To: ANDREW LEIMER
Andrew.Leimer@fcc.gov
FCC Equipment Authorization Branch

From: Edward Gerhardt
ed@adapt4.com
Adapt4

CC: TCB - TIMCO Engineering

Re: FCC ID: TR4-A4XG1-2170

Applicant: ADAPT4 LLC.
Correspondence Reference Number: 26659
731 Confirmation Number: TC724842
Date of Original Email from Andrew Leimer: 02/17/2006
Date of Original Response from Adapt4: 03/02/2006

Subject: Adapt4 responses to Mr. Leimer's questions regarding FCC Equipment Authorization

Ref: FCC Equipment Authorization System

Question 1:
The electronic filing on-line User's Manual states that the Description field is for a "description of the product being marketed. Report and Order (FCC 05-57) clearly stated that cognitive radio is a type of technology. The operational description and the information in your user manual is inconsistent with the definition of FCC 05-57. Similarly, the information in your user manual is inconsistent with the information published on your web site. Please provide more appropriate description in the Description field and FCC ID Label to reflect a description of the product, not the technology used. Submit a new FCC ID label.

Adapt4 response to Question 1.

- **The XG1 is a radio (FCC 05-057, II (14), page 6) "whose hardware limits its transmission range to permissible frequency ranges, with software selecting a particular transmission frequency within those ranges" (i.e. non-SDR). The term "cognitive" best describes Adapt4's non-SDR technology. (IEEE P1900.1 Standard Definitions and Concepts for Spectrum Management and Advanced Radio Technologies – not all cognitive radios are software defined radios).**
- **"Cognitive Radio" is an appropriate product description for the XG1 radio as marketed.**

a) Appropriate "description of product being marketed": Cognitive Radio
b) Current FCC ID Label reflects this product description.
c) The marketing term "Cognitive Software-Defined Radio" (SDR) on website has been changed to "Cognitive Software Radio".

Please refer to ATTACHMENTS A and D for additional clarification.

Question 2:
According to the Users manual, the software versions can be changed. Please explain why this device is not filed as software defined radio per FCC 05-57 requirements for such devices. Specifically, will the radio hardware be marketed with any other versions of software that will allow it to operate outside its authorized range? If yes, will any third parties (end users, professional installers, trained technicians, etc) be able to modify, configure or load different versions of software that may change the authorized radio frequency parameters.

Adapt4 response to Question 2:

The XG1 will not be marketed with any version of software that allows it to operate outside of the authorized range or frequency parameters. Frequency band, modulation, maximum output power, and the circumstances under which the transmitter operates in accordance with Commission rules are factory set and cannot be altered by user or third party. In accordance with FCC05-057, filing as a software defined radio is not required.

Please refer to ATTACHMENT B for clarification as to user permitted changes.

Question 3:
Provide a description of how the license holders in the authorize band under Section 90.259 can benefit from using the channel blocking-out and the spectrum analyzer features of this device and ensure that they operate only on the channels available to them

Adapt4 response to Question 3:

a) The license holders in the authorized band under Section 90.259 can benefit from using the channel blocking-out feature to (1) avoid interfering with primary users and (2) partition bandwidth to permit multiple XG1 networks to operate in the same geographical area.

Other manufactured radios currently authorized by the FCC to operate under 90.259 (Telemetry, Secondary Use) cannot automatically avoid inferring with a primary licensed user when the primary user transmits on their authorized channel. Other 90.259 radios must be manually retuned (requires site visit and a new license frequency) prior to retransmission or permanently disabled (turned-off).

b) The license holders in the authorized band under Section 90.259 can benefit from using the spectrum analyzer feature as an additional static analytical tool. The display provides only a visual snapshot of spectrum as viewed by the radio.

Please refer to ATTACHMENT C for additional description of feature benefits.

ATTACHMENT A
BACKGROUND INFORMATION
RESPONSE TO QUESTION 1

Reference from FCC website:
8/02/05
Approvals for cognitive, or "smart," radio systems that became effective August 2, 2005 will facilitate continued growth in the deployment of radio equipment employing cognitive radio technologies. These "smart" radio systems are able to operate in multiple radio modes as needed to facilitate communications between different radio services and/or to avoid interference. Manufacturers should note that the new rules require some radio systems to be filed as a Software Defined Radio (SDR) if the software can be modified by third parties.

Predominate nature of most certified SDR's (Vanu, Cisco, and Meteor) is to allow a user or third party to change frequency bands. Adapt4's XG1 Cognitive Radio cannot be modified by user or third parties.

Like most digital radios manufactured today, the XG1 incorporates digital signal processing, but does not allow a user or third party to change parameters that would degrade spurious and out-of-band emissions.

As discussed with the OET several times last year, Adapt4 planned to file for equipment authorization in phases that reflect advancements in radio technologies.

Phase I, December 2005 - XG1, a non-SDR cognitive radio (CR). (30Dec05)

Adapt4 elected to file for a non-software defined radio certification for the XG1 because it is a specific product "whose hardware limits its transmission range to permissible frequency ranges, with software selecting a particular transmission frequency within those ranges" (i.e. non-SDR), and all critical operating parameters are fixed at time of manufacture per Part 90.259. Users or third parties cannot change frequency band, modulation, maximum output power or other parameters that effect emissions.

Factory-Set Parameters:

Frequency band: 217-220MHz
Modulation type: QPSK
Maximum Output power: 29dBm
Channel Spacing: 6.25 kHz (Mask E)
Bandwidth: Less than 50kHz Contiguous

Part 90.207 Types of Emissions:
90.207 (n) Other emissions:
Based on discussions and written correspondence with Mr. Tim Maguire (FCC), 6K25GXD was selected as the appropriate Emissions Designator for Adapt4's XG1 Cognitive Radio. The XG1 does not cause more interference than other currently permitted emissions for telemetry operations (A1D, A2D, F1D, and F2D)

As a prelude to future XG series certifications, Adapt4 has incorporated many security features currently found in SDR's such as Unalterable Electronic Serial Numbers (ESN),User ID/Password and Authorized Site Lists.

