (Ex. 1010, "Lin")
[5] U.S. Patent No. 6,011,884, issued January 4, 2000 (Ex. 1021, "Dueck")

Capabilities," reissued September 6, 2011, from U.S. Patent No. RE 39,397 ("the '397 patent"). Ex. 1001. The '397 patent reissued November 14, 2006, from U.S. Patent No. 6,625,346 ("the '346 patent"). *Id.* The '346 patent issued September 23, 2003, from U.S. Patent Application No. 09/938,426, filed August 23, 2001.

According to the '678 patent, "fiber-optic communications networks commonly employ wavelength division multiplexing (WDM), for it allows multiple information (or data) channels to be simultaneously transmitted on a single optical fiber by using different wavelengths and thereby significantly enhances the information–bandwidth of the fiber." *Id.* at 1:37–42. An optical add-drop multiplexer (OADM) is used both to remove wavelengths selectively from a multiplicity of wavelengths on an optical fiber (taking away one or more data channels from the traffic stream on the fiber) and to add wavelengths back onto the fiber (inserting new data channels in the same stream of traffic). *Id.* at 1:45–51.

The '678 patent describes a "wavelength-separating-routing (WSR) apparatus that uses a diffraction grating to separate a multi-wavelength optical signal by wavelength into multiple spectral channels, which are then focused onto an array of corresponding channel micromirrors." *Id.* at Abstract. "The channel micromirrors are individually controllable and continuously pivotable to reflect the spectral channels into selected output ports." *Id.* According to Petitioner, the small, tilting mirrors are sometimes called Micro Electro Mechanical Systems or "MEMS." Pet. 8. The WSR described in the '678 patent may be used to construct dynamically

reconfigurable OADMs for WDM optical networking applications. Ex. 1001 at Abstract.

Figure 1A of the ’678 patent is reproduced below.

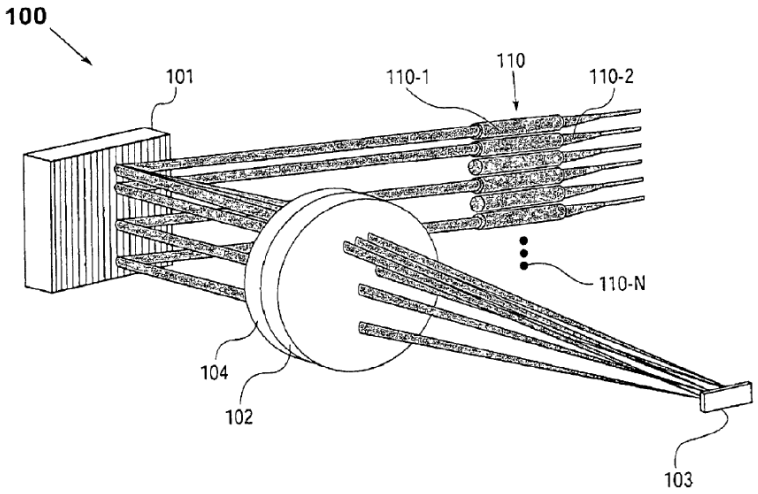

Fig. 1A

Figure 1A depicts wavelength-separating-routing (WSR) apparatus 100, in accordance with the ’678 patent. WSR apparatus 100 is composed of an array of fiber collimators 110 (multiple input/output ports, including input port 110-1 and output ports 110-2 through 110-N), diffraction grating 101 (a wavelength separator), quarter wave plate 104, focusing lens 102 (a beam-focuser), and array of channel micromirrors 103. Ex. 1001, 6:57–63, 7:55–56.

A multi-wavelength optical signal emerges from input port 110-1 and is separated into multiple spectral channels by diffraction grating 101, which are then focused by focusing lens 102 into a spatial array of distinct spectral spots (not shown). *Id.* at 6:64–7:2. Channel micromirrors 103 are positioned such that each channel micromirror receives one of the spectral channels. *Id.* at 7:2–5.

Figure 1B of the ’678 patent is reproduced below.

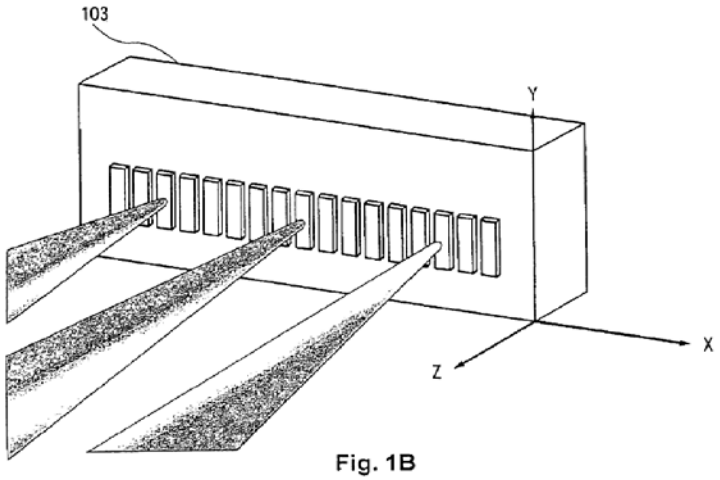

Fig. 1B

Figure 1B depicts a close-up view of the array of channel micromirrors 103 shown above in Figure 1A. *Id.* at 8:6–7. The channel micromirrors “are individually controllable and movable, e.g., pivotable (or rotatable) under analog (or continuous) control, such that, upon reflection, the spectral channels are directed” into selected output ports by way of focusing lens 102 and diffraction grating 101. *Id.* at 7:6–11.

According to the ’678 patent:

> [e]ach micromirror may be pivoted about one or two axes. What is important is that the pivoting (or rotational) motion of each channel micromirror be individually controllable in an analog manner, whereby the pivoting angle can be continuously adjusted so as to enable the channel micromirror to scan a spectral channel across all possible output ports.

Id. at 9:8–14.

Figure 3 of the ’678 patent is reproduced below.

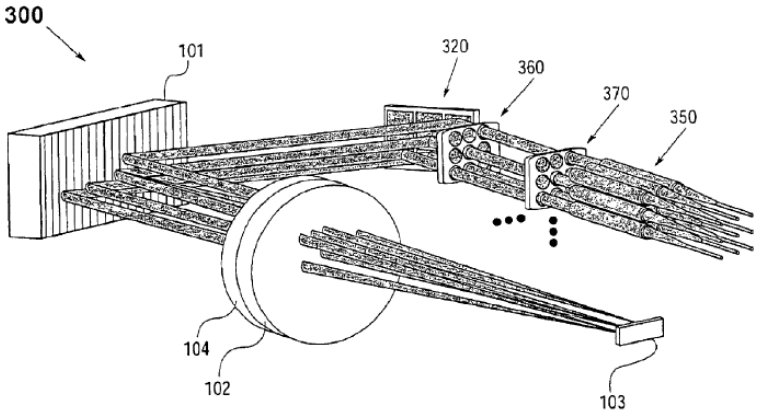

Fig. 3

Similar to Figure 1A, above, Figure 3 also shows a WSR apparatus as described by the ’678 patent. *Id.* at 10:25–26. In this embodiment, two-dimensional array of fiber collimators 350 provides an input port and plurality of output ports. *Id.* at 10:31–32. First and second two-dimensional arrays of imaging lenses 360, 370 are placed in a telecentric arrangement between two-dimensional collimator-alignment mirror array 320 and two-dimensional fiber collimator array 350. *Id.* at 10:37–43. “The channel micromirror 103 must be pivotable biaxially in this case (in order to direct its corresponding spectral channel to any one of the output ports).” *Id.* at 10:43–46.

The WSR also may incorporate a servo-control assembly (together termed a “WSR-S apparatus”). *Id.* at 4:65–67. According to the ’678 patent:

> The servo-control assembly serves to monitor the power levels of the spectral channels coupled into the output ports and further provide control of the channel micromirrors on an individual basis, so as to maintain a predetermined coupling efficiency of

> each spectral channel in one of the output ports. As such, the servo-control assembly provides dynamic control of the coupling of the spectral channels into the respective output ports and actively manages the power levels of the spectral channels coupled into the output ports.

Id. at 4:47–56.

Figure 5 of the ’678 patent is reproduced below.

