

United States District Court,
D. New Jersey.

GLOBESPANVIRATA, INC,
Plaintiff.

v.

**TEXAS INSTRUMENT, INC., The Leland Stanford Junior University and its Board of Trustees, and
Stanford University OTL, LLC,**
Defendants.

TEXAS INSTRUMENT, INC,
Counterclaimant.

v.

**GLOBESPANVIRATA, INC. and Conexant Systems,
Inc.** Counterclaim Defendants.

No. Civ.03-2854(GEB)

April 7, 2005.

Background: Patentee brought action against electronics company and research university, alleging infringement of patent pertaining to multicarrier modulation transmission systems.

Holdings: The District Court, Brown, J., held that:

- (1) term "a programmed and possibly frequency-variable transmit power mask" was construed to mean "a programmed limit on the maximum amount of power to be transmitted in each of the several carriers which can vary by carrier;
- (2) term "the programmed power mask" was construed to mean "a programmed limit on the maximum amount of power to be transmitted in each of the several carriers which can vary by carrier;
- (3) term "power or power-spectral-density constraint" was construed to mean "an absolute limit in the transmitter power or a limit in maximum transmit power allowed at particular frequencies; and
- (4) term "subcarrier-indexed estimates of transmission quality" did not require that measurements of estimates be determined by any of four factors enumerated in patent preamble.

Judgment entered accordingly.

Court-Filed Expert Resumes

5,479,447. Construed.

Robert J. Stickles, Klett, Rooney, Lieber & Schorling, PC, William B. McGuire, Brian M. English, Tompkins McGuire Wachenfeld & Barry LLP, Thomas F. Doherty, McCarter & English, LLP, Newark, NJ, for Plaintiff.

MARKMAN OPINION

BROWN, J.

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INTRODUCTION

This is a case involving antitrust and patent infringement claims. On June 12, 2003, Plaintiff Globespanvirata, Inc. ("Plaintiff") filed suit against Defendants Texas Instruments, Inc., The Leland Stanford Junior University and its Board of Trustees, and Stanford University OTL, LLC (collectively referred to as "Defendants"). On July 6, 2004, Plaintiff filed an Amended Complaint, alleging violations of antitrust laws including, *inter alia*, monopolization and unlawful conspiracy in restraint of trade in violation of the Sherman Act s. 1. (Pl.'s 1st Am. Compl.). Plaintiff also seeks a declaratory judgment of non-infringement, invalidity and unenforceability of the patents. (*Id.*). Defendants filed an Amended Answer on July 30, 2004 and asserted counterclaims against Plaintiff. Defendants allege that Plaintiff's products infringe three patents which are owned by Defendants. (Defs.' Answer & Countercl.). The Court bifurcated the case-staying the antitrust phase of the litigation until the infringement claims are resolved. Proceeding with the patent infringement phase of this lawsuit, the parties asked this Court to construe the disputed patent claim terms pursuant to *Markman v. Westview Instruments, Inc.*, 52 F.3d 967 (Fed.Cir.1995) (*en banc*), *aff'd*, 517 U.S. 370, 116 S.Ct. 1384, 134 L.Ed.2d 577 (1996).

On September 2, 2004, the parties timely filed their Opening Claim Construction briefs with the Court. Thereafter, the parties submitted their Reply briefs on September 23, 2004. FN1 After having reviewed the submissions and concluding that the parties did not clearly identify the disputed claim terms and issues, the Court requested that the parties submit a Joint Claim Construction Chart ("Chart") clearly setting forth the disputed issues. On January 20, 2005, the parties jointly submitted the Chart which identified a total of thirty-five disputed claim terms, Plaintiff and Defendants' proposed constructions for each term, and also stipulated to the construction of several other terms. A *Markman* hearing was held on January 31, 2005.

FN1. Defendants sought permission to resubmit their Reply brief because their initial filing exceeded the page limitation. This Court granted permission and their revised Reply was filed on September 27, 2004.

BACKGROUND

There are three patents-in-suit. All of the patents relate to the field of digital communications, specifically data transmission using multicarrier modulation transmission systems. The inventions represent advancements in digital subscriber line ("DSL") and asymmetric digital subscriber line ("ADSL") technology, which enable large amounts of digital data to be transmitted over regular telephone lines. FN2 DSL/ADSL technology is a key factor in the improvement of telecommunication services-one of the most notable and widely used being high-speed Internet access. The patents are aimed at increasing the speed and reliability of the transmission of data in DSL/ADSL technology and other telecommunication systems.

FN2. ADSL technology concerns a system in which greater transmission capacity is available in the downstream transmission of data from the telephone network or central office, to the customer premises, as opposed to the reverse direction. This resulted from the recognition that individual subscribers download information into their home or office more often than they upload information to the telephone network. (Pl.'s Opening Br. at 3 (citing Hartogs Report, para. 14-15, 19)).

The first patent-in-suit, U.S. Patent No. 5,479,447, is entitled "Method and Apparatus for Adaptive, Variable Bandwidth, High-Speed Data Transmission of a Multicarrier Signal Over Digital Subscriber

Lines." U.S. Patent No. 5,479,447 (issued Dec. 26, 1995) ("the '447 Patent"). The patent issued from the U.S. Patent and Trademark Office ("PTO") on December 26, 1995. It issued from Application No. 57,301, which was filed with the PTO on May 3, 1993. Peter S. Chow and John M. Cioffi are the named inventors. Defendant The Board of Trustees of the Leland Stanford Junior University owns the '447 Patent. Defendant Texas Instruments, Inc. ("TI") is an exclusive licensee who has the right to bring an action for infringement based on this patent. The patent discloses two principle objectives of the invention. The first is "to provide a method and apparatus for calculating the optimal transmission bandwidth during on-line system initialization." '447 Patent, col. 5, ll. 32-36. The second objective is that the method and apparatus are "real-time adaptive during normal system operation, with continuous data transmission, to compensate for changes in transmission medium characteristics." Id. at col. 5, ll. 38-41. The patent describes the concept of a continuously adaptive transmitter working in conjunction with a continuously adaptive receiver as distinct over the prior art. Id. at col. 6, ll. 2-5.

The second patent-in-suit, U.S. Patent No. 5,400,322, is entitled "Updating of Bit Allocations in a Multicarrier Modulation Transmission System." U.S. Patent No. 5,400,322 (issued Mar. 21, 1995) ("the '322 Patent"). The patent issued from the PTO on March 21, 1995. It issued from Application No. 109,489, which was filed with the PTO on August 20, 1993. Ronald R. Hunt and Peter S. Chow are the named inventors. TI is the owner of this patent. The object of the invention is "to provide an improved method of updating allocations of bits to carriers in a transmission system using multicarrier modulation." '322 Patent, col. 2, ll. 40-42. Updating bit allocations is necessary in this type of system to respond to the varying signal-to-noise ratios ("SNRs"), which result from changes in the temperature or traffic on the transmission channels. The invention provides the desirable effect of updating bit allocations to accommodate such changes in the channels.

The third patent-in-suit, U.S. Patent No. 5,596,604, is entitled "Multicarrier Modulation Transmission System with Variable Delay." U.S. No. Patent 5,596,604 (issued Jan. 21, 1997) ("the '604 Patent"). The patent issued from the PTO on January 21, 1997. It issued from Application No. 107,200, which was filed with the PTO on August 17, 1993. John M. Cioffi, Po Tong, James T. Aslanis and Antoinette H. Gooch are the named inventors. TI also owns this patent. The invention addresses a problem known in the art as impulse noise, which causes errors on transmission channels. '604 Patent, col. 1, ll. 57-67. To reduce errors caused by impulse noise, the invention employs techniques known as forward error correction coding ("FECC") and codeword interleaving. The patent contemplates the application of these techniques in a manner that results in the maintenance of high reliability and minimized transmission delay for the various types of data signals. Id., col. 2, ll. 25-27.

DISCUSSION

I. LAW OF CLAIM CONSTRUCTION

The first step in a patent infringement analysis is to define the meaning and scope of the claims of the patent. *Markman v. Westview Instruments, Inc.*, 52 F.3d 967, 976 (Fed.Cir.1995) (*en banc*), *aff'd*, 517 U.S. 370, 116 S.Ct. 1384, 134 L.Ed.2d 577 (1996). Claim construction, which serves this purpose, is a matter of law exclusively for the court. Id. at 979. When construing claims, the court must first consider the intrinsic evidence. Specifically, the focus of the court's analysis must begin and remain on the language of the claims, "for it is that language that the patentee chose to use to 'particularly point[] out and distinctly claim[] the subject matter which the patentee regards as his invention.'" *Interactive Gift Express, Inc. v. Compuserve, Inc.*, 256 F.3d 1323, 1331 (Fed.Cir.2001) (quoting 35 U.S.C. s. 112, para. 2).

Generally, there is a presumption that the words of a claim will receive the full breadth of its ordinary meaning. *NTP, Inc. v. Research In Motion, Ltd.*, 392 F.3d 1336, 1346 (Fed.Cir.2004). The ordinary meaning may be derived from a variety of sources including the claim language, the written description, drawings, the prosecution history, and dictionaries or treatises. FN3 *Id.* The presumption may be rebutted if the patentee acted as his or her own lexicographer by clearly setting forth a definition of the claim term unlike its ordinary and customary meaning. *Brookhill-Wilk 1, LLC. v. Intuitive Surgical, Inc.*, 334 F.3d 1294, 1298-99 (Fed.Cir.2003). Any intent by the patentee to redefine a term must be expressed in the written description, and must be sufficiently clear. *Merck & Co, Inc. v. Teva Pharms. USA, Inc.*, 395 F.3d 1364, 1370 (Fed.Cir.2005). The presumption may also be overcome "if the inventor has disavowed or disclaimed scope of coverage, by using words or expressions of manifest exclusion or restriction, representing a clear disavowal of claim scope." *Brookhill-Wilk*, 334 F.3d at 1299. To ascertain the true ordinary meaning of a term, one must not refer to relevant dictionaries in isolation, but more importantly, in the context of its surrounding text in the claim, the written description and the prosecution history. *Brookhill-Wilk*, 334 F.3d at 1300; *NTP, Inc.*, 392 F.3d at 1346. Such intrinsic evidence should be "examined through the viewing glass of a person skilled in the art." *Brookhill-Wilk*, 334 F.3d at 1300.

FN3. The Court notes at the outset that neither Plaintiff nor Defendants cited to the prosecution histories of any of the patents-in-suit in their Claim Construction briefs. Therefore, the prosecution histories were not submitted as evidence to the Court prior to the *Markman* hearing. The parties relied on the claim language, the specification, and expert opinions in support of their arguments. At the hearing, however, Globespan introduced a portion of the prosecution history for the '447 Patent to support one of its proposed constructions. This is discussed in Part II.A.4 of this Opinion.

In consulting dictionaries to discern the ordinary meaning, such reference should be limited to dictionaries that are contemporaneous with the patent. *Brookhill-Wilk*, 334 F.3d at 1299. Dictionaries published after the patent issued may not accurately reflect the meaning of a term to a person of ordinary skill in the art as of the grant of the patent, and therefore should not be considered in a claim construction analysis. *Id.* If more than one possible dictionary definition exists, the claim term may be interpreted to encompass all definitions if they are consistent with the usage of the term in the intrinsic record. *Id.* at 1300; *Texas Digital Sys., Inc. v. Telegenix, Inc.*, 308 F.3d 1193, 1203 (Fed.Cir.2002).

The court may consult extrinsic evidence, including expert opinion, to guide its comprehension of the relevant technology in accordance with the understanding of a skilled artisan. *Altiris, Inc. v. Symantec Corp.*, 318 F.3d 1363, 1369 (Fed.Cir.2003). Such evidence, however, need not be considered by the court if it is able to determine the ordinary meaning based on the intrinsic evidence and appropriate dictionaries or treatises. *Vitronics Corp. v. Conceptrons, Inc.*, 90 F.3d 1576, 1583 (Fed.Cir.1996). Moreover, extrinsic evidence may not be relied upon to contradict or vary the meaning of the term as used in the claim. *Altiris*, 318 F.3d at 1369.

Lastly, the court must be mindful of the well-settled rule "that while proper claim construction requires an examination of the written description and relevant prosecution history to determine the meaning of claim limitations, additional limitations may not be read into the claims." *Storage Tech. Corp. v. Cisco Sys., Inc.*, 329 F.3d 823, 831 (Fed.Cir.2003); *see also* *In re Donaldson Co.*, 16 F.3d 1189, 1195 (Fed.Cir.1994) (noting the "general claim construction principle that limitations found only in the specification of a patent or patent application should not be imported or read into a claim."). FN4

FN4. On February 8, 2005, the Federal Circuit held an *en banc* hearing in the matter of Phillips v. AWH Corp., 376 F.3d 1382 (Fed.Cir. July 21, 2004). The court's ruling is anticipated to provide clarification in claim construction law, including how dictionaries should be used in a claim construction analysis. Until the Federal Circuit issues its ruling, the Court will adhere to the general principles outlined in this Opinion which follow the current and binding Federal Circuit precedent.

II. THE DISPUTED CLAIM TERMS

A. The '447 Patent

The first seven disputed claim terms are found in Claims 1 and 2 of the '447 Patent. Claim 1, an independent claim, and Claim 2, a dependent claim, read as follows:

1. In a multicarrier data transmission system that transmits data continuously over dispersive, noisy subscriber loops for digital service from a telephone central office to a user location and corresponding digital service between transmitters and receivers at said user location and said central office, a method for implementing variable transmission bandwidth as a function of line frequency-variable attenuation, noise power spectrum, a set of programmed and possibly variable carrier target bit-error-rates, and a programmed and possibly frequency-variable transmit power mask to improve data transmission speed or to improve performance margin at any given transmission speed subject to a power or power-spectral-density constraint, said method using subcarrier-indexed measurements of channel gains, channel noises, desired carrier bit-error-rates, and the programmed power mask to provide subcarrier-indexed estimates of transmission quality and to maintain the transmission quality at high levels, comprising the steps of:

(a) sorting the subcarrier-indexed estimates of the transmission quality, scaled by the desired subcarrier bit-error-rates, into an invertible ordering for assessment of the relative data-carrying capabilities of the subcarriers at initialization and/or during data transmission;

(b) calculating bit and energy allocation tables for said multicarrier data transmission system based on the sorted subcarrier-indexed estimates for either improving aggregate transmitted data rate as fixed performance margin with said power or power-spectral-density constraint, or improving performance margin at a fixed data rate with said power or power-spectral-density constraint;

(c) communicating said bit and energy allocation tables between the transmitters and the receivers of said multicarrier transmission systems; and

(d) implementing said bit and energy allocation tables in coordination between the transmitters and the receivers during initialization of said multicarrier transmission system and/or during simultaneous transmission of said digital data by said multicarrier transmission system.