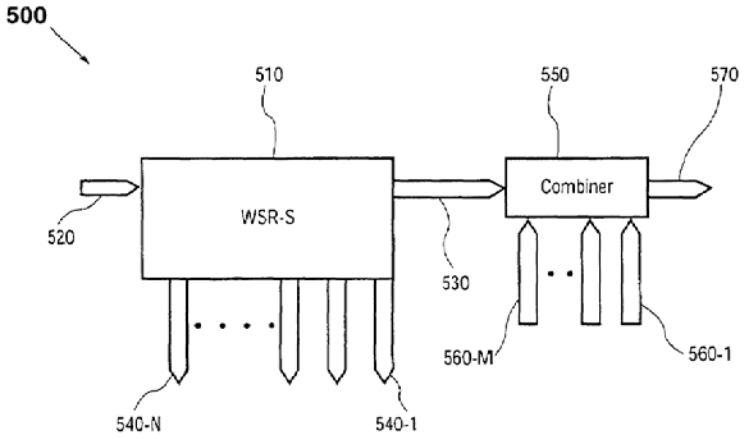

Fig. 5

Figure 5 depicts OADM 500 in accordance with the ’678 patent composed of WSR-S (or WSR) apparatus 510 and optical combiner 550. *Id.* at 12:40–44. Input port 520 transmits a multi-wavelength optical signal, which is separated and routed into a plurality of output ports, including pass-through port 530 and one or more drop ports 540-1 through 540-N. *Id.* at 12:44–48. Pass-through port 530 is optically coupled to optical combiner 550, which combines the pass-through spectral channels with one or more add spectral channels provided by one or more add ports 560-1 through 560-M. *Id.* at 12:52–56. The combined optical signal is then routed into an existing port 570, providing an output multi-wavelength optical signal. *Id.* at 12:56–58.

B. Illustrative Claims

Challenged claims 1, 21, 44, and 61 of the '678 patent are independent. Challenged claims 2–4, 9, 10, 13, 17, 19, and 20 ultimately depend from claim 1; claims 22, 23, 27, and 29 ultimately depend from claim 21; claims 45, 46, and 53 ultimately depend from claim 44; and, claims 62–65 ultimately depend from claim 61. Claims 1, 21, and 61 of the '678 patent are illustrative of the claims at issue:

> 1. A wavelength-separating-routing apparatus, comprising:
>
> a) multiple fiber collimators, providing an input port for a multi-wavelength optical signal and a plurality of output ports;
>
> b) a wavelength-separator, for separating said multi-wavelength optical signal from said input port into multiple spectral channels;
>
> c) a beam-focuser, for focusing said spectral channels into corresponding spectral spots; and
>
> d) a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being *pivotal about two axes and being* individually and continuously controllable to reflect [[said]] *corresponding received* spectral channels into *any* selected ones of said output ports *and to control the power of said received spectral channels coupled into said output ports*.

Ex. 1001, 14:6–23 (emphases in original, "[[ ]]" indicating matter in the first reissue that forms no part of the second reissue, and matter in italics indicating additions made by second reissue).

> 21. A servo-based optical apparatus comprising:
>
> a) multiple fiber collimators, providing an input port for a multi-wavelength optical signal and a plurality of output ports;

> b) a wavelength-separator, for separating said multi-wavelength optical signal from said input port into multiple spectral channels;
>
> c) a beam-focuser, for focusing said spectral channels into corresponding spectral spots; and
>
> d) a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being individually controllable to reflect said spectral channels into selected ones of said output ports; and
>
> e) a servo-control assembly, in communication with said channel micromirrors and said output ports, for maintaining a predetermined coupling of each reflected spectral channel into one of said output ports.

Ex. 1001, 15:29–48.

> 61. A method of performing dynamic wavelength separating and routing, comprising:
>
> a) receiving a multi-wavelength optical signal from an input port;
>
> b) separating said multi -wavelength optical signal into multiple spectral channels;
>
> c) focusing said spectral channels onto a spatial array of corresponding beam-deflecting elements, whereby each beam-deflecting element receives one of said spectral channels; and
>
> d) dynamically and continuously controlling said beam-deflecting elements [[, thereby directing]] *in two dimensions to direct* said spectral channels into [[a plurality]] *any selected ones of said* output ports *and to control the power of the spectral channels coupled into said selected output ports*.

Ex. 1001, 18:55–19:3 (emphases in original, with "[[ ]]" indicating matter in the first reissue that forms no part of the second reissue, and matter in italics indicating additions made by second reissue).

III. ANALYSIS

A. Claim Construction

The Board interprets a claim using the "broadest reasonable construction in light of the specification of the patent in which it appears." 37 C.F.R. § 42.100(b). We presume a claim term carries its "ordinary and customary meaning," which is "the meaning that the term would have to a person of ordinary skill in the art in question" at the time of the invention. *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). A patentee may, however, act as their own lexicographer and give a term a particular meaning in the specification, but must do so with "reasonable clarity, deliberateness, and precision." *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994). Only terms which are in controversy need to be construed, and then only to the extent necessary to resolve the controversy. *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999).

1. "*continuously controllable*"

Claims 1 and 44 require "a spatial array of channel micromirrors . . . being individually and continuously controllable." Ex. 1001, 14:16–20; 17:43–47. Similarly, claim 61 requires "dynamically and continuously controlling said beam-deflecting elements." *Id.* at 18:65–66. Petitioner asserts that "continuously controllable" should be construed to mean "able to effect changes with fine precision." Pet. at 11. Petitioner also notes, however, that the '678 patent identifies "under analog control" as an example of continuous control, and contends that "the example of analog control does not alone define" the broadest reasonable interpretation of "continuously controllable." *Id.* at 12; *see also* Ex. 1028 ¶¶ 59–60

(explaining that a mirror that is disclosed to be under analog control would fit within the scope of "continuously controllable"). Petitioner identifies the following disclosures of the '678 patent as supporting its proposed construction:

> The '678 Patent explains that "[a] distinct feature of the channel micromirrors in the present invention, in contrast to those used in the prior art, is that the motion…of each channel micromirror is under *analog control* such that its pivoting angle can be *continuously adjusted*." ([Ex. 1001], 4:7–11; emphasis added).) Another passage in the specification states that "[w]hat is important is that the pivoting (or rotational) motion of each channel micromirror be individually *controllable in an analog manner, whereby the pivoting angle can be continuously adjusted* so as to enable the channel micromirror to scan a spectral channel across all possible output ports." (*Id*. at 9:9–14; emphasis added). '678 Patent states "channel micromirrors 103 are individually controllable and movable, e.g., pivotable (or rotatable) under analog (or continuous) control." (*Id*. *at 7:6–8*).

Pet. 11–12. Patent Owner disputes Petitioner's proposed construction, but offers no express alternative. PO Response 47–48. We find that Petitioner: (1) offers no sufficient explanation for how its proposed definition accounts for the term "continuously" in "continuously controllable"; (2) directs us to no portion of the specification of the '678 patent that uses "fine precision"; and (3) fails to explain what "fine precision" is intended to encompass or exclude. *See* Pet. 11–12. Additionally, based on all of the evidence presented, we are not persuaded that "continuously controllable" is limited to "analog control," or that "analog control" necessarily corresponds to "continuous" control under all circumstances. We determine that "continuously controllable," in light of the specification of the '678 patent,

encompasses "under analog control such that it can be continuously adjusted."

2. "*servo-control assembly*" and "*servo-based*"

Challenged claims 2–4, 21–23, and 45 recite a "servo-control assembly." Petitioner asserts "servo-control assembly" means "feedback-based control assembly," thereby suggesting "servo" means "feedback-based." Pet. 12. Challenged claims 21–25, 27, and 29 recite a "servo-based optical apparatus." Petitioner asserts that "servo-based" means "feedback-based control." *Id*. Patent Owner offers no construction of the terms. We are not persuaded that "servo" necessarily means "feedback" or "feedback-based" merely because the '678 patent describes a processing unit within a servo-control assembly as using power measurements from the spectral monitor to provide feedback control of the channel mirrors. *See* Pet. 13–14.

The '678 patent does not use the term "servo-based" outside of the preamble of challenged claims 21–25, 27, and 29. "If . . . the body of the claim fully and intrinsically sets forth the complete invention, including all of its limitations, and the preamble offers no distinct definition of any of the claimed invention's limitations, . . . then the preamble is of no significance to claim construction because it cannot be said to constitute or explain a claim limitation." *Pitney Bowes, Inc. v. Hewlett-Packard Co.*, 182 F.3d 1298, 1305 (Fed. Cir. 1999) (citations omitted). The bodies of claims 21–25, 27, and 29 fully and intrinsically set forth the complete invention; therefore, the use of "servo-based" in the preamble does not serve as a limitation and need not be construed for purposes of this decision.

With respect to "servo-control assembly," the '678 patent states that it "serves to monitor the power levels of the spectral channels coupled into the output ports and further provide control of the channel micromirrors on an individual basis." Ex. 1001, 4:47–50. Further, "[i]f the WSR apparatus includes an array of collimator-alignment mirrors . . . the servo-control assembly may additionally provide dynamic control of the collimator-alignment mirrors." *Id*. at 4:56–60. According to the '678 patent, "[a] skilled artisan will know how to implement a suitable spectral monitor along with an appropriate processing unit to provide a servo-control assembly in a WSP-S apparatus according to the present invention, for a given application." Ex. 1001, 12:11–15.

Based on the specification, a "servo-control assembly" encompasses a spectral monitor and processing unit to monitor spectral channel power levels and control channel micro mirrors on an individual basis. *See id*. at 11:10–36.

3. "*port*"

Claim 1 recites "multiple fiber collimators, providing an input port . . . and a plurality of output ports." Ex. 1001, 14:8–10. By comparison, claim 61 does not recite a collimator, but instead requires "receiving a multi-wavelength optical signal from an input port," and "controlling said beam deflecting elements . . . to direct said spectral channels into . . . output ports." *Id*. at 18:57–19:1. Patent Owner offers no definition of "port," and does not suggest that the '678 patent provides an express definition of the term, but instead argues that a "port," as claimed, is not a "circulator port"

because the ’678 patent “disavows circulator-based optical systems.” PO Resp. at 35–36. We disagree.

There is no dispute that the ordinary and customary meaning of “port” encompasses circulator ports, and, indeed, any “point of entry or exit of light.” *See* Dr. Sergienko Deposition Transcript (Ex. 1051), 43:16–23, 45:12–13 (“The circulator ports are ports with constraints.”). Nor does the ’678 patent equate the term “port” to “collimator,” as both “port” and “collimator” appear separately in the claims of the ’678 patent. Ex. 1001, 14:8–10. We have considered the testimony of Dr. Sergienko as well (Ex. 2022 ¶¶ 168–172), and find that even if certain fiber collimators serve as ports in the ’678 patent, that does not redefine the term “port” to mean “collimator.” *See id*. at ¶ 171. Thus, the primary issue is whether the ’678 patent disavows circulator ports from the scope of the term “port.”

Although the broad scope of a claim term may be intentionally disavowed, this intention must be clear, *see Teleflex, Inc. v. Ficosa N. Am. Corp*., 299 F.3d 1313, 1325 (Fed. Cir. 2002) (“[t]he patentee may demonstrate an intent to deviate from the ordinary and accustomed meaning of a claim term by including in the specification expressions of manifest exclusion or restriction, representing a clear disavowal of claim scope”), and cannot draw limitations into the claim from a preferred embodiment. *Conoco, Inc. v. Energy & Envtl. Int’l.*, 460 F.3d 1349, 1357-58 (Fed. Cir. 2006).

Patent Owner fails to show any expressions of manifest exclusion or restriction, representing a clear disavowal of claim scope with respect to the use of “port” in the ’678 patent. Patent Owner argues: (1) that the ’678

patent provides a scalable system without circulator ports (PO Resp. 1), (2) that a provisional application to the '678 patent "describes existing add/drop architectures that had a number of problems" (PO Resp. 37); (3) that U.S. Patent No. 6,984,917 shows how experts use the term "input port" and "output port" because it uses elements "similar to how the '678 patent describes fiber collimators serving as ports" (PO Resp. 43–44); and (4) that because the inventors of the '678 patent "consistently emphasized the limitations of circulator-based switches and provided an alternative configuration," a person of ordinary skill in the art would have understood that the inventors were disavowing the use of optical circulators (PO Resp. 36–37). S*ee also* PO Resp. 34–40 (citing Ex 2022 ¶ 182).

We do not discern any "clear disavowal of claim scope" from the arguments advanced by Patent Owner. Dr. Sergienko merely states that based on market differentiation, construing "ports" to include circulator ports "goes beyond the intent of the '678 patent." Ex. 2022, ¶ 182. Even if the '678 patent were viewed as Dr. Sergienko suggests, a speculative purported intent of market differentiation is not disavowal. Moreover, Petitioner further demonstrates that a provisional application to the '678 patent in fact uses circulator ports as "ports." Pet. Reply 15–16 (citing Ex. 1008, 3, Fig. 9). Such usage undermines Patent Owner's disavowal contention. Patent Owner's argument that the provisional application is "entirely consistent with the '678 patent's use of collimators" fails to negate the fact that the provisional application uses circulator ports as "ports." *See* PO Resp. 42–43. Similarly, we find insufficient support for Patent Owner's argument based on the preamble that "circulators can only be coupled to, but

not part of, the [optical add drop] apparatus. *See id.* at 40–41. We are not persuaded that the preamble's recitation of a "[a]n optical add-drop apparatus comprising" of claim 1 is limiting because "the body of the claim fully and intrinsically sets forth the complete invention, including all of its limitations." *See Pitney Bowes, Inc. v. Hewlett-Packard Co.*, 182 F.3d 1298, 1305 (Fed. Cir. 1999). Because "the preamble offers no distinct definition of any of the claimed invention's limitations, but rather merely states . . . the purpose or intended use of the invention, . . . the preamble is of no significance to claim construction." *Id.* (citing *Rowe v. Dror*, 112 F.3d 473, 478 (Fed. Cir. 1997); *Corning Glass Works v. Sumitomo Elec. U.S.A., Inc.*, 868 F.2d 1251, 1257 (Fed. Cir. 1989); *Kropa v. Robie*, 187 F.2d 150, 152 (CCPA 1951)). We also are persuaded that Bouevitch's "Configurable Optical Add/Drop Multiplexer" is recognized as an optical add-drop apparatus and includes circulators. *See* Pet. Reply 16. We have considered all of the arguments advanced by Patent Owner in its effort to redefine "port" as excluding "circulator ports" (PO Resp. 32–44), and find insufficient support for Patent Owner's contention that the '678 patent disavows or otherwise excludes circulator ports from the scope of the term "port." We determine that "port," in light of the specification of the '678 patent, encompasses "circulator port."

4. "*beam-focuser*"

Claims 1, 21, and 44 each require a "beam-focuser, for focusing said spectral channels into corresponding spectral spots." The '678 patent states that "[t]he beam-focuser may be a single lens, an assembly of lenses, or other beam focusing means known in the art." Ex. 1001, 4:20–22.

Petitioner contends that "beam focuser" is "a device that directs a beam of light to a spot." Pet. 14. According to Petitioner:

> The Summary of the '678 patent states that the "beam-focuser focuses the spectral channels into corresponding spectral spots." ([Ex. 1001], 3:63–64.) The specification also explains that the beams of light are "focused by the focusing lens 102 into a spatial array of distinct spectral spots (not shown in FIG. lA) in a one-to-one correspondence." (*Id*. at 6:65–7:5.) The MEMS mirrors are in turn "positioned in accordance with the spatial array formed by the spectral spots, such that each channel micromirror receives one of the spectral channels." (*Id*.)

Id. Patent Owner does not dispute expressly Petitioner's proposed construction, and provides no alternative construction of "beam focuser." Consistent with Petitioner's proposed construction, Dr. Sergienko testified that "focusing means bringing of the energy in the original image limited to the focal spot." Ex. 1051, 245:17–19. We agree that, based on the specification of the '678 patent, "beam focuser" means "a device that directs a beam of light to a spot."

5. Additional Claim Terms

Petitioner addresses several additional claim terms, including "spectral monitor," "in two dimensions," "control the power," and "optical sensor." Pet. 13–16. For purposes of this decision, no express construction of any additional claim terms is necessary.

B. References Asserted as Prior Art

Petitioner relies on Bouevitch, Sparks, Lin, and Dueck with respect to its assertion that the challenged claims would have been obvious.