2. A multicarrier transmission system as recited in claim 1 and further comprising the steps of:

communicating changes in bit allocation by removing a single or several bits from those bits allocated to a carrier or subcarrier with a quality estimate below a specified threshold and placing that bit or bits on a second subcarrier or carriers with a quality estimate exceeding a second specified threshold; and

coordinating the implementation of said changes in both the transmitters and the receivers by

communication through a bi-directional overhead data channel, said overhead data channel being simultaneously present with the user data channel on the same communication line.

'447 Patent, col. 12, l. 54-col. 13, l. 41.

1. "*a programmed and possibly frequency-variable transmit power mask*"

[1] The first disputed claim term is found in both Claims 1 and 2. The parties initially posed two issues before the Court-specifically, whether the term is a claim limitation and if so, what is the proper construction. At the *Markman* hearing, however, the parties agreed that the true dispute centers around the first issue. Defendants argue that the term "a programmed and possibly frequency-variable transmit power mask," which appears in the preamble portion of Claim 1, is not a claim limitation and therefore does not require construction. Plaintiff asserts that the term is a claim limitation. As indicated at the hearing, the Court will construe the claim term, but will reserve its decision at this juncture as to whether the term is a limitation. FN5 (*See* Tr. of *Markman* Hearing at 14:1-21 ("Tr.")). Accordingly, the Court adopts the construction to which the parties stipulated at the hearing. (*See id.* at 9:19-10:6.) Therefore, the meaning of disputed term [1] "a programmed and possibly frequency-variable transmit power mask" is "a programmed limit on the maximum amount of power to be transmitted in each of the several carriers which can vary by carrier." FN6

FN5. The parties are instructed to raise this issue again in their appropriate post- *Markman* hearing motions should this issue remain disputed.

FN6. Throughout the Opinion, bracketed numbers refer to the corresponding number of the disputed term as referenced in the Chart.

2. "*the programmed power mask*"

[2] With regard to the second disputed claim term, the parties stipulated at the *Markman* hearing that if the Court determines that the term is a claim limitation, it should be construed in the same manner as the first disputed term. (*See* Tr. at 5:1-9). The Court will likewise reserve its decision regarding the claim limitation issue and will adopt the parties' stipulated construction. Accordingly, disputed term [2] "the programmed power mask" means "a programmed limit on the maximum amount of power to be transmitted in each of the several carriers which can vary by carrier."

3. "*power or power-spectral-density constraint*"

[3] With regard to the third disputed claim term, Plaintiff does not offer a proposed construction, but rather asserts that it is indefinite and invalid. Plaintiff interprets Defendants' proposed construction as one that is "effectively synonymous" with the meaning of "power mask." (Pl.'s Reply at 11). Based on the claim language and specification, Plaintiff asserts that the terms "power-spectral-density constraint" and "power mask" cannot be synonymous. (Pl.'s Reply at 11; Tr. at 19:15-20:5).

Plaintiff is correct. It is clear, however, that Defendants do not propose that "power constraint" and "power mask" mean the same thing. At the hearing, Defendants described the system as having a "power constraint" which serves as an overall limit to the transmitter, as well as a "power mask" which limits the power in

each individual carrier. (Tr. at 17:9-13, 18:1-2). Further, the plain language of Claim 1 clearly differentiates between the terms "power mask" and a "power or power-spectral-density constraint." Moreover, the specification also differentiates between these terms:

When given a set of initial SNR estimates of the orthogonal carriers of a multicarrier communication system, a set of target bit error rates for the carriers, and an arbitrary *transmit power mask* together with an overall transmit *power constraint*, the present invention provides a method of determining the initial bit and energy allocations, and therefore the corresponding bandwidth.

'447 Patent, col. 7, ll. 11-17 (emphases added). Therefore, these terms are not interchangeable.

Regarding the proper construction of "power or power-spectral-density constraint," Defendants propose that the term should be read in the disjunctive. Specifically, Defendants argue that the transmitter is subject to either a "power constraint" or a "power-spectral-density constraint." FN7 (Tr. at 16:13-24). A plain reading of the claim language supports this proposition. Defendants submit that "power constraint" refers to "an absolute limit on the transmitter power," and "power-spectral-density constraint" is "one that may vary by frequency." (*Id.*). Defendants noted at the hearing that this definition for "power constraint" directly originates from the specification. The basis of Defendants' definition for "power-spectral-density constraint," however, is unclear.

FN7. At the hearing, Defendants requested that they modify their proposed construction as set forth in the Chart. (Tr. at 15:24-16:11). The modified construction, however, is identical to the original construction advanced in Defendants' Opening Brief. *Compare* Defs.' Opening Br. at 37 ("[a] limit on maximum power allowed at particular frequencies"), *with* Tr. at 16:5-6 ("maximum power allowed at particular frequencies").

The Court agrees with Defendants' construction of "power constraint" as a limit of maximum power based on the specification. A preferred embodiment of the invention, as explained in the specification, describes an algorithm associated with the initialization procedure. This states that the mathematical term E_{target} equals the "total input energy, or power constraint at the transmitter," and E_{maxj} is the "maximum energy, or power, allowable in [a] carrier due to the transmit power mask." '447 Patent, col. 8, ll. 17-22; col. 9, ll. 49-54. Thus, it appears that E_{target} is the maximum amount of energy at the transmitter and E_{maxj} is the maximum energy that can be used by each individual carrier. Additionally, the specification states that "in no event is $[E_{\text{target}}/k$ (k being the number of used carriers)] greater than the allowable amount of individual carrier transmit energy due to the power mask." '447 Patent, col. 8, ll. 25-27. This description comports with Defendants' proposed construction for "power constraint."

The Court is then left to determine the proper construction of "power-spectral-density constraint." In defining this term, the record is limited to several dictionary definitions cited by Defendants, the claim language, specification, and the opinion of Defendants' expert, Tim A. Williams, Ph.D. ("Dr. Williams"). Defendants' proffered construction is based on a series of dictionary definitions. Such definitions, however, are taken from dictionaries that were published well after the patent issued. The Federal Circuit noted that reliance on dictionaries and treatises should be limited to those that are contemporaneous with the patent. *Brookhill-Wilk*, 334 F.3d at 1299 (declining consideration of references published after the date of the patent grant because they did not reflect the definitions that would have been given to them by a person of ordinary skill in the art). In the present case, the '447 Patent was filed in May 1993 and issued in December

1995. Defendants submitted references dated between 1998 and 2004. As such, the Court will not consider these references in its claim construction analysis.

The claim language and specification is devoid of a clear meaning for "power-spectral-density constraint." As a result, the Court is left with the expert opinion of Dr. Williams for insight as to how a skilled artisan would interpret this term. Dr. Williams opines that a person of ordinary skill in the digital communications field would interpret "power-spectral-density constraint" to mean "a limit for the maximum transmit power allowed at particular frequencies." (Williams Report, para. 140). In light of the absence of contradictory evidence in the claims and the specification, the Court will accept Dr. Williams' opinion as indicative of the proper construction.

Therefore, based on the evidence set forth in the record, the Court will adopt Defendants' proposed construction for this term. Accordingly, disputed term [3] "power or power-spectral-density constraint" means "an absolute limit in the transmitter power or a limit in maximum transmit power allowed at particular frequencies."

4. "*subcarrier-indexed estimates of transmission quality*"

[4] The next disputed term appears in both the preamble and body of Claim 1. The issue presented with respect to this term is whether the "subcarrier-indexed estimates of transmission quality" must be measured by the four factors appearing in the preamble, namely channel gains, channel noises, desired carrier bit-error-rates, and the programmed power mask. (*See* Tr. at 24:1-19, 28:8-20).

Plaintiff contends that this term is a claim limitation because the antecedent basis for the term appearing in the body of the claim, specifically in step (a), is derived from the term in the preamble. '447 Patent, col. 13, ll. 2-6. At the hearing, Plaintiff introduced the prosecution history for the '447 Patent in support of its proposition.FN8 The prosecution history shows that Claims 1 through 15 of the '447 Patent were initially rejected by the PTO under 35 U.S.C. s. 112. The PTO indicated that the original term that appeared in the body of the claim, namely "the measured subscriber channel quality estimates," lacked a clear antecedent basis. *See* Office Action dated June 21, 1994 at 2. In response to the Office Action, the patentees amended the claim by adding "subcarrier-indexed estimates of the transmission quality" to both the preamble and body of the claim.

FN8. The Court notes that this evidence was not contained in the record prior to the *Markman* hearing. Neither Plaintiff nor Defendants relied on any prosecution history evidence to support their claim construction arguments, despite having been given an opportunity to revise their written submissions prior to the hearing. Although Globespan submits this evidence at a late stage, the Court will nonetheless consider it, particularly since Defendants did not object at the hearing. (*See* Tr. 29:1-31:10).

Unfortunately, what the PTO's reaction was to that amendment remains a mystery. Did the PTO allow the claims, recognizing that the amendment added sufficient specificity to the claims? Or, did the PTO require more? Because Plaintiff failed to submit the complete prosecution history, the Court does not know the answer to these simple, but potentially dispositive questions. Nonetheless, assuming *arguendo* the answer to the first question is in the affirmative, Plaintiff then argues that the method encompassed by Claim 1 incorporates the limitations associated with the term as set forth in the preamble. Plaintiff characterizes this as a "clear prescribed method [] for determining sub-carrier quality estimates." (Tr. at 28:8-10). Thus,

Plaintiff argues that the claim requires the estimates of transmission quality be determined "by reference to channel gains, channel noises, desired carrier bit-error-rates, and the programmed power mask." (Tr. at 28:17-20; *see also* Chart at 2).

Conversely, Defendants argue that the claim does not require the estimates to be based on these four factors. Rather, Defendants assert that the subcarrier-indexed estimates may be measured using a variety of methods, some of which may include all or none of the factors listed in the preamble. According to Defendants, estimates may be measured simply by SNRs. Defendants contend that the specification clearly supports their argument. It states the following:

When *given a set of initial SNR estimates* of the orthogonal carriers of a multicarrier communication system, a set of target bit error rates for the carriers, and an arbitrary transmit power mask together with an overall transmit power constraint, the present invention provides a method of determining the initial bit and energy allocations, and therefore the corresponding transmission bandwidth.

'447 Patent, col. 7, ll. 10-17 (emphasis added). Defendants argue that nothing in the specification suggests that the "set of initial SNR estimates" must be measured by channel gains, channel noises, desired carrier bit-error-rates, and the programmed power mask-factors which only appear in the preamble.

This Court agrees with Defendants. Generally, a preamble is a limitation of the invention if it "recites essential structure or steps, or if it is necessary to give life, meaning, and vitality to the claim." *Catalina Mktg. Int'l v. Coolsavings.com, Inc.*, 289 F.3d 801, 808 (Fed.Cir.2002) (quotations omitted). However, if the patentee's use of the preamble merely states an intended purpose or use, and the patentee defined a structurally complete invention in the body of the claim, the preamble is not limiting. *Id.* Furthermore, although claim scope may be limited if a particular disputed term derives antecedent basis from the preamble, the Court's determination must be based on an examination of the patent as a whole, "to gain an understanding of what the inventors actually invented and intended to encompass by the claim." *Id.* (citing *Corning Glass Works v. Sumitomo Elec. U.S.A., Inc.*, 868 F.2d 1251, 1257 (Fed.Cir.1989)).

This Court concludes that "subcarrier-indexed estimates of transmission quality" need not be measured by any of the four factors listed in the preamble. Although the prosecution history suggests that the claim was amended to include an antecedent basis in the preamble for the disputed term, this alone does not support Plaintiff's contention that the claim should be read to require the four factors. Simply because the term appears in the preamble, the Court is not required to import all the words surrounding the term. Plaintiff has not cited any case law that would suggest otherwise. Additionally, and perhaps more importantly, the claim language itself, specifically the language contained in Claims 5 and 6, indicate that subcarrier quality estimates may be made "through the computation of an average signal-to-noise measure on a subcarrier ... [or] ... the computation of an average signal-to-noise ratio multiplied by a subcarrier dependent programmed reliability factor...." '447 Patent, col. 13, l. 65-col. 14, l. 10. Thus, the claims themselves demonstrate that subcarrier-indexed estimates of transmission quality need not be measured by four factors, but may be measured, for example, through the computation of SNRs. This comports with Defendants' assertion.

Furthermore, one of the preferred embodiments described in the specification shows why Plaintiff's argument is incorrect. The preferred embodiment describes an algorithm consisting of several steps involved in the initialization procedure. '447 Patent, col. 7, l. 35-col. 8, l. 56. The first step involves computing SNR estimates, or estimates of transmission quality. The fifth step involves the maximum energy allowable in the carrier as defined by the power mask. Plaintiff's requirement that the estimates be measured based on,

among other things, the power mask would effectively exclude this preferred embodiment from the claim scope, since it is not until after the calculation of estimates that the power mask comes into play.

As the Federal Circuit has articulated, "a claim construction that would exclude the preferred embodiment 'is rarely, if ever, correct and would require highly persuasive evidentiary support.'" *Rexnord Corp. v. Laitram Corp.*, 274 F.3d 1336, 1342 (Fed.Cir.2001) (quoting *Vitronics Corp. v. Conceptor, Inc.*, 90 F.3d 1576, 1583 (Fed.Cir.1996)). Plaintiff has not shown sufficient evidence to support its narrow construction. Accordingly, it must be rejected. Therefore, this Court concludes that disputed term [4] "subcarrier-indexed estimates of transmission quality" does not require that the measurements of the estimates be determined by any of the four factors enumerated in the preamble.

5. "sorting the subcarrier-indexed estimates of the transmission quality, scaled by the desired subcarrier bit-error-rates, into an invertible ordering" FN9

FN9. The parties stipulated that the meaning of "*bit-error-rates*" is "on average, the ratio of the number of bits in error to the total number of bits received." (Chart at 16).

The dispute with respect to this term concerns the proper meaning of "sorting." Plaintiff submits that this term means "reordering the subcarrier-indexed estimates of the transmission quality, which have been scaled by the desired subcarrier bit-error-rates, into an arrangement of transmission quality estimates that is capable of being put back into the original subcarrier-indexed order." (Chart at 2). In essence, Plaintiff argues that the term "sorting" as used in the claim means "reordering" or "sorting into a new order ." (Pl.'s Opening Br. at 10-11).

Plaintiff relies on the claim language and the opinion of its expert, Dirk Hartogs, Ph.D. ("Dr.Hartogs"). Dr. Hartogs opines that a person of ordinary skill in the art would understand "that the term 'sorting' as used in Claim 1 requires a re-ordering of the subcarrier-indexed estimates of transmission quality for each carrier." (Hartogs Report, para. 41). Dr. Hartogs heavily relies upon an example of the invention as illustrated in the preferred embodiment. It states: "[s]ort the resulting $SNR(i)/(\gamma)(i)$'s into descending order and label them.... The mapping from the original carrier labels to the sorted carrier labels is stored and is invertible." '447 Patent, col. 7, ll. 49-52; col. 8, l. 65-col. 9, l. 1. Based on this disclosure, Dr. Hartogs suggests that a person of ordinary skill in the art would understand "that the result of the sort is an ordering of estimates from the highest to the lowest." (Hartogs Report, para. 42).