1. Bouevitch

Bouevitch describes an optical device for rerouting and modifying an optical signal, including modifying means such as a MEMS array and a liquid crystal array which function as an attenuator when the device operates as a dynamic gain equalizer (DGE), and as a switching array when the device operates as a configurable optical add/drop multiplexer (COADM). Ex. 1003, Abstract. According to Petitioner, the COADM described in Bouevitch "uses MEMS mirrors with 1 axis of rotation." Pet. 19. Petitioner also contends that the Bouevitch COADM controls the power of its output channels by tilting beam-deflecting mirrors at varying angles. *Id.* at 18.

2. Sparks

Sparks describes an optical switch arranged to misalign the optical beam path to provide a predetermined optical output power. Ex. 1004, Abstract. According to Sparks, "[t]he system operates by controlling the movable micromirrors (16, 26), which are fabricated using MEMS technology and are capable of two axis movement, to carefully align the beams so as to ensure that the maximum possible input optical signal is received at the output of the switch." *Id.* at 4:43–46.

3. Lin

Lin describes a "spatial light modulator… operable in the analog mode for light beam steering or scanning applications." Ex. 1010, Abstract. Lin explains that the angular deflection of a mirror about the torsional axis is a function of the voltage potential applied to an address electrode. *Id*. at 6:29–32. Petitioner contends that Figure 3B of Lin depicts a continuous and

linear relationship between the deflection angle of the MEMS mirrors and the applied voltage. Pet. 31–32.

4. Dueck

Dueck describes a wavelength division multiplexer that integrates an axial gradient refractive index element with a diffraction grating to provide efficient coupling from a plurality of input sources. Ex. 1021, Abstract. Petitioner contends that Dueck describes various diffraction gratings for use in WDM devices. Pet. 18.

C. Asserted Obviousness Over Bouevitch, Sparks, and Lin

Petitioner asserts that claims 1–4, 9, 10, 13, 17, 19–23, 27, 29, 44–46, 53, and 61–65 would have been obvious over Bouevitch, Sparks, and Lin.[6] Pet. 5.

1. Claim 1

Claim 1, directed to a wavelength-separating-routing apparatus, requires "multiple fiber collimators, providing an input port . . . and a plurality of output ports." Ex. 1001, 14:6–10. Petitioner shows that Bouevitch describes microlenses 12a and 12b, corresponding to the recited

[6] Petitioner initially argues that Patent Owner admitted in a Replacement Reissue Application Declaration by Assignee that all elements of claim 1, except for two-axis mirrors, were disclosed by Bouevitch. Pet. 9–11 (quoting Ex. 1002, 104). Petitioner identifies no persuasive authority for the proposition that such a statement should be treated as an admission in this proceeding. Moreover, rather than admit that all original elements of claim 1 are disclosed by Bouevitch, the statement makes clear that three additional references not relied upon by Petitioner in this proceeding were considered in combination with Bouevitch. As a result, we are not persuaded that Patent Owner has admitted all elements of claim 1, except for two-axis mirrors, were disclosed by Bouevitch.

"multiple fiber collimators." Pet. 24–25. Petitioner's declarant, Sheldon McLaughlin, an employee of Petitioner, equates microlenses 12a and 12b to fiber collimators. Ex. 1028 ¶ 43. Petitioner further asserts that the microlenses of Bouevitch, in conjunction with fiber waveguides and circulators, provide an input port (labeled "IN"), and a plurality of output ports (labeled "OUT EXPRESS" and "OUT DROP"). Pet. 25–26 (citing Ex. 1003, Fig. 11). Petitioner's contentions are supported by Mr. McLaughlin. Ex. 1028 ¶¶ 44–45.

Patent Owner argues that, under its proposed claim construction of "port," Bouevitch discloses at most two ports because the '678 patent equates "port" to "collimator" and disavows circulator ports. PO Resp. 32–45. For the reasons explained above in our claim construction analysis, we reject Patent Owner's claim construction for "port." Accordingly, we do not agree with Patent Owner's contention that the only ports disclosed by Bouevitch are collimator lenses 12a and 12b. *See* PO Resp. 45. Petitioner has shown, as discussed above and as supported by Mr. McLaughlin, that Bouevitch discloses the recited "multiple fiber collimators, providing an input port . . . and a plurality of output ports," as recited by claim 1.

Claim 1 further requires "a wavelength-separator" for separating the multi-wavelength optical signal input into multiple spectral channels. Petitioner identifies diffraction grating 20 of Bouevitch as corresponding to the recited "wavelength-separator." Pet. 26. Petitioner also identifies Bouevitch's reflector 10 as a "beam-focuser," as also recited in claim 1. *Id.* at 27.

For each of the channel micromirrors, claim 1 further requires that they be "*pivotal about two axes*," and be "individually and continuously controllable to reflect *corresponding received* spectral channels into *any* selected ones of said output ports *and to control the power of said received spectral channels coupled into said output ports*." Petitioner shows that reflectors 51 and 52 in MEMS array 50 of Bouevitch are micromirrors and that "Bouevitch teaches positioning its micromirrors such that each receives a corresponding spectral channel dispersed by the diffraction grating." Pet. 28 (citing Ex. 1003, 14:53–65, 7:33–38, 10:43-51, Fig. 3). Petitioner also shows that Bouevitch discloses "individual" control for each mirror in MEMS array 50 and explains that "[e]ach reflector is individually controlled in to deflect the respective beam to either the output or the drop port." *Id.* at 29 (citing Ex. 1028 ¶ 55).

Patent Owner argues that the beam in Bouevitch is "propagate[d]" to an output port, and that Petitioner has not shown that "deflecting" or "propagating" to an output port is "reflecting," as claimed. PO Resp. 45–46. We find Patent Owner's argument not persuasive. Patent Owner provides no construction of "to reflect" to explain why a beam that is reflected and then propagated or deflected is excluded. Patent Owner's argument is not persuasive because it is beyond the scope of the claims. Petitioner has shown that Patent Owner's argument implies a requirement that the beam be directly reflected to an output port which is contrary to an embodiment of the '678 patent. *See* Pet. Reply 16–17. In this regard, we agree with Petitioner that the '678 patent does not require reflection *directly* to an output port and, contrary to Patent Owner's argument, "Fig. 1A of the '678

patent, for example, discloses a light beam that reflects off micromirror 103, and then propagates back though both focusing lens 102 and quarter-wave plate 104 before being directed to an output port." Pet. Reply 17.

The '678 patent provides analog control as an example of "continuously controllable," and Petitioner shows that Bouevitch discloses continuously controllable power attenuation as an analog function of the angle of the deflector, which is also described as "variable." Pet. at 28–30. As Mr. McLaughlin explains, a person of ordinary skill would understand from Bouevitch that "the level of control, required to balance the optical power differentials among the wavelength channels[,] is achieved via analog voltage control." Ex. 1028 ¶ 56; s*ee also* Declaration of Dr. Dan Marom, Ex. 1029 ¶ 58 (explaining that Bouevitch discloses the use of variable attenuation for power control, and a person of ordinary skill in the art would understand that the necessary level of control required to balance the optical power differentials among the wavelength channels is achieved in Bouevitch with continuous control over the mirror tilt via analog voltage control); Ex. 1003, 7:35–37 (stating that "[t]he degree of attenuation is based on the degree of deflection provided by the reflector (i.e., the angle of reflection)"). Patent Owner does not otherwise dispute Petitioner's contention that Bouevitch discloses continuous control of beam-deflecting elements via analog voltage control with respect to a single axis. *See* PO Resp. 47–49.

Petitioner also shows that Lin discloses "continuous control." Pet. 31–32. Lin describes a spatial light modulator (SLM) operable in the analog mode for light beam steering or scanning applications. Ex. 1010, Abstract. Figures 3A and 3B of Lin are reproduced below.