Conversely, Defendants argue that the claim does not require a reordering of the data. Defendants contend that the term is used in a manner that is consistent with its ordinary and customary meaning. (Defs.' Opening Br. at 33-34.) Defendants offer a general definition of the word "sort" from Webster's New World Dictionary. According to this reference, "sort" means "to arrange according to class or kind." WEBSTER'S NEW WORLD DICTIONARY 563 (1995). Defendants also provide a technical definition for "sort" from the International Organization for Standardization. In this reference, "sort" means "[t]o segregate items into groups according to specified criteria without necessarily *ordering* the items within each group." INT'L ORG. FOR STANDARDIZATION, ISO 2382-6 Info. Processing Sys.-Vocabulary-Part 6: Preparation and Handling of Data 10 (2d ed.1987) (emphasis in original).

This Court agrees that the term "sorting" does not require reordering of the data. The ordinary meaning of the word "sort" suggests that mere placing or arranging into a class is sufficient. Although the claim uses the

words "sorting ... into an invertible ordering," Plaintiff's construction rests on the incorrect assumption that "invertible ordering" is synonymous with a "new order." This assumption is unsupported. The word "invertible" does not mean "new." The plain meaning of the word "invert" means "to reverse the order, position, direction ... of." WEBSTER'S NEW WORLD DICTIONARY 313 (1995). Thus, something that is "invertible" is something that is capable of being reversed in order, position or direction thereof. Consequently, an "invertible ordering" is an ordering capable of being reversed, not necessarily a new order.

The Court concludes that the preferred embodiment should not limit the meaning of the term. To sort the estimates into a "descending order," as described in the preferred embodiment, is only one example of how the estimates may be "sorted." To adopt the requirement that the estimates must be "sorted," and thus "reordered," on this basis would violate the general prohibition against importing a limitation from the specification into the claims. *See Storage Tech. Corp. v. Cisco Sys., Inc.*, 329 F.3d 823, 831 (Fed.Cir.2003). Therefore, Plaintiff's construction must be rejected.

Accordingly, the Court concludes that disputed term [5] "sorting the subcarrier-indexed estimates of the transmission quality, scaled by the desired subcarrier bit-error-rates, into an invertible ordering" requires mere "sorting" of the estimates, i.e., segregating the estimates into groups based on specified criteria, and does not require reordering.

6. "scaled"

The parties stipulated at the *Markman* hearing that "scaled" means "changed by a factor." (Tr. at 45:22). Consequently, the Court adopts that construction.

7. "(b) calculating bit and energy allocation tables for said multicarrier data transmission system based on the sorted subcarrier-indexed estimates"

The issue presented with respect to the next disputed term concerns the order in which the steps of the claim must be performed. Plaintiff argues that step (a), the sorting step, must occur before step (b), the calculating step. Plaintiff contends that the plain language of Claim 1, and the interconnection of each step, indicate an implicit requirement that the steps occur in a particular order. (Pl.'s Opening Br. at 9). Specifically, Plaintiff asserts that the calculating step must occur after the sorting step because the calculation of bit and energy allocation tables are "*based on the sorted subcarrier-indexed estimates.*" '447 Patent, col. 13, ll. 11-12 (emphasis added). Plaintiff asserts that something must be in existence before anything can be "based on" it. (Tr. at 47:20-24). Conversely, Defendants contend that the claim does not require a particular order of steps. Citing *Altiris, Inc. v. Symantec Corp.*, 318 F.3d 1363, 1369 (Fed.Cir.2003), Defendants argue that if a claim recites steps, but not an order, there is a presumption that the sequence of steps is not required.

In *Altiris*, the Federal Circuit explained, "[u]nless the steps of a method actually recite an order, the steps are not ordinarily construed to require one. However, such a result can ensue when the method steps implicitly require that they be performed in the order written." *Id.* at 1369 (quoting *Interactive Gift Express, Inc. v. CompuServe Inc.*, 256 F.3d 1323 (Fed.Cir.2001)). There is a two-part inquiry for determining whether a method claim, which does not recite a specific order, must be carried out in the order in which it is written.

First, we look to the claim language to determine if, as a matter of logic or grammar, [the steps] must be performed in the order written.... If not, we next look to the rest of the specification to determine whether it directly or implicitly requires such a narrow construction. If not, the sequence in which such steps are written is not a requirement.

Id. (quotations omitted). In *Altiris*, the Federal Circuit concluded that the trial court erred by imposing a limitation on a method claim that required the steps to be performed in a particular order. *Id.* at 1371. The court concluded that nothing in the claim language logically or grammatically indicated that the "setting step" of the method had to be performed in a specific order. The court further concluded that the written description did not contain any statements concerning the importance of the order of steps, or any evidence disclaiming any order of steps. *Id.*

In the present case, the Court likewise concludes that the steps of Claim 1 and 2 need not be performed in the order in which the steps are written. First, the Court does not find support in the claim language supporting such a narrow construction. Although the words "based on" suggest that the calculation of the bit and energy tables are determined only after the estimates are sorted, Plaintiff's proposed construction would impose an absolute requirement that step (b) occurs after step (a) at all times. The plain language of the claim does not indicate that this is always the case.

Second, the written description does not support a narrow construction. As the court found in *Altiris*, here there are no statements in the specification suggesting that the method must be performed in the way Plaintiff proposes, nor are there statements indicating that the method would not work if the "calculating step" is performed before the "sorting step." While Plaintiff's argument focuses on events occurring in one subcarrier, the specification describes a dynamic system in which multiple carriers are acting in concert. For example, the specification states:

Another objective of the present invention is to provide a method and apparatus that is also real-time adaptive during normal system operation, with continuous data transmission, to compensate for changes in transmission medium characteristics.

'447 Patent, col. 5, ll. 37-41. Additionally, Claim 16 describes "a multicarrier transmission system having transmitters and receivers to transmit and receive data continuously over communication lines." '447 Patent, col. 20, ll. 27-29. Thus, it is possible that "the calculating step" is being performed before "the sorting step" at any given time.

Plaintiff relies on the preferred embodiments, or algorithms in the specification, in support of its argument that the steps must occur in a particular order. (Hartogs Report, para. 43). Once again, however, limitations appearing in the preferred embodiment should not be imported into the claims themselves without justification. *See Storage Tech. Corp. v. Cisco Sys., Inc.*, 329 F.3d 823, 831 (Fed.Cir.2003). As explained above, the Court finds no justification.

Accordingly, with regard to disputed term [7], the Court construes the claim as not requiring that steps (a) and (b) be performed in any particular order.

8. The Remaining Disputed Claim Terms of the '447 Patent

The remaining terms of the '447 Patent concern means-plus-function limitations, and therefore will be analyzed together. Means-plus-function terms are governed by 35 U.S.C. s. 112, para. 6. This section provides that:

[a]n element in a claim for a combination may be expressed as a means or step for performing a specified

function without the recital of structure, material, or acts in support thereof, and such claim shall be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof.

35 U.S.C. s. 112, para. 6 (Thomson/West 2005). This statutory provision allows patentees to "claim an element of a combination functionally, without reciting structures for performing these functions." *Apex, Inc. v. Raritan Computer, Inc.*, 325 F.3d 1364, 1371 (Fed.Cir.2003). In exchange for the convenience of employing s. 112, para. 6, the patentee must disclose structure in the specification that is clearly linked or associated with the claimed function. *Budde v. Harley Davidson, Inc.*, 250 F.3d 1369, 1377 (Fed.Cir.2001).

In construing a means-plus-function claim limitation, the court must engage in a two-part inquiry. *Id.* at 1376. First, the court must identify the particular function that is claimed. *Id.* Second, the court must determine the corresponding structure that performs the claimed function. *Id.* Failure to disclose adequate corresponding structure renders the claim's scope indefinite, and therefore invalid under s. 112, para. 2. *Id.* A finding that a claim containing a means-plus-function limitation lacks structural support must be supported by clear and convincing evidence that the specification does not disclose structure sufficient to perform the recited function. *Id.* at 1376-77. Such a determination must be made from the viewpoint of a skilled artisan. *Id.* at 1376.

In determining whether s. 112, para. 6 applies to a particular claim term, the use of the word "means" is central to the court's analysis. Generally, the use of the word "means" creates the presumption that s. 112, para. 6 does apply, whereas the absence of the word "means" creates the presumption that it does not apply. *Personalized Media Communications, LLC v. Int'l Trade Comm'n*, 161 F.3d 696, 703-04 (Fed.Cir.1998). The presumption may be rebutted by the intrinsic and extrinsic evidence. The court should focus its inquiry on whether "the claim as properly construed recites sufficiently definite structure to avoid the ambit of s. 112, para. 6." *Id.* at 704. Moreover, the court should inquire as to whether the term has a "reasonably well understood meaning in the art." *Apex, Inc.*, 325 F.3d at 1372 (Fed.Cir.2003) (quoting *Greenberg v. Ethicon Endo-Surgery, Inc.*, 91 F.3d 1580, 1583 (Fed.Cir.1996)).

In the present case, the disputed terms are found in Claims 11 and 12 of the '447 Patent. Claim 11, an independent claim, and Claim 12, a dependent claim, read as follows:

11. A multicarrier communication system comprising: a[11] *transmitter means* and a[12] *receiver means* communicatively linked together by a datalink, the signal carrying characteristics of which are randomly variable, said [11] *transmitter means* including,

means for establishing a plurality of frequency domain subchannels for respectively communicating various quantities of data bits selected from a stream of data bits;

[8] *means for measuring the capability of the datalink to efficiently communicate the data bits in each said subchannel and for developing an optimum energy allocation and an optimum data bit allocation for each said subchannels*; and

means for causing an input data stream to be divided and modulated onto a plurality of frequency domain carriers, each corresponding to one of said subchannels for transmission over said datalink to said [12] *receiver means*, the quantity of data bits transmitted over each said subchannel being selected as a function of said optimum data bit allocation and said [12] *receiver means* including,

means for monitoring the quality of the transmission over each said subchannels; and

[9] *means for returning an indication of the monitored quality to said [11] transmitter means.*

12. A multicarrier communication system as recited in claim 11 wherein said [11] *transmitter means* further includes:

[10] *means responsive to said indication of monitored quality and operative to change the data bit allocation among said subchannels to improve the quality of the transmission.*

'447 Patent, col. 14, l. 58-col.15, l. 26 (emphases added).

The parties disagree as to whether the terms "transmitter means" and "receiver means" are subject to 35 U.S.C. s. 112, para. 6. Defendants argue that these terms do not have associated corresponding functions, and therefore do not invoke the presumption of means-plus-function under s. 112, para. 6. It is Defendants' position that "transmitter means" and "receiver means" actually refer to a "transceiver containing a transmitter and a receiver," similar to the central office transceiver 27, or customer premises transceiver 28, which are depicted in Figure 5a of the patent. (Chart at 4-5). Conversely, Plaintiff argues that "transmitter means" and "receiver means," as first used in the claim, are associated with the means enumerated after the "including" and "further including" language in Claims 11 and 12. (Pl.'s Opening Br. at 15-16). Thus, Plaintiff asserts that these terms are means-plus-function elements. (*Id.* at 13-14; Chart at 4-5).

The Court concludes that "transmitter means" and "receiver means" recite sufficient structure and therefore are not governed by s. 112, para. 6. The presumption arises that s. 112, para. 6 is applicable because the terms employ the word "means." However, the presumption is rebutted because the terms convey sufficient structure, namely a "transmitter" and a "receiver." These structures are constantly referenced throughout the specification and figures. *See* '447 Patent, col. 2, ll. 39-46, col. 7, ll. 1-6; Figures 5a & 5b. Based on the patent's disclosure the "transmitter" may be the "central office transmitter 30" or "customer premises transmitter 30," and the "receiver" may be the "central office receiver 32" or "customer premises receiver 32."

Plaintiff asserts that the terms do not connote structure. However, Plaintiff undermines its assertion by stipulating that the claimed functions of disputed terms [8] and [10] must "be in the transmitter means," and that the function of disputed term [9] must "be in the receiver means." (Chart at 16). By making these stipulations, Plaintiff implicitly acknowledges that "transmitter means" and "receiver means" connote structure, thereby reinforcing the Court's conclusion that "transmitter means" and "receiver means" fall outside the ambit of s. 112, para. 6.

The Court also rejects Defendants' argument that "transmitter means" and "receiver means" actually refer to a transceiver which contains both a transmitter and receiver. Defendants repeatedly suggested at the *Markman* hearing that the claims and specification indicate that a transmitter must have an associated receiver, and a receiver must have an associated transmitter in order to perform its function. (*See* Tr. at 55:21-57:8). Defendants referred to the transceivers in Figure 5a, which are depicted by dotted lines, as examples of structures that contain both a transmitter and receiver.

A review of the specification shows that both the transmitter and receiver are in constant communication, as

Defendants propose. However, a closer examination of the specification, particularly Figures 5a, 5b, 13 and 14, demonstrates why the transmitter and receiver are not necessarily part of a transceiver. According to the specification, the data bit buffer and encoder 36 and the FEQ and decoder 58, which are illustrated in Figures 13 and 14, are involved in calculating the initial bit and energy allocation tables. The specification states:

The initial bit and energy allocation tables are calculated at the receiver. These tables are stored in the receiver as the *receive bit allocation table 78 and the receive energy allocation table 80*, and these receiver tables are available to the data symbol decoder 72 during normal continuous system operation. *These same tables are also reliably communicated back to the transmitter* and stored therein as the *transmit bit allocation table 66 and the transmit energy allocation table 68*, and these transmitter tables are available to the data symbol encoder 64 during normal continuous system operation.

'447 Patent, col. 12, ll. 27-37 (emphases added). This describes a process by which the receiver reliably communicates the initial bit and energy allocation tables to the transmitter. This comports with Defendants' assertion that the receiver must have an associated transmitter, and vice versa. However, focusing on the figures, it is clear that this communication occurs between the data bit buffer and encoder, which is numerically represented as 36 in the figure, and the FEQ and decoder, which is numerically represented as 58. Figure 5b shows that the data bit buffer and encoder 36 is part of the top half of the figure, or the transmitter, which is numerically represented as 30. The FEQ and decoder transmitter 58 is part of the bottom half of the figure, or the receiver, which is represented as 32. Thus, the figures indicate that communication occurs between the transmitter 30 and the receiver 32.

Figure 5a sheds further light on the structure of the invention. This figure represents the principal components of the discrete multitone ("DMT") modulation communication system, and illustrates the physical relationship between transmitters and receivers. Based on this figure, it becomes apparent that the structure labeled 30 represents both the central office transmitter, as well as the customer premises transmitter. Likewise, the structure labeled as 32 represents both the central office receiver and the customer premises receiver. Taking into account all of the information provided in Figures 5a, 5b, 13, and 14, it becomes clear that communication is not limited to a transmitter and receiver located within a transceiver. The specification and figures, as drafted, would allow communication to occur between the central office transmitter 30 and the customer premises receiver 32, which fall outside the confines of a transceiver. Therefore, Defendants' argument that "transmitter means" and "receiver means" should be construed to mean a "transceiver containing a transmitter and a receiver" must be rejected. FN10 Accordingly, the Court finds that "transmitter means" and "receiver means" recite sufficient structure, that is a transmitter and a receiver, and are therefore not governed by s. 112, para. 6.

FN10. Defendants noted in their Reply that the term "transceiver" is often used interchangeably with the term "transmitter" in the industry. (Defs.' Reply at 11, n. 4). Even assuming this contention is true, the Court concludes that the patentees acted as their own lexicographer by differentiating between "transceiver" and "transmitter" in the written description and drawings.

The Court must now turn its attention to disputed terms [8] to [10]. Disputed term [8], which is found in Claim 11, is a "means for measuring the capability of the datalink to efficiently communicate the data bits in each said subchannel and for developing an optimum energy allocation and an optimum data bit allocation for each said subchannels." (Chart at 3). The parties stipulated that this disputed term is a means-

plus-function limitation governed by 35 U.S.C. s. 112, para. 6. (Id. at 16).FN11 The Court agrees with this stipulation because the claim describes this "means for" element as being included in the "transmitter means," i.e., the transmitter, but does not specify the actual structure that performs the function in the claim itself.

FN11. As aforementioned, the parties also stipulated that the functions associated with this term must be performed in the "transmitter means." (Id.).

The parties agree that the term has two claimed functions: 1) "measuring the capability of the datalink to efficiently communicate the data bits in each said subchannel," and 2) "developing an optimum energy allocation and an optimum data bit allocation for each said subchannels." (Tr. at 66:20-21; Tr. at 67:22-23). The Court must next determine whether the patent discloses sufficient corresponding structure necessary to perform these specific functions.

After proffering numerous arguments in their briefs and identifying various structures as the corresponding structure required to perform the claimed functions, Defendants ultimately argued that the corresponding structures for both of the functions are digital signal processors (DSP), random access memory (RAM), a communications bus and other corresponding digital and analog components. (Chart at 3). Defendants further identify, in the alternative, custom Very Large Scale Integration (VLSI) designs plus other corresponding digital and analog components as the corresponding structure. (Id.). Defendants also contend that the structure includes the software programs required to implement these functions.

Plaintiff responds by arguing that the patent does not disclose sufficient structure. Plaintiff asserts that the means-plus-function limitation does not meet the requirements of 35 U.S.C. s. 112, para. 6, and therefore the claim is invalid.

The Court agrees with Plaintiff's assertion that no corresponding structure sufficient to perform the claimed functions is disclosed in the specification. After examining the specification, the Court concludes that the patent does not provide the clear linkage or association between the claimed functions and the corresponding structures proffered by Defendants. Defendants fail to demonstrate how the structures they identified, such as the DSPs, RAM, and VLSI, are clearly linked or associated with the functions—a critical requirement for means-plus-function claims. There is no mention of the "measuring" function or "developing" function in the portion of the specification where these structures are discussed. Instead, the specification only makes a general reference to "[t]he above described processes." '447 Patent, col. 12, l. 11. Moreover, the Court notes that Defendants arrived at their final proposed corresponding structure after offering numerous alternate arguments in their Claim Construction briefs.FN12 Defendants' vacillation on what constitutes corresponding structure further buttresses this Court's conclusion that there is none. Thus, the Court concludes that the specification fails to disclose corresponding structure because it does not provide the requisite clear linkage between the functions and any sufficient structure. Accordingly, because the patentees have failed to live up to their end of the bargain in exchange for claiming a term in means-plus-function language, the claim is indefinite and consequently invalid under s. 112, para. 2.

FN12. Defendants offered a number of ever-changing arguments with regard to the corresponding structure. Beginning with Defendants' Opening Claim Construction brief, Defendants nearly rely on the entire specification for disclosure of the structure. Defendants stated that "[t]he corresponding structures are shown in Figures 9 and 10, the portion of the specification describing those figures, and in the specification at

columns 12:11-25, 12:26-44, 5:43-60 and 7:11-20 ... as well as Figures 11 and 12 and columns 11:1-12:10." (Defs.' Opening Br. at 39). In their Reply brief, Defendants inexplicably altered their proposed corresponding structure and submitted that the "means for measuring and for developing is the receiver portion of the right hand transceiver (28) of Figure 5a." (Defs.' Reply at 11). Defendants also stated that generally, "the digital signal processors (DSPs) or custom designs are programmed to accomplish the specified functions." (Id.). Defendants ultimately proffered the structures listed above as the corresponding structure.

Terms [9] and [10] suffer the same fatal flaw. Disputed term [9], which also appears in Claim 11, involves a "means for returning an indication of the monitored quality to said transmitter means." (Chart at 3). The parties stipulated that s. 112, para. 6 applies, and that the claimed function is "returning an indication of the monitored quality to said transmitter means," but disagree as to whether there is corresponding structure. (Chart at 3, 16). FN13 Because Defendants have not shown a link between their proffered corresponding structure and the claimed function, and the Court cannot find any, the Court must likewise conclude that the claim is indefinite, and consequently invalid.

FN13. The parties stipulated that this element must be performed in the "receiver means." (Chart at 16).

Disputed term [10], which appears in Claim 12, recites: "means responsive to said indication of monitored quality and operative to change the data bit allocation among said subchannels to improve the quality of the transmission." (Chart at 4). The parties stipulated that s. 112, para. 6 applies, and that the claimed functions are: 1) "responding to said indication of monitored quality" and 2) "changing the data bit allocation among said subchannels to improve the quality of the transmission," but disagree as to whether there is corresponding structure.FN14 (Tr. at 67:9-17). Because the Court again concludes that the specification does not provide a clear link between the claimed functions and the proffered corresponding structures, the claim is indefinite and consequently invalid.

FN14. The parties also stipulated that this element must be performed in the "transmitter means." (Chart at 16).

Accordingly, the Court construes the remaining disputed terms of the '447 Patent as follows: 1)[11] "transmitter means" is not governed by s. 112, para. 6 as it connotes sufficient structure; 2)[12] "receiver means" is not governed by s. 112, para. 6 as it connotes sufficient structure; 3) disputed terms [8], [9], and [10] are means-plus-function limitations, but are indefinite because the specification fails to clearly link corresponding structure to the claimed functions, and are therefore invalid.

B. The '322 Patent

1. "a transmission system using multicarrier modulation"

The first issue presented with respect to the '322 Patent is whether the term "a transmission system using multicarrier modulation," which appears in the preamble of Claim 1, is a claim limitation. Claim 1 reads as follows:

1. A method of changing a parameter of a transmission system using multicarrier modulation, comprising

the steps of:

identifying symbols transmitted by the system by a symbol count;

communicating between a transmitter and a receiver of the system information identifying a change in said parameter and a symbol count value for implementing said change;

implementing said change at the transmitter in response to a transmitted symbol having a symbol count matching said value; and

implementing said change at the receiver in response to a received symbol having a symbol count matching said value.

'322 Patent, col 11, l. 64-col. 12, l. 11 (emphases added).

Plaintiff argues that the phrase "using multicarrier modulation" merely states one intended use, and therefore is not meant to limit the claim's scope. (Pl.'s Opening Br. at 25-27). Plaintiff further asserts that the body of Claim 1 does not make any reference to multicarrier modulation, which indicates that the four steps of Claim 1 may be applied to a single-carrier system. Lastly, Plaintiff directed the Court's attention to Claim 20, where the patentees made a specific reference to "multicarrier modulation." Plaintiff asserts that if the patentees meant to limit the reference to "multicarrier modulation" in Claim 1, they would have specifically referred to "multicarrier modulation" as they did in Claim 20. (Tr. at 76:4-9 ("[I]f there's a specific reference to multi-carrier modulation in Claim 20, the patentees knew how to say it when they meant it, and they do not make such a statement in Claim 1.")).

Defendants argue that the term must be read as a claim limitation. Citing *Storage Technology Corp. v. Cisco Systems, Inc.*, 329 F.3d 823 (Fed.Cir.2002), Defendants assert that a term is "unquestionably" a limitation "[w]hen the body of a claim refers back to a portion of the preamble." (Def.' Reply at 19). Defendants note that the terms "the system" and "said parameter," which appear in the body of the claim, refer to both the "system" and the "parameter" in the preamble, providing an antecedent basis for those terms. *Id.* Defendants also refer to Claim 7, a dependent claim of Claim 1, which refers to at least "one subchannel of the system." *Id.* Such reference to "one subchannel," Defendants contend, implicitly requires a multicarrier system.

The Court concludes that the term "a transmission system using multicarrier modulation" is a claim limitation. Terms appearing in the body of claim 1 and in subsequent dependent claims, such as Claim 7, depend on this disputed phrase for antecedent basis. Such dependence on a preamble phrase, as the Federal Circuit articulated, "indicates a reliance on both the preamble and claim body to define the claimed invention" and therefore may limit the claim's scope. *Catalina Mktg. Int'l v. Coolsavings.com, Inc.*, 289 F.3d 801, 808 (Fed.Cir.2002). Moreover, the Federal Circuit stated that the preamble may operate as a limitation of the claim when additional structure or steps are recited in the preamble and are underscored as important in the specification. *Id.* In the present case, the written description clearly supports the conclusion that the use of "multicarrier modulation" is a key aspect of the invention, and necessary to perform the claimed method.

Having concluded that the term is a claim limitation, the Court must now construe it. Because Plaintiff has not proffered a claim construction that treats this term as a claim limitation, and Defendants' proposed construction is persuasive, the Court will adopt Defendants' construction. Accordingly, the Court concludes

that disputed term [13] "a transmission system using multicarrier modulation" serves as a claim limitation and means a "transmission system using modulation of more than one carrier."

2. Terms Which Depend on the Construction of "symbol count"

Disputed term [14] is "identifying symbols transmitted by the system by a symbol count," and disputed term [16] is "symbol count ." Because the construction of both terms depends on how the Court construes "symbol count," the Court will analyze these terms together. The terms are found in Claims 1 to 19 of the '322 Patent. The issue presented is whether the "count" identifying transmitted symbols is limited to a count of individual symbols, or includes a count of groups of symbols.

Plaintiff argues that the language of the patent indicates that the "identifying" step of the claim "requires that a symbol count be associated or linked with each symbol, in a way that individually distinguishes that symbol from other symbols." (Pl.'s Opening Br. at 19). Focusing on the language of Claim 1, Plaintiff notes that in addition to the "identifying" step, the claim recites the step of "communicating ... information identifying *a change* in said parameter and a symbol count for implementing said change." (*Id.* at 20 (emphasis in original)). Plaintiff argues that because the claim uses the term "change" in the singular form, the "identifying" step should be limited to individual "symbols" in order to maintain consistency.

Plaintiff also focuses on language in the specification which states: "Preferably the step of identifying symbols comprises maintaining a count identifying transmitted symbols at the transmitter and maintaining a count identifying received symbols at the receiver. Conceivably, however, *each* symbol could instead or additionally be identified by transmission of the symbol count as part of the symbol itself...." '322 Patent, col. 2, ll. 61-67 (emphasis added). The patentees' use of the word "each," Plaintiff contends, evinces the patentees' intent that the identification of symbols is a process only involving individual symbols. (Pl.'s Opening Br. at 20). Further, Plaintiff offers a dictionary definition for the term "identity." According to Webster's New World Dictionary, "identity" is defined as the "state or fact of being a specific person or thing; individuality." WEBSTER'S NEW WORLD DICTIONARY 292 (1995).

Defendants' proposed construction for "symbol count," namely "a count of symbols, either individually or by groups," is based on the plain language of the claims and the specification. Defendants assert that the claim language does not limit counting by individual symbols. Rather, the language of the claims may be read to allow counting by groups of symbols. Defendants further argue that the specification provides an even stronger basis for their position. Defendants posit that the patentees acted as their own lexicographer by providing a meaning for the term "symbol count" in the specification. The specification reads as follows:

In addition, the transmit and receive symbol counters need not be incremented once for each symbol, but instead could for example be incremented after every N symbols, where N is an integer greater than one; for example N=68. In this case the implementation of the changes is similarly determined in relation to the counts, for example coincident with the boundaries between *groups of N symbols* .

'322 Patent, col. 11, ll. 55-62 (emphasis added). Thus, Defendants argue that the patent's disclosure specifically describes counting by groups of symbols, and not only by individual symbols. (Tr. at 77:13-78:16).

The Court finds that the specification supports Defendants' proposed construction for the term "symbol count." Although one portion of the specification describes incrementation by the symbol counter occurring

after the transmission or reception of each symbol, a subsequent portion expressly discloses that incrementation may occur after groups of symbols. *See* '322 Patent, col. 7, ll. 9-13; col. 11, ll. 55:62. The specification also describes the term "symbol count" as a process that identifies or links symbols, not only one symbol, as they are transmitted or received through the symbol counter. '322 Patent, col. 2, ll. 61-64. Furthermore, the plain language of the claims supports this construction. For example, Claim 4 refers to "maintaining a count identifying transmitted symbols at the transmitter and maintaining a count identifying received symbols at the receiver." '322 Patent, col. 12, ll. 18-21. The word "symbols" is plural. Accordingly, the Court concludes that disputed term [16] "symbol count" means "a count of individual or groups of symbols."

As for the remainder of disputed term [14], Plaintiff submitted a dictionary definition for the term "identify." This term is defined as "to connect or associate closely." WEBSTER'S NEW WORLD DICTIONARY 292 (1995). The Court will adopt the ordinary meaning of "identify" in its construction. Therefore, the Court concludes that disputed term [14] "identifying symbols transmitted by the system by a symbol count" means "connecting or associating a symbol count with individual symbols or groups of symbols."

3. "symbol"

The parties dispute the meaning of the term "symbol," which appears throughout most of the claims of the patent. The point of contention is whether a symbol may exist pre-modulation, i.e., in an unmodulated form. (Tr. at 82:13-15). Plaintiff argues that the inventor imparted a particular meaning with respect to "symbol," one that differs from its ordinary meaning. Plaintiff contends that "symbol" should be construed as "the modulated waveform resulting from a single iteration of the modulator." (Chart at 6). Plaintiff relies on the specification for both the '322 Patent and the '447 Patent to support its definition.