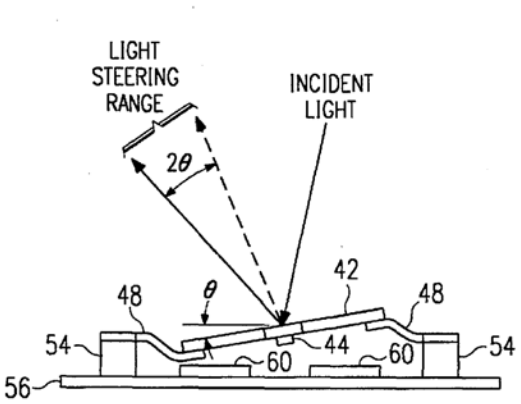

FIG. 3A

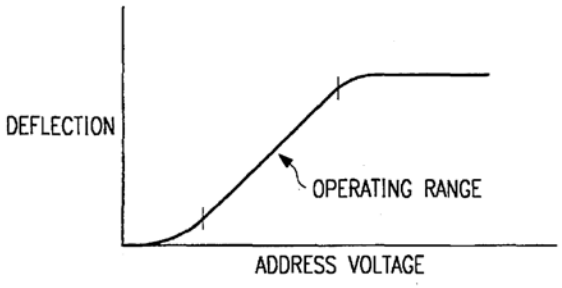

FIG. 3B

Figure 3A is a spatial light modulator, "illustrating the pixel being deflected about the torsion hinge to steer incident light in a selected direction, the deflection of the pixel being a function of the voltage applied to the underlying address electrode." Ex. 1010, 5:20–25. As Petitioner explains, Figure 3B shows a graph disclosing the continuous deflection angle of MEMS mirrors as a function of the voltage applied to affect that deflection. Pet. 31. Mr. McLaughlin testifies that Lin "confirms that continuous and analog control of MEMS mirrors was known prior to the '678 patent's

priority date." Ex. 1028 ¶ 59. Lin explains that "the angular deflection of mirror 42 about the torsional axis defined by hinges 44 is seen to be a function of the voltage potential applied to one of the address electrodes 60." Ex. 1010, 6:29–32. Lin further explains that:

> With an address voltage being applied to one address electrode 60 being from 0 to 20 volts, mirror 42 is deflected proportional to the address voltage. When SLM 40 is operated as an optical switch or light steerer, incident light can be precisely steered to a receiver such as an optical sensor or scanner. The mirror tilt angle can be achieved with a excellent accuracy for pixel steering.

Id. at 7:13–19.

Patent Owner argues that Petitioner hasn't shown that Lin discloses continuous control because such control cannot be shown by the input signal alone, and Petitioner did not "look at the structure of the mirror, how the voltage affects movement of the mirror, and what control loop algorithm has been utilized." PO Resp. 52 (citing Ex. 2022 ¶¶ 204–05 (stating that Lin Figure 3B "may represent a mirror that is controlled in a step-wise manner")). We find the speculative testimony of Dr. Sergienko not persuasive over the express disclosure of Lin of analog control whereby "mirror 42 is deflected proportional to the address voltage," thereby demonstrating "continuous control," as claimed. *See* Ex. 1010, at 7:13–19; *see also* Ex. 1028 ¶ 59.

With regard to beam-deflecting elements controllable in two dimensions, as required by claim 1, Petitioner also shows that "Sparks describes 'movable micromirrors (16,26), which are fabricated using MEMS technology and are capable of two axis movement, to carefully align the beams so as to ensure that the maximum possible input optical signal is

received at the output of the switch.'" Pet. 33–34 (quoting Ex. 1004, 4:43–47); *see also* Ex. 1028 ¶ 64). Patent Owner does not dispute that Sparks discloses MEMS controllable in two dimensions, including "to control the power," as claimed. *See* PO Resp. 49–50; *see also* Ex. 1004 Abstract (describing "switching means arranged to switch an optical signal by redirection of the optical beam path of said signal, wherein said optical switch is arranged to misalign the optical beam path so as to provide a predetermined optical output power")).

In summary, for the reasons discussed above, Petitioner has established that Bouevitch discloses all of the recited limitations of claim l for multiple fiber collimators, a wavelength-separator, a beam-focuser, and a spatial array of channel micromirrors individually and continuously controllable on a single axis, but not on a two axis (i.e., "pivotal about two axes") array "to reflect said corresponding received spectral channels into any selected ones of said output ports and to control the power of said received spectral channels coupled into said output ports." Patent Owner did not dispute that Bouevitch discloses continuous control of beam-deflecting elements via analog voltage control with respect to a single axis, and Petitioner has demonstrated that Lin also discloses such "continuous control." Finally, Petitioner has established that Sparks discloses an array of mirrors controllable in two dimensions "to reflect" and "to control," as recited by claim 1. Thus, the remaining issue is whether Petitioner has provided "some articulated reasoning with some rational underpinning to

support the legal conclusion of obviousness." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 418 (2007).[7]

With respect to a rationale for combining Bouevitch and Sparks, Petitioner shows the use of the two-axis mirror of Sparks in Bouevitch: (1) is a simple substitution of one known element for another yielding predictable results, (2) is the use of a known technique to improve similar devices, (3) would be obvious to try as there are only two options for tilting MEMS mirrors: one-axis and two-axis mirrors, and (4) would be motivated to help ensure that all channels have nearly equivalent power and to overcome manufacturing deviations by being actuatable to adjust for any unintentional misalignment in two axes. Pet. 20–23. Petitioner also shows that several reasons support the addition of Lin's continuous, analog control to the asserted combination:

> (1) continuously controlled mirrors were known to be interchangeable with discrete step mirrors; (2) continuously controlled mirrors allow arbitrary positioning of mirrors and can more precisely match the optimal coupling value; and (3) Lin specifically teaches that its analog, continuous MEMS mirrors would be useful in optical switching applications like

[7] The question of obviousness is resolved on the basis of underlying factual determinations including (1) the scope and content of the prior art, (2) any differences between the claimed subject matter and the prior art, (3) the level of skill in the art; and (4) secondary considerations, i.e. objective evidence of unobviousness. *See Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). We have considered each of the Graham factors and incorporate our discussion of those considerations, to the extent there is a dispute, in our evaluation of the reasoning that supports the asserted combination. We further observe that, in this proceeding, evidence of secondary considerations has not been offered for evaluation.

> Bouevitch's and Sparks' optical switch devices. (Lin, Ex. 1010 at 2:6–9; McLaughlin Decl., Ex. 1028 at ¶ 52.)

Pet. 32.

Patent Owner disputes the sufficiency of the rationale provided in the Petition. PO Resp. 14–30. First, Patent Owner argues that Petitioner combines disparate embodiments of Bouevitch, noting that the Petition cites portions of Bouevitch describing not only figure 11, but also figures 1, 5, 6a, and 9 which correspond to other embodiments. *Id*. at 15–17. Noting that various portions of a reference are cited does not show that the asserted combination is dependent upon a disclosure appearing only with respect to one embodiment and not another. Petitioner persuasively explains that it relies "only on the Fig. 11 embodiment of Bouevitch." Pet. Reply 1–2. Although Petitioner includes a discussion of Bouevitch's disclosure of power control in the Petition, it is clear that the asserted combination does not stand or fall on that disclosure. The Petition states that a person of ordinary skill in the art "would be motivated to use the 2-axis system of Sparks within the system of Bouevitch for power control." Pet. 36. Petitioner's discussion of the power control embodiment of Bouevitch in support of the rationale for the asserted combination with Sparks (i.e., both Sparks and Bouevitch address power control) does not impose an obligation on Petitioner to articulate a rationale for including the power control embodiment of Bouevitch in the asserted combination.

Patent Owner also argues that a person of ordinary skill in the art would not have combined Bouevitch and Sparks for various reasons. PO Resp. 18–31. Patent Owner argues that if Bouevitch accomplishes both switching and power control using a one-axis mirror, absent hindsight a

person of ordinary skill "would have had *no* reason" to use a two-axis mirror to control power, particularly because it would make it "vastly more complex." *Id*. at 18. We find Patent Owner's argument conclusory and not persuasive because it fails to address the benefits of a two-axis mirror disclosed by Sparks which would be apparent to one of skill in the art without hindsight. *See* Pet. Reply 3 ("Sparks expressly states that an advantage of the optical switches with two-axis mirrors is that attenuation (*i.e*., power control) can be achieved without incorporating separate attenuators within the system. (*See*, *e.g.*, Sparks, Ex. 1004, col. 2, ll. 28–30, col. 4, ll. 55–58.)"). Petitioners' expert Mr. McLaughlin testified that a person of ordinary skill would have been capable of overcoming any problems presented by technical issues. Ex. 2032, 125:18–126:10, 134:11–19, 137:16–23.) Patent Owner concedes that two-axis mirrors were known and cited during prosecution. PO Resp. 20. Patent Owner argues that Petitioner "fails to address the technical challenges" that would prevent it from being a simple substitution. PO Resp. 20–23. Dr. Sergienko was asked whether similar technical considerations presented problems that could not be overcome by one of skill in the art, and indicated "no." Ex. 1051, 266:16–267:25.