Plaintiff refers to the portion of the '322 Patent's specification which states:

By way of example, as part of the initialization process of the system the control unit 36 can control the transmitter 18 to transmit two consecutive symbols the second of which is the negative of the first (i.e. if the first symbol has a waveform of $f(t)$, then the second has a waveform of $-f(t)$), resetting the transmit symbol counter to a count of zero immediately after the transmission of the second symbol.

'322 Patent, col. 7, ll. 27-34. Plaintiff contends that this language specifies that a symbol must have a waveform. Plaintiff further relies on the disclosure of the '447 Patent, which is incorporated by reference, to support its argument that the waveform must also be modulated. *See* '322 Patent, col. 1, ll. 12-28. Specifically, the '447 Patent states: "The b_{total} bits in each multicarrier symbol are *modulated* in modulator 16 by N separate carriers with b_i bits modulated by the i^{th} carrier." '447 Patent, col. 1, ll. 29-31 (emphasis added). In light of both specifications, Plaintiff concludes that a "symbol" must be a modulated waveform. Plaintiff includes the phrase "resulting from a single iteration of the modulator" in its proposed construction based on its understanding that a symbol becomes a modulated waveform as a result of "a corresponding cycle of operation or 'iteration' of the modulator." (Pl.'s Opening Br. at 19).

Defendants assert that Plaintiff's proposed construction is overly restrictive and unsupported by the intrinsic evidence. At the hearing, Defendants explained that the '322 Patent disclosure supports their assertion that a symbol exists prior to modulation. (Tr. at 82:19-84:14). According to Figure 2 of the '322 Patent, which is a functional block diagram of the invention, Defendants assert that the parties do not dispute that modulation

occurs at IFFT, D-A, Filter, & Line Interface 34. (Tr. at 83:17-21); *see also* '447 Patent, col. 1, ll. 32-35 (describing the use of an Inverse Fast Fourier Transform (IFFT) during modulating). Defendants also argue that symbols interact with the trellis coder and the transmit symbol counter. (Tr. at 82:24-83:6). Defendants reason that symbols must exist prior to modulation if they are in fact involved with the transmit symbol counter and the trellis coder, before they even reach the unit 34 which is responsible for modulation.

The Court finds Defendants' reasoning persuasive. The Court agrees that Figure 2 suggests symbols need not be in modulated form. Plaintiff's reliance on the '447 Patent is misplaced for two reasons. First, the excerpt cited by Plaintiff refers to Figure 1 of the disclosure which represents a basic multicarrier transmitter and receiver as known in the prior art, not an embodiment of the invention claimed. *See* '447 Patent, col. 1, ll. 19-21. Second, the excerpt describes what takes place as the symbols are processed by the modulator. Not surprisingly, the symbols become modulated. This is not sufficient to support the conclusion that symbols are always modulated. Defendants also accurately note that the inventors themselves distinguished between modulated and demodulated symbols in the specification. Focusing on Figure 3 of the '447 Patent, and Column 1, lines 52 to 54 which states: "The general structure of a DMT system is illustrated in Fig. 3 where $\{X_0, X_1, \dots, X_{N-1}\}$ are the original, complex, input data symbols, $\{x_k\}$ is the modulated data sequence," it is clear that the inventors distinguished between symbols that are modulated and those that are not. '447 Patent, col. 1, ll. 52-54. Therefore, the Court concludes that a symbol does exist prior to modulation, which renders Plaintiff's proposed construction incorrect and overly restrictive. Moreover, the Court finds no basis for imposing the additional restrictive language that the modulated waveform results from "a single iteration of the modulator."

Having concluded that a "symbol" may exist prior to modulation, the Court must now construe the term. There is no competent evidence before the Court that reflects the technical meaning of "symbol," except for the opinion of Defendants' expert. FN15 Dr. Williams opines that "symbol" would be understood by a person of ordinary skill in the art as "a finite, pre-selected representation of the information to be conveyed from the transmitter to the receiver." (Williams Report, para. 85). Given the lack of other viable choices, the Court will adopt this definition.

FN15. Defendants do submit a general dictionary definition of "symbol." (Defs.' Reply at 14). That definition is "an object used to represent something abstract." WEBSTER'S NEW WORLD DICTIONARY 598 (1995). However, this general definition does not comport with how that technical term is used in the claim. Defendants also submit a technical dictionary definition for "symbol." Defs.' Opening Br. at 9. That definition, however, cannot be taken into consideration because it was set forth in a dictionary that was not published until three years after the patent issued, and therefore may not reflect the meaning of the term as used in the patent.

Accordingly, the Court construes disputed term [15] "symbol" to mean "a finite, pre-selected representation of the information to be conveyed from the transmitter to the receiver."

4. Terms Which Depend on the Construction of "transmitted symbol" and "received symbol"

Disputed terms [17] to [22] of the '322 Patent will be analyzed together as they largely depend on the Court's construction of the terms "transmitted symbol" and "received symbol." Four terms are found in the last two steps of the method recited in Claim 1. The steps are:

[19] *implementing said change at the transmitter in response to a [17] transmitted symbol having a symbol count matching said value; and*

[20] *implementing said change at the receiver in response to a [18] received symbol having a symbol count matching said value .*

'322 Patent, col. 12, ll. 5-10. Two terms are also found in Claim 20. This claim reads as follows:

20. A transmission system using multicarrier modulation, comprising:

a transmitter including a modulator for modulating multiple carriers each with an individually allocated number of data bits per transmission symbol, the transmitter including a [17][21] *transmitted symbol counter for counting transmitted symbols* and a control unit for updating a number of data bits allocated to a carrier at a time dependent upon a count of the transmitted symbol counter; and

a receiver including a demodulator for demodulating the carriers to derive the allocated numbers of data bits from the multiple carriers, the receiver including a [18][22] *received symbol counter for counting received symbols* and a control unit for updating a number of data bits derived from a carrier at a time dependent upon a count of the received symbol counter.

'322 Patent, col. 14, ll. 17:34 (emphases added).

The parties dispute the construction of the two steps appearing in Claim 1. Based on the parties' proposed constructions, the issue is whether a "transmitted symbol" and "received symbol" must be entirely or completely transmitted or received, or simply be in the process of being transmitted or received. Plaintiff argues that the term "implementing said change at the transmitter in response to a transmitted symbol having a symbol count matching said value" requires two elements: 1) the change occurs after a symbol is "entirely transmitted," and 2) the change must be caused by that transmission. FN16 (Pl.'s Opening Br. at 22-25). Plaintiff submits that the use of the phrase "in response to" supports such an interpretation. Further, Plaintiff contends that the tense of the word "transmitted," that is past tense, signifies that the act of transmission must have been completed before a change is effectuated. (*Id.* at 23).

FN16. Plaintiff offers the corollary argument for the last step of Claim 1 involving "received symbols." (Pl.'s Opening Br. at 22-25).

Additionally, Plaintiff refers to portions of the specification to support its interpretation. For example, Plaintiff refers to the specification which describes Figure 3 in the patent. It states: "the transmitter control unit 36 includes the counter 38, which it increments immediately *after* the transmission of each symbol, and the receiver control unit 48 includes the counter 50, which it increments immediately *after* the reception of each symbol." '322 Patent, col. 7, ll. 10-14 (emphases added). Plaintiff asserts that this disclosure, in addition to the claim language, indicates that "it is the transmission of the symbol itself that ... instigat[es] cause for the change." (Pl.'s Opening Br. at 24). Logically, Plaintiff submits, these factors necessitate a construction that requires the "complete transmission" of a symbol.

In contrast, Defendants argue that in the context of the claims, and in light of the specification, a "transmitted symbol" is simply a symbol "being transmitted." (Chart at 6). Defendants claim that Plaintiff is

attempting to import various limitations by equating "in response to" with "entirely after." Defendants argue that the ordinary meaning of the term "in response to" should be adopted. Based on a competent dictionary reference, Defendants define the word "response" as "[a] reaction, as that of an organism or mechanism, to a particular stimulus." WEBSTER'S II NEW COLLEGE DICTIONARY 945 (1995). Further, Defendants submit that the ordinary meaning of "transmit" means "[t]o move data from one location to another location." THE NEW IEEE STANDARD DICTIONARY OF ELECTRICAL AND ELECTRONICS TERMS 1406 (1993). Combining these definitions, Defendants propose that the term should be construed as "implementing a change at the transmitter or receiver in reaction to symbols that are eventually transmitted." (Def.' Reply at 17). Defendants assert that neither the intrinsic evidence nor the ordinary meanings of the words require the limitation that the symbol be "entirely transmitted" before a change can be implemented.

Although the Court agrees with Plaintiff that the terms "transmitted" and "received" are drafted in the past tense, the Court concludes that the tense alone is insufficient to construe the terms as requiring "complete transmission" and "complete reception." The specification describes a dynamic or pipeline process in which symbols are being transmitted and received at any given time. Given the nature of the invention, it would be difficult to discern exactly what constitutes a "complete transmission" or "reception" of a symbol. Plaintiff demonstrated the difficulty at the *Markman* hearing. The Court asked Plaintiff's Counsel to explain how one knows when a transmission is completed. (Tr. at 102:5-9). Counsel responded, "when the symbol has been received and the symbol has been transmitted, it's completed." (Tr. at 102:15-16). Based on the vagueness and ambiguity of this proposed explanation of what constitutes "complete transmission," in addition to the lack of evidence in the claims and specification supporting such a restrictive construction, the Court rejects Plaintiff's proposed construction.

In addition, an examination of other claims in the patent provides greater insight regarding the proper construction. In particular, Claim 20 claims: "A transmission system using multicarrier modulation, comprising: a transmitter ... including a transmitted symbol counter for counting transmitted symbols...." '322 Patent, col. 14, ll. 17-23. The parties disagreed as to whether a "transmitted symbol" must leave the transmitter entirely, as Plaintiff suggests, or whether a symbol is considered "transmitted" while it still resides in the transmitter, as Defendants assert. The language in Claim 20 provides a clear answer. The drafters of the patent referred to "transmitted symbol" in describing the contents of a transmitter. Thus, the plain language of the claim does not rule out the possibility that a symbol may still be in the transmitter and be considered a "transmitted symbol ." The same reasoning applies to the construction of "received symbol." Therefore, the Court will adopt Defendants' construction of "transmitted symbol" and "received symbol," will apply these definitions to the other related disputed terms, and will adopt the ordinary meaning of the phrase "in response to."

Accordingly, the Court concludes: 1)[17] "transmitted symbol" means "a symbol that is in the process of being transmitted which may or may not be in the transmitter"; 2)[18] "received symbol" means "a symbol that is in the process of being received which may or may not be in the receiver"; 3)[19] "implementing said change at the transmitter in response to a transmitted symbol having a symbol count matching said value" means "a change is effectuated at the transmitter in reaction to symbols that are in the process of being transmitted that have a symbol count matching said value"; 4)[20] "implementing said change at the receiver in response to a received symbol having a symbol count matching said value" means "a change is effectuated at the receiver in reaction to symbols that are in the process of being received that have a symbol count matching said value"; 5)[21] "transmitted symbol counter for counting transmitted symbols" means "a counter that counts symbols that are in the process of being transmitted"; and 6)[22] "received symbol counter for counting received symbols" means "a counter that counts symbols that are in the process

of being received."

5. "the carriers"

The last term of the '322 Patent is found in Claim 20. The parties disagree as to the meaning of disputed term [23] "the carriers." The issue is whether "the carriers" refers to the "multiple carriers" that are being modulated by the modulator, or to all the carriers that make up the transmission system. Plaintiff relies on the claim language in support of its assertion that "the carriers" refers to the "multiple carriers" recited in the body of the claim. Plaintiff describes Claim 20 as claiming a transmission system "comprising a transmitter." According to Plaintiff, the claim proceeds to describe the transmitter as including a "modulator for modulating multiple carriers and a receiver for demodulating the carriers." (Tr. at 111:13-14). Plaintiff contends that the antecedent basis for "the carriers" is provided by the preceding term "multiple carriers." Plaintiff further contends that "it is those carriers that must be demodulated by the receiver having first been modulated by the transmitter." (Tr. at 107:16-18).

Defendants assert that Claim 20 claims an apparatus that includes a transmitter containing a modulator which modulates certain carriers, and a receiver containing a demodulator that demodulates certain carriers. (Tr. at 108:21-25, 110:14-18).FN17 Defendants argue that Plaintiff is attempting to import "a method limitation into an apparatus or system level claim." (Tr. at 108:14-16). Defendants further argue that importing a limitation as to how carriers are modulated or demodulated into this apparatus claim is impermissible.

FN17. Defendants also offer a dictionary definition for "carrier." It is defined as: "[A] A wave having at least one characteristic that may be varied from a known reference value by modulation. [B] That part of the modulated wave that corresponds in a specified manner to the unmodulated wave, having, for example, the carrier-frequency spectral components." THE NEW IEEE STANDARD DICTIONARY OF ELECTRICAL AND ELECTRONICS TERMS 160 (1993). The issue, however, does not appear to be the definition for the term "carriers," but rather the identity of the carriers to which the disputed term is referring.

The issue can be resolved by a plain reading of the claim itself. Claim 20 is an apparatus claim. The preamble recites "a transmission system using multicarrier modulation." According to the claim, the transmission system includes two main components, a transmitter and a receiver. The transmitter consists of a modulator for modulating multiple carriers. The receiver consists of a demodulator for demodulating the carriers. It is quite clear that "the carriers" which is referenced in the receiver portion of the claim derives its antecedent basis from the term "multiple carriers" in the transmitter portion of the claim, as this is the only reference to the word "carriers." This is one aspect of Plaintiff's argument and, with respect to this argument, the Court agrees.

Plaintiff seeks to impose the additional limitation, however, that "the carriers" that are demodulated in the receiver must be limited to those carriers that are first modulated in the transmitter. Although the specification, and common sense, would suggest that only modulated carriers are the carriers that are eventually demodulated, the claim as written does not require this additional limitation as part of the term's construction. Having concluded that "the carriers" refers to the "multiple carriers" in the body of the claim, the focus must now turn to the term "multiple carriers."

The claim simply states "a transmitter including a modulator for modulating multiple carriers." '322 Patent,

col. 14, ll. 19-20. There is no indication that "the multiple carriers" all become modulated. Rather, the phrase indicates that the transmission system includes "multiple carriers." Thus, the disputed term "the carriers," in essence, refers to the multiple carriers that make up the transmission system and not necessarily the carriers that are modulated by the modulator.

Accordingly, the Court concludes that the disputed term "the carriers" in Claim 20 refers to the "multiple carriers" in the body of the claim, but does not require the additional limitation that such carriers must be modulated by the transmitter. In conclusion, disputed term [23] "the carriers" means "the multiple carriers that make up the transmission system."

C. The '604 Patent

1. "*apparatus arranged for differently encoding a plurality of data signals*"

The first disputed term of the '604 Patent is found in Claims 1 to 14 and 22. Claim 1, a representative claim, provides:

1. A data transmission system using multicarrier modulation, comprising:

FECC (forward error correction code) coding and codeword interleaving [24] *apparatus arranged for differently encoding* a plurality of data signals to provide a plurality of encoded data signals with different delays through the coding and interleaving apparatus, the coding and interleaving apparatus comprises a plurality of data paths providing the encoded data signals with different delays, and a switch for switching different data signals to different data paths; and

a modulator arranged to modulate bits of the encoded data signals onto multiple carriers of the transmission system, different numbers of bits in each transmission system symbol period being allocated to different carriers.

'604 Patent, col. 11, ll. 6-20 (emphasis added). Plaintiff offered the following proposed construction in the Chart: "the apparatus implementing the encoding is actually arranged to carry out at least two types of encoding that are not the same." (Chart at 7). Defendants argue that the term must be construed as an "apparatus having the capability of encoding more than one data signal using encoding that is not the same." Id. Thus, the dispute centers around the construction of the phrase "arranged for." FN18

FN18. The parties agreed that there is no dispute concerning "a plurality of data signals." The phrase should be construed to mean "more than one" data signal. (Tr. at 114:7-20).

Plaintiff asserts that the term must be construed as "actually arranged." According to Plaintiff, "actually" is required to modify "arranged" to signify the "degree" of arrangement required by the claim. (Tr. at 116:10). Plaintiff states that the specification explains that hardware and software must be arranged in a particular manner in order to carry out particular functions. (Pl.'s Opening Br. at 31). It states: "The various units in the transceivers 10 and 12 can be implemented in various ways, using arrangements of hardware and/or software." '604 Patent, col. 8, ll. 35-37. Plaintiff asserts that Defendants' construction, which incorporates the phrase "capable of," is without meaning. (Tr. at 116:13).

Defendants argue that the ordinary meaning for the term "arranged" should be adopted. Defendants offer

two definitions from dictionaries that were published before the date the patent issued. First, "arrange" can mean "to put in the correct, proper or suitable order," or "to make ready; prepare or plan." WEBSTER'S NEW WORLD DICTIONARY 76 (1991). Second, "arrange" can mean "to put into a proper order or into a correct or suitable sequence, relationship, or adjustment." MERRIAM WEBSTER'S COLLEGIATE DICTIONARY 64 (1993).

The Court concludes that the ordinary meaning of the term "arranged" should be adopted. There is no evidence in the specification that the patentees chose to define the term in a different way. Interestingly, the Court finds that Plaintiff's reasoning more closely reflects the ordinary meaning than Defendants' proposed construction. Plaintiff's assertion that the apparatus must be arranged in a proper or suitable order to perform the particular functions comports with the plain meaning of "arranged." Defendants have not demonstrated that "capable of" is synonymous with "arranged." Thus, the Court adopts the ordinary meaning "to put into a proper or suitable order," but for the sake of simplicity, will use a simpler term that adequately reflects this definition. The Court concludes that the term "configured" serves this purpose, and will use it in its construction.

Accordingly, the Court concludes that disputed term [24] "apparatus arranged for differently encoding a plurality of data signals" means "the apparatus implementing the encoding is configured in such a way that it encodes more than one data signal by using at least two types of encoding that are not the same."

2. "a modulator arranged to modulate bits of the encoded data signals onto multiple carriers of the transmission system, different numbers of bits in each transmission symbol period being allocated to different carriers"

The next disputed term of the '604 Patent appears in Claims 1 to 14, and 22. There are two issues with respect to the parties' proposed constructions. First, the parties dispute the meaning of "arranged to." Second, the parties dispute whether "concurrently" should be incorporated in the term's construction to describe the modulation. Since the Court previously concluded that the ordinary meaning of "arranged" should be adopted in the previous term, the Court will adopt the ordinary meaning for "arranged" in this term. The Court will now address the issue regarding "concurrently." FN19

FN19. It should be noted that the Court's reasoning and conclusion regarding this issue will be applied to subsequent disputed terms which raise the same issue, namely disputed terms [32] and [34].

Plaintiff proposes that the term should be construed as: "a modulator actually arranged so that, in each transmission symbol period, the modulator *concurrently* modulates bits of the plurality of encoded data signals that have different delays." (Chart at 8 (emphasis added)). Relying on the claim language and specification, Plaintiff injects the word "concurrently" to describe the manner in which the encoded data signals are modulated onto the multiple carriers. Plaintiff explains that the allocation of bits onto the carriers must occur simultaneously during a symbol period. Plaintiff bases its contention, in part, on the patentees' use of the phrase "in each transmission symbol period."

Plaintiff also refers to other claims in the patent to support its construction. Plaintiff focuses on Claim 15 which recites "applying FECC ... coding and codeword interleaving differently to signals of different data channels to produce encoded data signals having different delays." '604 Patent, col. 13, ll. 43-46. From this language, Plaintiff contends that on its face, the claim "refers to at least two data channels, and specifies that

one of these data channels will be coded and codeword-interleaved in a first way, while *at the same time* another of these data channels will be coded and codeword-interleaved in a different way." (Pl.'s Opening Br. at 35-36 (emphasis added)). Moreover, Plaintiff relies on various portions of the specification as evidence that "the patent throughout contemplates simultaneous data signals, each with different degrees of delay, different ... coding [and] different interleaving." (Tr. at 125:23-25).

The Court disagrees with Plaintiff, finding that its construction unjustifiably attempts to import an additional limitation into the claim by adding the word "concurrently." Upon reviewing the patent's claims and specification, the Court concludes that there is nothing in the patent's disclosure requiring "concurrent" or "simultaneous" transmission of data signals. One glaring fact belying Plaintiff's arguments is the absence of the word "concurrently" in the patent. Indeed, Plaintiff admitted at the *Markman* hearing that the word "concurrently" does not appear in the patent at all. (Tr. at 124:18-19). Thus, the crux of Plaintiff's argument is that "concurrent" modulation is implicitly required.

The intrinsic evidence demonstrates there is no such requirement. The patent's disclosure describes a symbol period as a finite period of time. *See* '604 Patent, col. 5, l. 63. For example, a symbol period may last 250 (mu)s. *See id.* Importantly, however, there is no mention that modulation amongst the multiple carriers, or anything for that matter, must simultaneously occur within that finite period. This leaves open the possibility that modulation may occur at any time, for example, during smaller time frames, within the symbol period itself. Plaintiff's reasoning would require that the modulation occurring in the multiple carriers begin and end at the same time. Clearly, this is not the case. Thus, Plaintiff's argument that modulation must be simultaneous within a symbol period is needlessly limiting and contrary to the specification.

Accordingly, the Court concludes that disputed term [25] "a modulator arranged to modulate bits of the encoded data signals onto multiple carriers of the transmission system, different numbers of bits in each transmission symbol period being allocated to different carriers" means "a modulator configured to modulate bits of encoded data signals such that different numbers of bits are allocated to different carriers in each symbol period."

3. "*programmable FECC coder arranged to be programmed by the control unit*"

Disputed term [26] is found in Claims 3 and 9 of the patent. Plaintiff contends that the term means "the control unit recited in claims 2 and 8 programs the programmable FECC coder with any parameters that relate to FECC coding and interleaving." (Chart at 8). Defendants assert that the term should be construed as: "an FECC coder capable of being programmed by the control unit." (*Id.*). Two issues predominate construction of this term. The first involves the construction of "arranged to." Rather than argue that "arranged to" means "actually arranged," Plaintiff now asserts that "arranged to program" means "programs." Plaintiff has not proffered sufficient evidence or argument to convince this Court that the term should be construed as "programs." Accordingly, the Court will once again adopt the ordinary meaning of "arranged" and construe this phrase to mean "configured to."

The second issue is whether "any" parameters that relate to FECC coding and interleaving must be set through the control unit. Plaintiff submits that the term "control unit" in Claim 3 derives its antecedent basis from Claim 2. Claim 2, an independent claim, states:

2. A data transmission system using multicarrier modulation, comprising:

FECC (forward error correction code) coding and codeword interleaving apparatus arranged for differently encoding a plurality of data signals to provide a plurality of encoded data signals with different delays through the coding and interleaving apparatus, the coding and interleaving apparatus comprises a first store for storing the plurality of data signals, a second store, an FECC coder coupled between an output of the first store and an input of the second store, and a *control unit* for controlling the supply of data signals from the first store to the coder and for controlling storage of FECC codewords from the coder into the second store to provide codeword interleaving; and

a modulator arranged to modulate bits of encoded data signals onto multiple carriers of the transmission system, different numbers of bits in each transmission symbol period being allocated to different carriers.

'604 Patent, col. 11, ll. 21-39 (emphasis added). Claim 8, the claim on which Claim 9 depends, recites, in pertinent part:

8. A data transmission system using multicarrier modulation, comprising:

FECC (forward error correction code) coding and codeword interleaving apparatus ... the coding and interleaving apparatus comprises ... a *control unit* for controlling the supply of data signals from the first store to the coder and for controlling storage of FECC codewords from the coder into the second store to provide codeword interleaving....

'604 Patent, col. 12, ll. 24-39 (emphasis added). On this basis, Plaintiff argues that the control unit as recited in Claims 2 and 8 sets "any" parameter that relates to the FECC coding and interleaving. In contrast, Defendants argue that the word "any" does not appear in Claims 3 or 9 or in the specification. Further, Defendants assert that the patent's disclosure does not define or limit the types of parameters that are being controlled by the control unit. (Tr. at 129:4-18).

The Court agrees that the "control unit" recited in Claim 3, which is a dependent claim, derives its antecedent basis in Claim 2. Plaintiff's proposed construction, however, is unduly restrictive and unsupported by the claim language and specification. Claim 2 itself does not recite the phrase "with any parameters that relate to FECC coding and interleaving." Nor does the Court find this limitation inherent in the claim language as Plaintiff suggests. Additionally, the specification does not mention this limitation when describing the FECC coder. It states: "The coder 72 is programmed by the control unit 68 to perform sequentially the functions of the plurality of FECC coders 32 in Fig. 2, and R can be different for different FIFOs of the RAM 70." '604 Patent, col. 9, ll. 9-12. Therefore, the Court declines to import such a limitation into the claim.

Accordingly, the Court construes disputed term [26] "programmable FECC coder arranged to be programmed by the control unit" to mean "programmable FECC coder configured in a way that enables it to be programmed by the control unit."

4. "the modulator is arranged to allocate bits of encoded data signals having relatively less interleaving to carriers carrying relatively fewer bits in each symbol period"

The next disputed term is found in Claims 7 to 14 and 17 to 20 of the '604 Patent. Plaintiff proposes that the term means "the modulator is actually arranged to allocate bits such that, in each symbol period, carriers that have been allocated relatively fewer bits will be modulated to include bits from data signals having

relatively less interleaving." (Chart at 8). Defendants assert that term means "the modulator is capable of allocating bits of encoded data signals having relatively less interleaving to carriers carrying relatively fewer bits in each symbol period." (*Id.*). Again, the issue arises concerning the construction of "arranged to ." The Court will adopt the ordinary meaning of this phrase as articulated above.

In their Reply brief, however, Defendants suggested that Plaintiff's construction could be interpreted to exclude the possibility that interleaved, or slow, data can be allocated to the carriers carrying fewer bits. (Defendants' Reply at 27). Although the Court does not interpret Plaintiff's construction as necessarily incorporating that limitation, the Court concludes that the disputed term should not be construed in such a way that prohibits the encoded data signals with greater interleaving from being allocated to the carriers with fewer bits.

Accordingly, the Court construes disputed term [27] "the modulator is arranged to allocate bits of encoded data signals having relatively less interleaving to carriers carrying relatively fewer bits in each symbol period" to mean "the modulator is configured in a way such that it allocates bits of encoded data signals with relatively less interleaving to carriers with relatively fewer bits in each symbol period."

5. *"means for reading the respective number of bits for each carrier from the second store in order of the different delays through the coding and interleaving apparatus"*

The next disputed term involves a means-plus-function limitation governed by 35 U.S.C. s. 112, para. 6. (*See* Chart at 9). This term is found in Claim 11 which reads:

11. A data transmission system as claimed in claim 8 wherein the modulator comprises a table for providing indices of the carriers in order of the number of bits in each transmission symbol period allocated to the carriers, *means for reading the respective number of bits for each carrier from the second store in order of the different delays through the coding and interleaving apparatus*, and sorting means for supplying the respective bits from modulation onto the respective carriers.

'604 Patent, col. 12, ll. 55-63 (emphasis added). The parties agreed that the function associated with this term is "reading the respective number of bits for each carrier from the second store in order of the different delays through the coding and interleaving apparatus." (Tr. at 133:9-10, 133:15-16; Chart at 9). The Court must now determine whether sufficient corresponding structure is disclosed in the specification and if so, identify that structure.

Plaintiff asserts that the corresponding structure for this function includes the bit and energy table 38, index table 40, trellis coder 36 in Figure 2 (also shown in Figure 3 as trellis coder 76), and the microprocessor control unit 68. (Chart at 9). In arriving at its construction, Plaintiff divides the function into two different components. First, Plaintiff excises the phrase "from the second store" from the function in order to argue that the first function is "reading the respective number of bits for each carrier in order of the different delays." (Tr. at 136:20-23, 137:13-16). This allows Plaintiff to argue that in addition to the control unit 68, the additional structures of tables 38 and 40 are necessary to carry out the function. Without these structures, Plaintiff contends that the information necessary to read the number of bits would not be available. (Tr. at 137:17-20). Plaintiff then focuses on the other component of the function, namely, "reading [the bits] from the second store." (Tr. at 137:21-23). Plaintiff asserts that the figures of the patent illustrate that the trellis coder "coordinates with [t]ables 38 and 40 in order to be able to obtain the bits from the second store." FN20 (Tr. at 138:9-14). Therefore, having broken up the function into two components, Plaintiff asserts that

the bit and energy table 38, index table 40, trellis coder 36 & 76, and the microprocessor control unit 68 are the corresponding structures required to perform these functions.

FN20. The parties represented that the "second store" or "storage" is RAM 74. (Tr. at 138:1-2; 139:7-8).

Defendants argue that the specification clearly articulates that the microprocessor control unit 68 is the only structure required to perform the function. Defendants refer to the part of the specification which provides: "The control unit 68 reads data from bits from the RAM 74 to the trellis coder 76, and stores the resulting amplitudes in the appropriate locations in the IFFT RAM 78...." '604 Patent, col. 9, ll. 35-38; (*see also* Defs.' Opening Br. at 27; Tr. at 134:15-135:3). Defendants contend that this language indicates that it is the control unit 68 that reads the data bits from the second store to the trellis coder.

The Court agrees with Defendants that the microprocessor control unit 68 is a corresponding structure for the claimed function. The parties agreed that the function being performed is "reading." Plaintiff's argument that there are two claimed functions is wrong. The Court concludes, and the parties agreed, that only one function is claimed here and that is a "reading" function. Further, Plaintiff's argument that additional structure is required to perform the claimed function is partly right. The portion of the specification cited by Defendants clearly indicates that it is the control unit that performs this "reading" function.