Moreover, "[t]he test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference. . . . Rather, the test is what the combined teachings of those references would have suggested to those of ordinary skill in the art." *In re Keller*, 642 F.2d 413, 425 (CCPA 1981). Here, the test for obviousness reflects what the combined teachings of Bouevitch, Sparks, and

Lin would have suggested to one of ordinary skill in the art, and does not require that any one particular component of a reference must be bodily incorporated, or physically inserted, into another reference.

Next, Patent Owner argues that a person of ordinary skill in the art would not have been motivated to combine Spark's tiltable mirrors with Bouevitch because it would disrupt Bouevitch's explicit teaching of parallel alignment, and "Bouevitch teaches away from misalignment for power control." PO Resp. 24–28. "The prior art's mere disclosure of more than one alternative does not constitute a teaching away from any of these alternatives because such disclosure does not criticize, discredit, or otherwise discourage the solution claimed in the … application." *In re Fulton*, 391 F.3d 1195, 1201 (Fed. Cir. 2004). While Bouevitch discusses how angular displacement is disadvantageous in certain respects (*see* Ex. 1003, 2:1–7), we are not persuaded such discussion is sufficient to constitute a teaching away. To the contrary, Petitioner has shown persuasively that Bouevitch uses angular misalignment to control power in at least some embodiments of Bouevitch. Pet. Reply 4–6.

Similarly, Patent Owner's contention that Bouevitch and Sparks are "incompatible technologies" is not persuasive. *See* PO Resp. 28–30. According to Patent Owner, Bouevitch would be rendered unsatisfactory for its intended purpose "to provide *both* power optimization control *and* optimally efficient optical coupling of the beam to the output port" because Bouevitch and Sparks perform attenuation "at opposite ends of the optical system." *Id.* at 29. As Petitioner notes, Bouevitch discloses embodiments that perform power attenuation by angular misalignment of the beam using

MEMS mirrors. Pet. Reply 6. Patent Owner's articulation of the intended purpose of Bouevitch focuses on only one objective, and fails to address what Bouevitch discloses as a whole to one of skill in the art. There is no dispute that the use of a two-axis mirror includes benefits as well as costs over a one-axis mirror. "The fact that the motivating benefit comes at the expense of another benefit, . . . should not nullify its use as a basis to modify the disclosure of one reference with the teachings of another. Instead, the benefits, both lost and gained, should be weighed against one another." *Winner Int'l.*, 202 F.3d at 1349 n.8. We are not persuaded that the costs identified by Patent Owner overcome the rationale of the asserted combination provided by Petitioner. Importantly, Patent Owner does not persuasively counter Petitioner's rationale that it would have been obvious to try, because, as Mr. McLaughlin testified: (1) there were only two solutions to the known need to deflect light beams with MEMS: 1-axis or 2-axis; (2) a person of ordinary skill would have had a high expectation of success to try two-axis mirror control in Bouevitch; and (3) the result of the combination would be predictable. *See* Pet. 20–23; Reply 3–4; Ex. 1028 ¶¶ 30–34; Ex. 1029 ¶ 45.

With respect to Lin, Patent Owner argues that "Petitioner provides no *KSR* rationale." PO Resp. 7. Patent Owner's argument neglects the rationale provided by Petitioner. *See* Pet. 32–33. Patent Owner also implicates "impermissible hindsight" in the combination with Lin (*id*. at 14, 54) and argues that Petitioner fails to explain how to modify Lin's structural elements to incorporate a two-dimensional rotation (*id.* at 52–53). As explained above, however, the test for obviousness is not whether the

features of one reference may be bodily incorporated into the structure of another reference. Moreover, the references of record reflect that there routinely are complex design considerations in the fiber optic communications field. Patent Owner does not explain persuasively why combining the teachings of Sparks and Lin would be beyond the skill of a skilled artisan. We find more persuasive Petitioner's contention that Lin specifically teaches that its analog, continuous MEMS mirrors would be useful in optical switching applications like Bouevitch's and Sparks' optical switch devices. *See* Pet. Reply 21; Ex. 1010, 2:6–9; Ex. 1028 ¶ 60.

Petitioner has articulated sufficient reasoning with some rational underpinning to support the legal conclusion of obviousness based on the asserted combination of Bouevitch, Sparks, and Lin. With regard to incorporating the teaching of a two-axis mirror in Sparks with Bouevitch, we are persuaded that it is a simple substitution, notwithstanding the fact that it may require substantial engineering as a practical matter. The asserted combination of Sparks and Bouevitch and Lin yields a predictable result. *See KSR*, 550 U.S. at 416 ("The combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results.").

We are further persuaded that Petitioner has identified additional "rational underpinning" in support of the asserted combination. Mr. McLaughlin explains that the references all address optical signal switches, that "the principles of operation of the MEMS-based actuating mirrors are essentially the same except that the mirrors of Sparks are actuatable in one more axis than those of Bouevitch," and that a two-axis

mirror in place of a one-axis mirror "would yield a predictable result of the same functionality (e.g., movement of a reflective surface in a first axis) yet with more control (e.g., the reflective surface moving in a second axis in similar manner as the movement in the first axis). Ex. 1028 ¶ 31. While Lin is not necessary in light of our determination that Bouevitch also discloses continuous control, Mr. McLaughlin persuasively explains that continuously controlled analog mirrors were recognized as interchangeable with discrete step mirrors. *Id*. at 32–34; *see also* Ex. 1010, 2:7–9, 3:41–57 (discussing analog control as an alternative to binary (discrete) control of mirrors to increase the precision of the mirror placement).

Finally, Patent Owner argues that "[i]ndustry adoption is additional evidence of non-obviousness and the fact that Petitioner relies on impermissible hindsight when making the combination." PO Resp. 56–57. In particular, Patent Owner argues that "[t]he industry recognized the advantages presented in [Patent Owner's] optical configuration. *Id*. at 56. Patent Owner quotes, for example, a statement that describes Patent Owner as offering "a 10-fiber port solution." *Id.* Patent Owner offers no explanation as to how such a statement is within the scope of the claims at issue. Similarly, Patent Owner refers to a "WavePath product line" without demonstrating any of those products practice the challenged claims. *See id*. Patent Owner further argues that "experts" adopted its ROADM configuration. *Id*. at 57–59. According to Patent Owner, if certain other patents held by Mr. Laughlin and Dr. Marom "are not evidence of nonobviousness themselves, they at the least show that Mr. McLaughlin and Dr. Marom are susceptible to hindsight bias because both worked on [Patent

Owner's] optical configuration, and both were aware of the [Patent Owner's] optical configuration after [Patent Owner] disclosed it to the public." *Id.* at 60.

We agree with Petitioner that Patent Owner does not offer adequate support that such alleged "industry adoption" suggests non-obviousness, and that Patent Owner does not demonstrate any nexus to the merits of the claimed invention. *See* Pet. Reply 23–24. We likewise agree with Petitioner that, to the extent that Patent Owner is suggesting that it is providing evidence of copying, it is insufficient because Patent Owner does not present any evidence of actual copying or a nexus to any of Patent Owner's products. *See, e.g.*, *Iron Grip Barbell Co. Inc. v. USA Sports, Inc.*, 392 F.3d 1317, 1325 (Fed. Cir. 2004) ("[C]opying requires the replication of a specific product."); *see also Tokai Corp. v. Easton Enters. Inc.*, 632 F.3d 1358, 1370 (Fed. Cir. 2011). We have considered all of the evidence of non-obviousness identified by Patent Owner. For the foregoing reasons, we conclude Petitioner has established by a preponderance of the evidence that claim 1 would have been obvious over Bouevitch, Sparks, and Lin.

2. Claims 2–4

Claim 2 depends from claim 1, and further requires "a servo-control assembly, in communication with said channel micromirrors and said output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said output ports." Claim 3 depends from claim 2, and further requires "said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said output

ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors." Claim 4 depends from claim 3, and further requires that "said servo-control assembly maintains said power levels at a predetermined value."

The '678 patent states that:

> The electronic circuitry and the associated signal processing algorithm/software for such processing unit in a servo-control system are known in the art. A skilled artisan will know how to implement a suitable spectral monitor along with an appropriate processing unit to provide a servo-control assembly in a WSP-S apparatus according to the present invention, for a given application.