However, if one does not crop the quote from the patent as Defendants do, and reads it in its entirety, it is also clear that the control unit uses tables 38 and 40 to perform the reading function. *See* '604 Patent, col. 9, ll. 35-39 ("The control unit 68 reads data bits from the RAM 74 to the trellis coder 76, and stores the resulting amplitudes in the appropriate locations in the IFFT RAM 78, *in accordance with the data in these tables and in the manner already described.*") (emphasis added). As for the trellis coder, the specification does not link it to the claimed function. Indeed, it specifically states it is not a necessary component of the claimed invention. '604 Patent, col. 7, ll. 7-14 ("In addition it is observed that, while preferred, the use of trellis coded modulation is not essential to the invention."). Therefore, the Court finds that the corresponding structure is the microprocessor control unit 68 and tables 38 and 40, since the specification clearly identifies these structure as the structures that perform the "reading" function.

Accordingly, the Court concludes that disputed term [28] "means for reading the respective number of bits for each carrier from the second store in order of the different delays through the coding and interleaving apparatus" has the claimed function of "reading the respective number of bits for each carrier from the second store in order of the different delays through the coding and interleaving apparatus," and the corresponding structures are the microprocessor control unit 68 and tables 38 and 40.

6. " *sorting means for supplying the respective bits for modulation onto the respective carriers* "

The next disputed term is likewise found in Claim 11. The parties dispute whether "sorting means for supplying the respective bits for modulation onto the respective carriers" is a means-plus-function limitation that is governed by 35 U.S.C. s. 112, para. 6. Plaintiff asserts that the term is governed by s. 112, para. 6 and that the claimed functions are: 1) "sorting" and 2) "supplying the respective bits for modulation onto the respective carriers." Plaintiff argues, however, that there is no corresponding structure disclosed in the specification and therefore, the claim is indefinite and invalid. (Pl.'s Opening Br. at 40-41; Chart at 9). Defendants contend that the term is not governed by s. 112, para. 6 and should be construed as "the apparatus that classifies the data to be modulated and supplies that data to the modulator for modulation."

(Chart at 9). If the Court concludes that the term is a means-plus-function limitation, Defendants argue in the alternative that the claimed function is "supplying bits for modulation onto the respective carriers" and that it is performed by: 1) sorter 42 and 2) microprocessor control unit 68 programmed to perform that function. (*Id.*).

The Court will first address whether s. 112, para. 6 is applicable in this instance. As discussed previously in this Opinion, the use of the word "means" is central to the court's analysis when determining whether s. 112, para. 6 applies to a particular claim term. *See supra* Part II.A.8. Use of the word "means" creates the presumption that the statutory mandate of s. 112, para. 6 is triggered. *Personalized Media Communications, LLC v. Int'l Trade Comm'n*, 161 F.3d 696, 703-04 (Fed.Cir.1998). The presumption, however, may be rebutted.

Defendants cite *Allen Engineering Corp. v. Bartell Industries, Inc.*, 299 F.3d 1336 (Fed.Cir.2002), in support of their contention that the presumption is overcome in this instance. In that case, the Federal Circuit articulated that the presumption may be rebutted in two ways: 1) "a claim element that uses the word 'means' but recites no function corresponding to the means does not invoke s. 112, para. 6" and 2) "even if the claim element specifies a function, if it also recites sufficient structure or material for performing that function, s. 112, para. 6 does not apply." *Id.* (quotations and citations omitted). The court further explained that sufficient structure is recited if the name for the structure "has a reasonably well understood meaning in the art." *Id.* (citing *Watts v. XL Sys., Inc.*, 232 F.3d 877, 880-81 (Fed.Cir.2000)).

Defendants argue that the presumption is rebutted here because a person of ordinary skill in the art would interpret "sorting means" to mean "sorter." Defendants assert that "sorter" is a known structure in the art of digital communications. (Defs.' Reply at 27 (citing Williams Report, para. 200)). The Court concludes, however, that Defendants have not proffered sufficient evidence to overcome the presumption that s. 112, para. 6 applies. The Court finds Dr. Williams' opinion on which Defendants wholly rely to be conclusory. More importantly, the plain language of the claims supports the conclusion that "sorting means" is not structure. While the drafters of the patent distinctly chose the term "sorting means" in Claim 11, the drafters chose to use the term "sorter" in the following claim, Claim 12. '604 Patent, col. 13, l. 5. This belies Defendants' assertion that "sorting means" connotes structure since the patentees could have chosen to use the term "sorter" in Claim 11 but chose not to.

Moreover, the term is clearly expressed in functional, rather than structural language. *See Sage Prods., Inc. v. Devon Indus., Inc.*, 126 F.3d 1420, 1428 (Fed.Cir.1997) (concluding that "closure means ... for controlling access" was properly construed as a means plus function limitation because it recited a function for the means and did not expressly recite structure needed to perform that function in the claim). Therefore, based on the term's use of the word "means," the presence of a function related to the means, and the absence of structure in the claim relating to the performance of the function, the Court concludes that the disputed term is governed by s. 112, para. 6.

The Court must now determine the function recited by the claim, and whether the specification discloses corresponding structure that performs the function. The parties agree that "supplying the respective bits for modulation onto the respective carriers" is a function of the term, but dispute whether "sorting" is another claimed function. (Chart at 9; Tr. at 143:1-18). Defendants argue that "sorting" should be construed as a descriptor of the means and not a function of the limitation. (Tr. at 143:11-13). The Court agrees with Defendants. Plaintiff merely states that "sorting" should be included as a function, but does not offer any explanation as to why this is the case. (Pl.'s Reply at 30). As with the Court's prior analysis of means-plus-

function claims, the corresponding function is what is performed by the means. In this case, this is clearly the function of "supplying the respective bits for modulation onto the respective carriers," which in essence involves "sorting." Plaintiff has not identified how "sorting" is different than the claimed function and why it should be separately adopted. In the absence of case law and evidence suggesting that "sorting" should be included as an additional function, the Court will not construe the term as claiming this second function.

With respect to corresponding structure, Plaintiff asserts that the specification does not disclose such structure. In Defendants' Claim Construction briefs, Defendants argue that the corresponding structure would be sorter 42, and not the trellis coder 76. (Defs.' Opening Br. at 31; Defs.' Reply at 28). At the *Markman* hearing, however, Defendants changed their position and asserted that the corresponding structure is the sorter 42 and microprocessor control unit 68. Defendants refer the Court to the specification which provides: "For each subchannel index *i* the trellis coder 36 produces amplitudes ... which are written by the sorter 42 into a position *i* in the buffer at the input of the IFFT apparatus 44." '604 Patent, col. 8, ll. 13-17. Defendants argue that this language supports their contention that the "supplying" function is performed by the sorter. (Tr. at 143:22-145:2).

Defendants point to another portion of the specification to support their argument that the microprocessor control unit 68 is also required to perform this function. In particular, the specification states: "The control unit 68 reads data bits from the RAM 74 to the trellis coder 76, and stores the resulting amplitudes in the appropriate locations in the IFFT RAM 78...." '604 Patent, col. 9, ll. 35-38.

The Court concludes that the corresponding structures disclosed in the specification are the bit and energy allocation table 38, the carrier index table 40, and the sorter 42. This is based on language in the specification which clearly designates these structures as the structures that perform the "supplying" function. In particular, the specification states: "The units 36 to 42 serve to read bits of the codewords from the buffers 34, implement trellis coding, *and supply resulting amplitudes to the IFFT apparatus 44* in each transmission symbol period for transmission via the multicarrier subchannels." '604 Patent, col. 6, ll. 45-50. As previously discussed, the trellis coder 36, although mentioned in this excerpt as structure involved in performing the "supplying" function, remains a structure not essential to the invention. *See* '604 Patent, col. 7, ll. 7-14. Accordingly, the Court does not construe the trellis coder as structure required to perform the claimed function.

The Court further concludes that Defendants have not proffered sufficient evidence to demonstrate that the microprocessor control unit 68 should be included as corresponding structure. The portion of the specification cited by Defendants makes no mention of its involvement with the "supplying" function, in contrast to the clear language associating the tables 38 and 40 and the sorter 42 with the claimed function.

Accordingly, the Court concludes that disputed term [29] "sorting means for supplying the respective bits for modulation onto the respective carriers" is a means-plus-function limitation that is governed by s. 112, para. 6. The claimed function is "supplying the respective bits for modulation onto the respective carriers" and the corresponding structures are the bit and energy allocation table 38, the carrier index table 40, and the sorter 42.

7. Claim Terms Involving "sorter"

The Court will analyze disputed terms [30] and [31] together as they both depend on the Court's construction of the term "sorter." FN21 The first disputed term, which is found in Claim 12, is "sorter for

supplying signal amplitudes supplied by the trellis coder to storage locations of the IFFT apparatus identified by the respective carrier indices." (Chart at 10). Plaintiff asserts that this element is governed by 35 U.S.C. s. 112, para. 6. Plaintiff contends that the functions are: 1) "sorting" and 2) "supplying signal amplitudes supplied by the trellis coder to storage locations of the IFFT apparatus identified by the respective carrier indices," and that no corresponding structure is disclosed in the specification. (*Id.*). Defendants submit that the term is not governed by s. 112, para. 6 and should be construed to mean an "apparatus that sorts." (*Id.*). In the alternative, should the Court conclude that this term is a means-plus-function limitation, Defendants argue that the function is "supplying signal amplitudes supplied by the trellis coder to storage locations of the IFFT apparatus identified by the respective carrier indices," and that the corresponding structures are the sorter 42 and the microprocessor control unit 68. (*Id.*).

FN21. Plaintiff indicated, and Defendants did not object, that the same arguments presented in disputed term [30] apply to [31]. (Tr. at 154:7-10).

The second term, which is found in Claim 22, is "sorter for sorting the carriers in accordance with the stored values." (*Id.*). Again asserting that s. 112, para. 6 governs, Plaintiff submits that the function is "sorting the carriers in accordance with the stored values" and that there is no corresponding structure in the specification. (*Id.*). Conversely, Defendants argue that this is not a means-plus-function limitation. Defendants propose that the term should be construed as "an apparatus that sorts." (*Id.*). In the alternative, Defendants propose that the function is "sorting the carriers in accordance with the stored values," with the same corresponding structure as the two previous terms. (*Id.*).

Thus, the Court must determine whether the strictures of s. 112, para. 6 are applicable to these two terms. In both instances, the word "means" is not used. Instead, the patentees purposely used the term "sorter." As previously discussed, "a claim term that does not use 'means' will trigger the rebuttable presumption that s. 112, para. 6 does not apply." *Apex Inc. v. Raritan Computer, Inc.*, 325 F.3d 1364, 1371 (Fed.Cir.2003) (citing *CCS Fitness Inc. v. Brunswick Corp.*, 288 F.3d 1359, 1369 (Fed.Cir.2002)). The presumption may collapse, however, "when a limitation lacking the term 'means' nonetheless relies on functional terms rather than structure or material to describe performance of the claimed function." *Id.* at 1372. That is not the case here. The Court concludes that "sorter" connotes structure. First, the claim itself uses the structural language "sorter," as opposed to a functional term such as "sorting means," which the patentees chose to use in Claim 11. Second, "sorter" is constantly referenced throughout the patent in structural terms and is depicted as a structure in a figure. *See* '604 Patent, col. 3, ll. 60-62; col. 5, ll. 34 & 42; col. 8, ll. 3, 15 & 28; figure 2. Additionally, Defendants' expert Dr. Williams opines that a "sorter" is a structure with a well-understood meaning in the field of digital communications. (Williams 2d Report, para. 27). Dr. Williams cites various references in which "sorter" is used as a term connoting structure. (*Id.*). Therefore, the Court finds that the claim recites sufficient structure, that is a "sorter," and does not rely on functional terms.

Having concluded that the term is not a means-plus-function limitation, the Court is left to construe the term "sorter." Unfortunately, the Court finds the record devoid of any assistance by the parties. Neither Plaintiff nor Defendants provide the Court with the ordinary meaning or dictionary definitions for "sorter," the key word in these disputed terms. The only definition given to the Court is the one proposed by Defendants, namely "an apparatus that sorts." FN22 Plaintiff offers no other definition, nor stated any objection to Defendants' proposed construction if the Court were to conclude that s. 112, para. 6 did not apply. Without any other information from which a construction may be drawn, the Court adopts Defendants' proposed construction for "sorter."

FN22. The Court notes that Defendants offered a dictionary definition for the term "sorting," but does not offer a definition for "sorter." Defs.' Opening Br. at 31.

Accordingly, the Court concludes that disputed term [30] "sorter for supplying signal amplitudes supplied by the trellis coder to storage locations of the IFFT apparatus identified by the respective carrier indices" and disputed term [31] "sorter for sorting the carriers in accordance with the stored values" are not governed by s. 112, para. 6. The Court further concludes that the term "sorter" means "an apparatus that sorts."

8. "*applying FECC (forward error correcting code) coding and codeword interleaving differently to signals of different data channels to produce encoded data signals having different delays*"

The next disputed term is found in independent Claim 15, and dependent Claims 16-18. Claim 15 reads:

15. A method of modulating multiple carriers with signals of a plurality of data channels, comprising the steps of:

applying FECC (forward error correcting code) coding and codeword interleaving differently to signals of different data channels to produce encoded data signals having different delays; and

modulating different numbers of bits of the encoded data signals onto different carriers,

wherein the step of applying FECC coding and codeword interleaving comprises the steps of:

storing signals of the different data channels;

sequentially FECC coding the stored signals to produce FECC codewords; and

storing the FECC codewords in an interleaved manner, the interleaving being different for the codewords of the different data channels.

'604 Patent, col. 13, ll. 40-56 (emphasis added). The issue before the Court is whether the application of FECC coding and codeword interleaving must be applied "concurrently." Plaintiff proposes that the term should be construed as "the FECC coding and interleaving is applied *concurrently* to at least two data channels, so that the FECC coding and interleaving that is applied to the first data channel differs from the FECC coding and interleaving that is applied to the second data channel." (Chart at 11 (emphasis added)). Defendants rely on the arguments they raised when the issue of "concurrently" was first addressed and assert that the inclusion of "concurrently" is again improper.

Based on the same reasoning previously set forth when the issue was first raised, the Court concludes that such a limitation is not warranted by the claims and specification. *See supra* Part II.C.2. Plaintiff has not offered additional arguments that persuade this Court to change its conclusion. Plaintiff merely asserts that the language "to produce encoded data signals having different delays" makes it "crystal clear" that the claim requires the "concurrently" limitation. (Tr. at 155:5-9). The Court does not agree and rejects Plaintiff's proposed construction.

Accordingly, the Court concludes that the construction of disputed term [32] "applying FECC (forward error correcting code) coding and codeword interleaving differently to signals of different data channels to produce encoded data signals having different delays" does not include the limitation "concurrently," and means "the FECC coding and codeword interleaving are applied in a way that differentiates among the data channels which results in the production of encoded data signals with different delays."

9. "storing the FECC codewords in an interleaved manner, the interleaving being different for the codewords of the different data channels"

The next disputed term also appears in Claims 15 to 18. Defendants assert that disputed term [33] means "storing the FECC codewords such that interleaving is different for the codewords of the different data channels." (Chart at 11). Plaintiff asserts that the term means "all FECC codewords, which are coded from stored signals of each of two or more different data channels, are stored in an interleaved manner, with the interleaving being different for each of the two or more different data channels." (*Id.*). Thus, Plaintiff seeks to incorporate two limitations in the construction of the term: 1) "all FECC codewords" and 2) the codewords are "coded from stored signals." (*See* Tr. at 156:18-22).

Plaintiff essentially bases its arguments on its reading of the claim language. Plaintiff submits that the storage process applies to "all" of the FECC codewords because "the claim makes no reference to any of these codewords being stored in any other manner ." Pl.'s Opening Br. at 42. Similarly, Plaintiff contends that the process of "sequentially FECC coding the stored signals" must apply to all stored signals "because no other reference is made to any other coding process involving these signals." (*Id.*).

The Court finds Plaintiff's arguments insufficient to overcome the general prohibition against importing limitations into the claim. *See* Storage Tech. Corp. v. Cisco Sys., Inc., 329 F.3d 823, 831 (Fed.Cir.2003). The Court notes that the word "all" does not appear in the claim itself. Nor has Plaintiff referenced any of the patent's disclosure that would suggest to the Court that such a narrow construction is proper. Plaintiff's construction is based on its own interpretation of the claim, and the Court disagrees with such an interpretation. Additionally, in a rather conclusory manner, Plaintiff contends that its construction should be adopted based on "antecedent basis." (*See* Tr. at 158:10-15). Again, the Court notes that the term "all" does not appear anywhere in this claim. Therefore, Plaintiff's antecedent basis argument for importing "all" as a limitation is inapt and is rejected.

Accordingly, the Court concludes that disputed term [33] "storing the FECC codewords in an interleaved manner, the interleaving being different for the codewords of the different data channels" means "storing the FECC codewords such that interleaving is different for the codewords of the different data channels."

10. "applying error correcting coding and interleaving such that the degree of interleaving differs depending on the input data channel, thereby producing encoded data signals having different delays"

The next disputed term is found in Claims 19 to 21. Plaintiff proposes the term means "the error correcting coding and interleaving is applied *concurrently* to at least two input data channels, so that the error correcting coding and interleaving that is applied to the first input data channel differs from the error correcting coding and interleaving that is applied to the second input data channel." (Chart at 12 (emphasis added)). Defendants again assert that "concurrently" is an improper claim limitation. Thus, the same issue concerning "concurrently" is presented. (*Id.* ; *see also* Tr. 158:16-159:16).

Plaintiff has not offered any arguments that convince this Court a different conclusion is warranted. *See*

Opinion Part II.C.2. Therefore, the Court rejects Plaintiff's proposed construction which incorporates this limitation. Accordingly, the Court concludes that disputed term [34] "applying error correcting coding and interleaving such that the degree of interleaving differs depending on the input data channel, thereby producing encoded data signals having different delays" does not include the limitation "concurrently," and means "the error correcting coding and interleaving are applied in such a way that the input data channels determine the degree of interleaving which results in the production of encoded data signals with different delays."

11. "*the different channels*"

The last term in dispute is "the different channels" which is found in Claims 19-21. Claim 19, which is an independent claim, provides:

19. A method for transmitting data signals to at least one receiver using multiple carriers, comprising:
receiving data signals to be transmitted from a plurality of input data channels;

applying error correcting coding and interleaving such that the degree of interleaving differs depending on the input data channel, thereby producing encoded data signals having different delays; modulating different numbers of bits of the encoded data signals onto different carriers based on the susceptibility of [35] *the different channels* to noise, thereby producing modulated data signals, the smaller the delay of the encoded data signals the fewer the number of bits said modulating uses when producing the modulated data signals for the different carriers; and

transmitting the modulated data signals to the [sic] at least one receiver using the different carriers.

'604 Patent, col. 14, ll. 4-21. Based on a plain reading of the claims, Plaintiff contends that the term refers to the "input data channels" recited in the first two elements of Claims 19 and 21. (Pl.'s Opening Br. at 43-44). Plaintiff asserts that this is a "straightforward antecedent basis argument," as the term "the different channels" derives antecedent basis from "the input data channels" appearing in the body of the claim. (Tr. at 162:9-10); *see* '604 Patent, col. 14, ll. 11 & 30.

In contrast, Defendants argue that Plaintiff's formalistic antecedent basis argument would not comport with a skilled artisan's understanding of the term. Rather, a person of ordinary skill in the art would understand "the different channels" to mean the input data channels, as well as the "communication channel in which the 'different carriers' are carried." (Chart at 12; Defs.' Reply at 30). Defendants focus on the accompanying language "based on the susceptibility of the different channels to noise" to support their argument. '604 Patent, col. 14, ll. 14-15 & 37-38. It is Defendants' position that throughout the specification, the concept of "susceptibility to noise" is always used in conjunction with regard to what they term "transmission channels" or "communication channels." (Tr. at 160:20-161:2; Chart at 12). Defendants cite two excerpts from the specification in support of their argument. The first states: "the different coders have different degrees of interleaving so that the transmitted data signals have different susceptibilities to impulse noise...." '604 Patent, col. 6, ll. 26-29. The second excerpt discloses: "[i]t follows that subchannels carrying relatively fewer bits in each symbol period are less susceptible to impulse noise (because of the greater attenuation) than subchannels carrying relatively more bits in each symbol period." '604 Patent, col. 7, ll. 47-52. Thus, Defendants contend that "the different channels" should be construed to mean the "input data channels" recited in the claim, as well as the "transmission" or "communication" channels because the specification

always refers to the channels used for transmission whenever it mentions "susceptibility to noise."

The Court finds that Plaintiff has the better argument. As the claim is written, "the different channels" refers to "the input data channels." Based on Defendants' proposed construction, Defendants are attempting to equate "channels" with "carriers." The way in which the patentees drafted this claim, however, does not support such a conclusion. First, the term "the different channels" derives antecedent basis from "the input data channels." Clearly, this is the only mention of "channels," other than the disputed term, in the claim. Second, the first three elements of the claim discuss: 1) receiving data signals from the input data channels, 2) applying a degree of coding and interleaving to the signals depending on the input data channels, and 3) modulating the encoded data signals onto different carriers based on the susceptibility of the channels to noise. Considering these elements as a whole, the focus of the claim thus far remains on coding and interleaving signals that originate from input data channels in a manner that takes into account the input data signals' susceptibility to noise, so that it may be modulated onto the carriers.

Not only does this interpretation comport with the Court's prior construction of disputed term [34], but the construction is supported by the patent's disclosure. The specification consistently mentions the different types of input data signals having different degrees of reliability.

Different types of signals, which may be required to be transmitted via a single transmission system, may have different requirements for reliability and transmission delay. For example, digital video signals that are highly compressed require a high reliability for their transmission, and ISDN voice signals must meet strict transmission delay requirements. In known transmission systems, it has been necessary to provide a compromise between high reliability and transmission delay for different types of signals.

'604 Patent, col. 2, ll. 19-27; *see also* id. at col. 14, ll. 9-12; col. 14, ll. 31-35. The specification also discusses the application of FECC coding and interleaving techniques to the various data signals from the input data channels.

A well known problem in the art of transmission systems is that of impulse noise.... In order to address this problem, it is known to apply forward error correction coding (FECC) and interleaving techniques in which a block of input data to be transmitted is augmented with parity data....

'604 Patent, col. 1, ll. 57-62. Thus, the specification describes a process of applying different degrees of coding and interleaving onto the signals from the various types of input data channels in order to deal with the problem of noise. Indeed, this touches upon the heart of the invention. Therefore, the claim, as supported by the specification, associates noise with input data channels.

Defendants' reliance on two excerpts of the specification as support for broadening the claim is tenuous at best. The first excerpt cited by Defendants may speak of "susceptibilities to impulse noise," but does not mention "transmission" or "communication" channels-the words that Defendants seek to import into the claim to broaden its applicability. The second excerpt mentions "subchannels," but again makes no mention of "transmission" or "communication" channels. Thus, the Court concludes that Defendants' broader claim construction is unsupported, and thus unwarranted, based on the patent's disclosure.

Accordingly, the Court concludes that disputed term [35] "the different channels" means "the input data channels" recited in the first two elements of the claim.

CONCLUSION

For the reasons set forth above, the disputed claim terms have the following meanings:

1. "*a programmed and possibly frequency-variable transmit power mask*" means "a programmed limit on the maximum amount of power to be transmitted in each of the several carriers which can vary by carrier";
2. "*the programmed power mask*" means "a programmed limit on the maximum amount of power to be transmitted in each of the several carriers which can vary by carrier";
3. "*power or power-spectral-density constraint*" means "an absolute limit in the transmitter power or a limit in maximum transmit power allowed at particular frequencies";
4. "*subcarrier-indexed estimates of transmission quality*" does not require that the measurements of the estimates be determined by any of the four factors enumerated in the preamble;
5. "*sorting the subcarrier-indexed estimates of the transmission quality, scaled by the desired subcarrier bit-error-rates, into an invertible ordering*" requires mere "sorting" of the estimates, i.e., segregating the estimates into groups based on specified criteria, and does not require reordering;
6. "*scaled*" means "changed by a factor";
7. "*(b) calculating bit and energy allocation tables for said multicarrier data transmission system based on the sorted subcarrier-indexed estimates*" means "steps (a) and (b) need not be performed in any particular order";
8. "*means for measuring the capability of the datalink to efficiently communicate the data bits in each said subchannel and for developing an optimum energy allocation and an optimum data bit allocation for each said subchannels*" is a means-plus-function limitation, but is indefinite because the specification fails to clearly link corresponding structure to the claimed functions, and is therefore invalid;
9. "*means for returning an indication of the monitored quality to said transmitter means*" is a means-plus-function limitation, but is indefinite because the specification fails to clearly link corresponding structure to the claimed function, and is therefore invalid;
10. "*means responsive to said indication of monitored quality and operative to change the data bit allocation among said subchannels to improve the quality of the transmission*" is a means-plus-function limitation, but is indefinite because the specification fails to clearly link corresponding structure to the claimed functions, and is therefore invalid;
11. "*transmitter means*" is not governed by s. 112, para. 6 as it connotes sufficient structure;
12. "*receiver means*" is not governed by s. 112, para. 6 as it connotes sufficient structure;
13. "a transmission system using multicarrier modulation" serves as a claim limitation and means a "transmission system using modulation of more than one carrier";

14. "*identifying symbols transmitted by the system by a symbol count*" means "connecting or associating a symbol count with individual symbols or groups of symbols";
15. "*symbol*" means "a finite, pre-selected representation of the information to be conveyed from the transmitter to the receiver";
16. "*symbol count*" means "a count of individual or groups of symbols";
17. "*transmitted symbol*" means "a symbol that is in the process of being transmitted which may or may not be in the transmitter";
18. "*received symbol*" means "a symbol that is in the process of being received which may or may not be in the receiver";
19. "*implementing said change at the transmitter in response to a transmitted symbol having a symbol count matching said value*" means "a change is effectuated at the transmitter in reaction to symbols that are in the process of being transmitted that have a symbol count matching said value";
20. "*implementing said change at the receiver in response to a received symbol having a symbol count matching said value*" means "a change is effectuated at the receiver in reaction to symbols that are in the process of being received that have a symbol count matching said value";
21. "*transmitted symbol counter for counting transmitted symbols*" means "a counter that counts symbols that are in the process of being transmitted";
22. "*received symbol counter for counting received symbols*" means "a counter that counts symbols that are in the process of being received";
23. "the carriers" means "the multiple carriers that make up the transmission system";
24. "*apparatus arranged for differently encoding a plurality of data signals*" means "the apparatus implementing the encoding is configured in such a way that it encodes more than one data signal by using at least two types of encoding that are not the same";
25. "*a modulator arranged to modulate bits of the encoded data signals onto multiple carriers of the transmission system, different numbers of bits in each transmission symbol period being allocated to different carriers*" means "a modulator configured to modulate bits of encoded data signals such that different numbers of bits are allocated to different carriers in each symbol period";
26. "*programmable FECC coder arranged to be programmed by the control unit*" means "programmable FECC coder configured in way that enables it to be programmed by the control unit";
27. "*the modulator is arranged to allocate bits of encoded data signals having relatively less interleaving to carriers carrying relatively fewer bits in each symbol period*" means "the modulator is configured in a way such that it allocates bits of encoded data signals with relatively less interleaving to carriers with relatively fewer bits in each symbol period";

28. "*means for reading the respective number of bits for each carrier from the second store in order of the different delays through the coding and interleaving apparatus*" has the claimed function of "reading the respective number of bits for each carrier from the second store in order of the different delays through the coding and interleaving apparatus," and the corresponding structures are the microprocessor control unit 68 and tables 38 and 40;

29. "*sorting means for supplying the respective bits for modulation onto the respective carriers*" is a means-plus-function limitation that is governed by s. 112, para. 6. The claimed function is "supplying the respective bits for modulation onto the respective carriers" and the corresponding structures are the bit and energy allocation table 38, the carrier index table 40, and the sorter 42;

30. "*sorter for supplying signal amplitudes supplied by the trellis coder to storage locations of the IFFT apparatus identified by the respective carrier indices*" is not governed by s. 112, para. 6, and the term "sorter" is construed as "an apparatus that sorts";

31. "*sorter for sorting the carriers in accordance with the stored values*" is not governed by s. 112, para. 6, and the term "sorter" is construed as "an apparatus that sorts";

32. "*applying FECC (forward error correcting code) coding and codeword interleaving differently to signals of different data channels to produce encoded data signals having different delays*" does not include the limitation "concurrently" and means "the FECC coding and codeword interleaving are applied in a way that differentiates among the data channels which results in the production of encoded data signals with different delays";

33. "*storing the FECC codewords in an interleaved manner, the interleaving being different for the codewords of the different data channels*" means "storing the FECC codewords such that interleaving is different for the codewords of the different data channels";

34. "*applying error correcting coding and interleaving such that the degree of interleaving differs depending on the input data channel, thereby producing encoded data signals having different delays*" does not include the limitation "concurrently," and means "the error correcting coding and interleaving are applied in such a way that the input data channels determine the degree of interleaving which results in the production of encoded data signals with different delays";

35. "*the different channels*" means "the input data channels" recited in the first two elements of the claim.