Ex. 1001, 12:9–15. Accordingly, the '678 patent expressly recognizes that the additional features of claims 2–4 were "known in the art" to a skilled artisan and would have been obvious to implement.

We agree with Petitioner's contention that the disclosure in Sparks of a "closed-loop servo control system" and "power measuring means" correspond to the claimed servo-control assembly and spectral monitor, and serve the same purpose. Pet. 37–43 (citing, *inter alia*, Ex. 1004, 2:59–65, 4:39–45, 4:61–67; Ex. 1028 ¶¶ 75–78).

Concerning "coupling," as claimed, we find persuasive Petitioner's explanation that:

> Sparks discusses its use of servo-control to achieve a particular degree of coupling of a channel to an output port. Sparks states "FIG. 2a illustrates how the optical beam 30 would normally be coupled into the optical fiber core 4a, which is surrounded by optical fibre cladding 4b, by the focusing lens 22. If . . . the optical beam path is misaligned, e.g. either to misalignment of one of the mirrors 16, 26 or movement of the lens 22, then FIG. 2b illustrates how only a portion of the beam

> 30 will be coupled into the optical fibre core 4a. Consequently, only the fraction of the beam profile 30 coupled into the output forms the output signal, and hence the optical signal is attenuated." (Ex. 1004 at 5:1-11.) Sparks teaches that "the optical switch is calibrated such that a predetermined misalignment produces a predetermined attenuation". (*Id.* at 2:52-53; *see also id*. at 3:15-22.) Thus, a predetermined coupling of each reflected spectral channel into an output port is maintained. (McLaughlin Decl., Ex. 1028 at ¶ 81.)

Pet. 39.

With regard to claim 4, Petitioner directs us to Sparks, which teaches "[a]n optical switch comprising switching means arranged to switch an optical signal by redirection of the optical beam path of said signal, wherein said optical switch is arranged to misalign the optical beam path so as to provide a predetermined optical output power." Pet. 43 (quoting Ex. 1004, Abstract). Petitioner also provides sufficient articulated reasoning with some rational underpinning to support the combination of the feedback loop in Sparks controller as a known alternative to "external feedback." *Id*. at 38. Petitioner further explains that the using the spectral monitor and processing unit of Sparks within the Bouevitch ROADM "would have been the mere combining of known prior art elements according to their known methods to yield predictable results." *Id.* at 42 (citing Ex. 1028 ¶¶ 85–93).

Patent Owner argues that Petitioner fails to explain how or why a person of ordinary skill would have been able to add Sparks's control features to Bouevitch. PO Resp. 54–55. As noted above, the obviousness test has no bodily incorporation requirement, and is instead focused on "what the combined teachings of the references would have suggested to those of ordinary skill in the art." *See Keller*, 642 F.2d at 425. Patent Owner

does not address the disclosure of the ’678 patent, which states that a “skilled artisan will know how to implement a suitable spectral monitor,” or the reasoning provided by Petitioner. We have considered Patent Owner’s arguments and find them to be insufficiently supported and conclusory. On the other hand, we conclude that Petitioner’s reasoning (Pet. 35–43) is sound and supported adequately by the record. Petitioner has established by a preponderance of the evidence that claims 2–4 would have been obvious over Bouevitch, Sparks, and Lin.

3. Claims 9, 10, 13, 19, and 20

Claims 9, 10, 13, 19, and 20 ultimately depend from claim 1. In addition to addressing the elements of claim 1, we agree with Petitioner’s identification of how claims 9, 10, 13, 19, and 20 would have been obvious over Bouevitch, Sparks, and Lin. Claim 9 requires that “each channel micromirror is continuously pivotable about one axis,” while claim 10 requires “each channel micromirror is pivotable about two axes.” Petitioner has shown that Bouevitch, Sparks, and Lin teach each of the features of claims 9, 10, 13, 19, and 20. Pet. 44–46, 48–49. Bouevitch discloses micromirrors continuously pivotable about one axis (Ex. 1003, 14:5–65, 15:30–34) and Sparks discloses mirrors that are continuously-pivotable in two axes (which includes “pivotable about one axis”). Ex. 1004, 4:43–47 (describing “movable micromirrors (16,26), which are fabricated using MEMS technology and are capable of two axis movement, to carefully align the beams so as to ensure that the maximum possible input optical signal is received at the output of the switch”).

Claim 13 requires that the fiber collimators "are arranged in a one-dimensional array." Both Bouevitch and Sparks disclose the claimed feature. *See* Pet. 44–46 (citing Ex. 1003 6:1–5, 13:9–18, 5:22–42, Figs. 2a, 2b, 9b–9d; Ex. 1004, 4:33–38).

Claim 19 requires that "each output port carries a single one of said spectral channels," a feature disclosed by Bouevitch. Pet. 48 (citing Ex. 1003, 14:27–15:18).

Claim 20 requires "one or more optical sensors, optically coupled to said output ports," a feature disclosed by Sparks. Pet. 48–49 (citing Ex. 1004, 2:59–65, 4:61–67, Fig. 4. We also find persuasive Petitioner's rationale for applying the optical sensors taught by Sparks to Bouevitch to "help achieve the equalization of the power levels." Pet. 49.

Patent Owner has not raised additional arguments with respect to claims 9, 10, 13, 19, and 20 beyond those asserted with respect to claim 1, addressed above. We have assessed the information provided and determine that Petitioner has established by a preponderance of the evidence that claims 9, 10, 13, 19, and 20 would have been obvious over Bouevitch, Sparks, and Lin for the same reasons discussed above with respect to claim 1.

4. Claims 21–23 and 27

Independent claim 21 recites many features substantially the same as features of claim 1, with the addition of "a servo-control assembly," as recited by claim 2. However, unlike claim 1, claim 21 does not require that the channel micromirrors be "pivotal about two axes" or that they "control the power." Petitioner provides an element-by-element analysis of each

feature of claim 21, relying in substantial part on its discussion of the same features from claims 1 and 2. Pet. 49–51. Claim 22 depends from claim 21 and requires the same additional features recited in claim 3. Claim 23 depends from claim 22 and requires the same additional features recited in claim 4. Claim 27 depends from claim 21 and requires the same additional features recited in claim 9. Petitioner contends claims 22, 23, and 27 would have been obvious for the same reasons provided with respect to claims 3, 4, and 9. *See id.* at 51–52.

Patent Owner has not raised additional arguments with respect to claims 21–23 and 27 beyond those asserted with respect to claims 1–4 and 9, addressed above. We have assessed the information provided and determine that Petitioner has established by a preponderance of the evidence that claims 21–23 and 27 would have been obvious over Bouevitch, Sparks, and Lin for the same reasons discussed above with respect to claims 1–4 and 9.

5. Claims 44–46

Independent claim 44 generally recites features substantially the same as features of claim 1, with relatively minor differences. For example, claim 1 recites a "wavelength-separating-routing apparatus" and "multiple fiber collimators," whereas claim 44 recites an "optical system comprising a wavelength-separating-routing apparatus" and "an array of fiber collimators." Unlike claim 1, claim 44 further requires "a pass-through port and one or more drop ports" among the plurality of output ports, and recites "said pass-through port receives a subset of said spectral channels."

We agree with Petitioner's contentions with respect to claim 44:

> Bouevitch also discloses that the output port can be used as the pass-through port of element 44[a] when the "modifying means"

> of the Bouevitch's ROADM allows a light beam to pass through unchanged. (Ex. 1003 at 6:20–25; []McLaughlin Decl., Ex. 1028 at ¶ 121). Bouevitch teaches another output port in the form of "OUT DROP" drop port in element 80b, port 3. [] Bouevitch also discloses additional output ports. (Ex. 1003 at 10:56–61 ("wherein each band has its own corresponding in/out/add/drop ports.") Each of these ports is provided by and comprised of microlens microcollimators. (McLaughlin Decl., Ex. 1028 at ¶ 121.)

Pet. 54. Claim 45 depends from claim 44 and requires the same additional features recited in claim 2. Claim 46 depends from claim 45 and requires the same additional features recited in claim 3.

Patent Owner has not raised additional arguments with respect to claims 44–46 beyond those asserted with respect to claims 1–3, addressed above. We have assessed the information provided and determine that Petitioner has established by a preponderance of the evidence that claims 44–46 would have been obvious over Bouevitch, Sparks, and Lin as discussed above, and for the same reasons provided with respect to claims 1–3.

6. Claims 61–65

Claim 61 is a method claim that parallels the features of claim 1. For example, claim 1 recites "a wavelength-separator, for separating said multi-wavelength optical signal from said input port into multiple spectral channels," whereas claim 61 recites "separating said multi-wavelength optical signal into multiple spectral channels." Petitioner contends, and Patent Owner does not dispute, that the only substantive difference between claim 1 and claim 61 is the replacement of the term "individually and continuously controllable" in claim 1 with "dynamically and continuously

controlling" in claim 61. Pet. 55. Petitioner has demonstrated that both Bouevitch and Sparks disclose "dynamically" controlling. We agree with Petitioner's contentions with respect to claim 61:

> Both Bouevitch and Sparks teach dynamic control during operation. (McLaughlin Decl., Ex. 1028 at ¶ 135). Bouevitch's device can be used as a "dynamic gain equalizer and/or configurable add/drop multiplexer," which includes dynamic control of the mirrors that perform those actions. (Ex. 1003 at 2:24–25.) Sparks teaches closed-loop 2-axis control (Ex. 1004 at 4:39–47) which the [person of ordinary skill] would have understood to mean making adjustments to the deflection of the beam in response to real-time monitoring of the channel power level. (McLaughlin Decl., Ex. 1028 at ¶ 135.)

Pet. 58.

Claim 62 depends from claim 61 and, similar to claim 2, further requires "the step of providing feedback control of said beam-deflecting elements to maintain a predetermining coupling of each spectral channel directed into one of said signal output ports." We agree with Petitioner that "Sparks discloses this feedback control in the form of a control means 130 that receives feedback from an power measuring means 130 (Ex. 1004 at 4:65–67; *see also id.* at Fig. 4; McLaughlin Decl., Ex. 1028 at ¶ 136.)." Pet. 59.

Claim 63 depends from claim 62 and substantively requires the same additional features recited in claim 4. Claim 64 depends from claim 62 and substantively requires the same additional features recited in claim 19. Claim 65 depends from claim 61 and requires the same additional features recited in claim 44.

Patent Owner has not raised additional arguments with respect to claims 61–65 beyond those asserted with respect to claims 1, 2, 4, 19, and 44

addressed above. We have assessed the information provided and determine that Petitioner has established by a preponderance of the evidence that claims 61–65 would have been obvious over Bouevitch, Sparks, and Lin as discussed above, and for the same reasons provided with respect to claims 1, 2, 4, 19, and 44. *See* Pet. 55–60.

D. Asserted Obviousness Over Bouevitch, Sparks, Lin, and Dueck

Petitioner contends claims 17, 29, and 53 would have been obvious over Bouevitch, Sparks, Lin, and Dueck. Pet. 46–48, 52, 55. Claim 17, which depends from claim 1, and claim 53, which depends from claim 44, both further require "said wavelength-separator comprises an element selected from the group consisting of ruled diffraction gratings, h[o]lographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing gratings."[8] Claim 29 contains essentially the same recitation, but refers to "dispersing prisms" in place of "dispersing gratings."

Petitioner contends that any of the types of wavelength-selective devices recited in claim 17 would have been obvious because "[e]ach type was known in the prior art, each was interchangeable as a wavelength-selective device, and each was one of a small set of possible choices." Pet. 47 (citing Ex. 1028 ¶ 101). Petitioner also contends that Bouevitch discloses the claimed wavelength selective device by disclosing the use of dispersing gratings. Pet. 47. Patent Owner does not dispute that Bouevitch discloses the additional elements of claims 17, 29, and 53. Petitioner also asserts that Dueck discloses "ruled diffraction gratings," as claimed. *Id.*; Ex. 1021, 6:26–30. Petitioner further asserts that it would have been

[8] Claim 17 appears to misspell "holographic" as "halographic."

obvious to try Dueck's ruled diffraction gratings in the devices of Bouevitch and Sparks because it represents the "best mode" of separating wavelengths in WDM devices. *Id.* at 47–48.

Patent Owner argues that a person of ordinary skill would not have been motivated to use Dueck's diffraction grating. PO Resp. 30–32. According to Patent Owner, Dueck discloses a diffraction grating that reflects an input light beam to an output port at very nearly the same angle as the incident angle. *Id*. at 30. Patent Owner reasons that because no configuration shown in Bouevitch is designed to reflect a light beam at the same angle as Dueck, there is no motivation to use Dueck's diffraction grating in Bouevitch. *Id*. at 31–32. In reply, Petitioner asserts that Dueck was relied on "to show that ruled diffraction gratings were one of a small set of known and interchangeable choices." Pet. Reply 8. As noted above, the obviousness test has no bodily incorporation requirement, and is instead focused on "what the combined teachings of the references would have suggested to those of ordinary skill in the art." *In re Keller*, 642 F.2d at 425. While the particular configuration of the ruled diffraction grating in Dueck may not be incorporated readily into Bouevitch, Dueck nonetheless discloses the broader concept of a ruled diffraction grating. Indeed, Dr. Sergienko testified that a ruled diffraction grating could have been used in Bouevitch, as well as holographic diffraction grating, or an echelle grating, as they are all reasonable substitutes for one another and would be expected to work. *See* Ex. 1051, 256:13–259:7.

We have assessed the information provided and determine that Petitioner has established by a preponderance of the evidence that claims 17,

29, and 53 would have been obvious over Bouevitch, Sparks, Lin, and Dueck.

E. Conclusion

Petitioner has shown by a preponderance of the evidence that claims 1–4, 9, 10, 13, 19–23, 27, 44–46, and 61–65 would have been obvious over Bouevitch, Sparks, and Lin, and that claim 17, 29, and 53 would have been obvious over Bouevitch, Sparks, Lin, and Dueck.

IV. MOTIONS TO SEAL

Petitioner and Patent Owner filed a joint motion to seal Exhibit 2032, along with a proposed protective order. Paper 17. Petitioner also filed a motion to Seal (Paper 22) directed to its Motion to Re-Caption the Proceeding (Paper 20). Patent Owner also filed a motion to seal Exhibit 2035. Paper 28. Redacted copies of Exhibits 2032 and 2035 and Paper 20 were also filed. We hereby grant entry of the parties' Stipulated Protective Order.

There is an expectation that information will be made public where the information is identified in a final written decision, and that confidential information that is subject to a protective order ordinarily becomes public 45 days after final judgment in a trial, unless a motion to expunge is granted. 37 C.F.R. § 42.56; Office Patent Trial Practice Guide, 77 Fed. Reg. 48,756, 48,761 (Aug. 14, 2012). In rendering this Final Written Decision, it was not necessary to identify, nor discuss in detail, any confidential information. However, a party who is dissatisfied with this Final Written Decision may appeal the Decision pursuant to 35 U.S.C. § 141(c), and has 63 days after the date of this Decision to file a notice of appeal. 37 C.F.R. § 90.3(a). Thus, it

remains necessary to maintain the record, as is, until resolution of an appeal, if any.

In view of the foregoing, the confidential documents filed in the instant proceeding will remain under seal, at least until the time period for filing a notice of appeal has expired or, if an appeal is taken, the appeal has concluded. The record for the instant proceeding will be preserved in its entirety, and the confidential documents will not be expunged or made public, pending appeal. Notwithstanding 37 C.F.R. § 42.56 and the Office Patent Trial Practice Guide, neither a motion to expunge confidential documents nor a motion to maintain these documents under seal is necessary or authorized at this time. *See* 37 C.F.R. § 42.5(b).

V. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that, based on a preponderance of the evidence, claims 1–4, 9, 10, 13, 17, 19–23, 27, 29, 44–46, 53, and 61–65 of U.S. Patent No. RE42,678 are unpatentable;

FURTHER ORDERED that the Stipulated Protective Order of the parties is entered;

FURTHER ORDERED that the Joint Motion to Seal Exhibit 2032 is granted;

FURTHER ORDERED that Petitioner's Motion to Seal Paper 20 is granted;

FURTHER ORDERED that Patent Owner's Motion to Seal Exhibit 2035 is granted; and

FURTHER ORDERED that, because this is a Final Written Decision, the parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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