Because the XG1 is manufactured to operate under Part 90.259 rules, users are required to obtain a secondary user license. Since secondary licensed users cannot interfere with primary licensed user, the cognitive behavior of the XG1 is to sense the authorized band prior to transmission, i.e. the term "Cognitive Radio" (CR)". Hence, when describing our "product as it is marketed" and on our website, the term "Cognitive Radio" appears to best describe it's functionally.

Since FCC 05-057 does not specifically define the term "Cognitive Radio" (CR) and the fact that Adapt4 does not allow any user or third party to change frequency band, modulation, or maximum output power, or other operating parameters that would degrade spurious and out-of-band emissions, flexibility should be granted in Adapt4's use of the term "Cognitive Radio" (CR) on Form 731 (item 10), manuals, and website, etc. To avoid confusion with certified SDR's, Adapt4 will refer to the XG1 as a "Cognitive Radio" (CR) or "Cognitive Software Radio" (CSR). From a marketing perspective, CR and CRS are interchangeably.

Please note that on our website, we specifically state … "parameters defining frequency band, modulation, and maximum output power are preloaded at the factory to eliminate operator errors" and the XG1 operates "… using a spectrum usage policy in accordance with the FCC".

We believe the term "Cognitive Radio" reflects the correct nomenclature for form 731 (item 10) and label. (IEEE P1900.1 Standard Definitions and Concepts for Spectrum Management and Advanced Radio Technologies).

Like all manufactures, Adapt4 talks about the future of radio technology … at workshops, exhibits, conferences, website, newsletters, and press releases. But we are very clear that our future visions parallel regulatory guidelines. Examples from our website… "Under FCC guidelines, XGs will incorporate features such as …"

Other planned XG series certifications:

Phase II - Other FCC permitted secondary use bands. This will require a hardware change and new certification.

Phase III & IV – Proprietary; To be announced

ATTACHMENT B
BACKGROUND INFORMATION
REPONSE TO QUESTION 2

The product can have "feature" upgrades through software changes provided by the factory. Some typical feature changes include:

a) User data port protocol:

For example, in the water management industry, many asynchronous protocols are used. We will begin by supporting the most popular ones (such as Data Flow Systems' protocol and Modbus ASCII) and add more as the market requires. This only affects the format of user data entering the RS-232 asynchronous port; it has no effect on the radio modulation scheme.

Similarly, the Ethernet port supports a wide variety of applications, such as security monitoring video cameras, point of sale terminals and water management devices. Examples of changes to the Ethernet support would be flow control to limit the rate of Ethernet messages or routing to support IP routing applications; as with the asynchronous port example, this only affects user data processing, not the modulation scheme.

Another improvement might by adding a new type of encryption for user data packets; this only affects the format of the user data going over the air, not the modulation scheme itself.

b) Radio management improvements:

The network management system (NMS) may be upgraded in the future.
For example, additional reports may be added to improve visibility into network traffic patterns or alarms. While this is mostly done in an external computer, a new printed report might require reporting of a different set of statistics from the radio. Reporting of the statistics does not affect the radio modulation.

Another example would be adding support for the examples of a) above.

For example, a new asynchronous protocol might require storage of a host ID for inclusion in user messages, which only affects the asynchronous message format.

In the example of adding a new encryption feature, the radio may need a new management variable to store an encryption key.

c) Bug fixes that do not alter any factory set parameters:

Any change required correcting functionality to match the original intent of the software and that does not alter frequency band, modulation, or maximum output power.

The representative examples specifically DO NOT affect:

a) Frequency Band:

There are no user controls (or software updates) that can or will affect the frequency band used in the product. Such capability will not be added in any software update. (A radio for another band would be a new product and certified.) The controls related to frequency selection are those that allow the user to "select or avoid channels within the authorized band".

b) Radio modulation:

There are no controls (or software updates) that allow the user to change the radio modulation scheme.

c) Transmit power levels:

The user controls allow the user to lower the transmit power, but never to increase beyond the certified limit.

The user might want to lower power for near-in sites so that the minimum power needed is used. (The radio has automatic gain control features for this same purpose.)

In addition, hardware in the RF power circuit limits the power to the authorized level. In the case of the XG1, power is limited to a maximum of .810 watts (significantly less than the 2 Watts permitted by 90.259).

Such software updates can be made WITHOUT changing the critical radio parameters and without giving the users/operators additional controls that would permit use outside the authorized band, operating parameters, or that would effect emissions.

Specifically, professional installers, trained technicians, etc will be unable to modify, configure or load different versions of software that may change the authorized radio frequency parameters. Authorized radio frequency parameters are factory set.

ATTACHMENT C
BACKGROUND INFORMATION
REPONSE TO QUESTION 3

One of the applications of the Adapt4 radio is to support secondary use in a licensed band. It does so by detecting busy channels in real time through continuous spectral analysis and choosing channels that are not in use (by a primary or other secondary user).

As an additional layer of protection for primary licensees, the network operator can choose to administratively block out any channels in the authorized band so that they will never be among the "candidate" channels for secondary use; the operator might do this because traffic patterns show that certain of the channels are heavily used.

In addition, the operator can also use the feature to partition the available bandwidth among adjacent networks.

Thirdly, the operator may block channels used by distant networks, improving QoS in marginal situations to reduce interference caused by non XG1 radios.

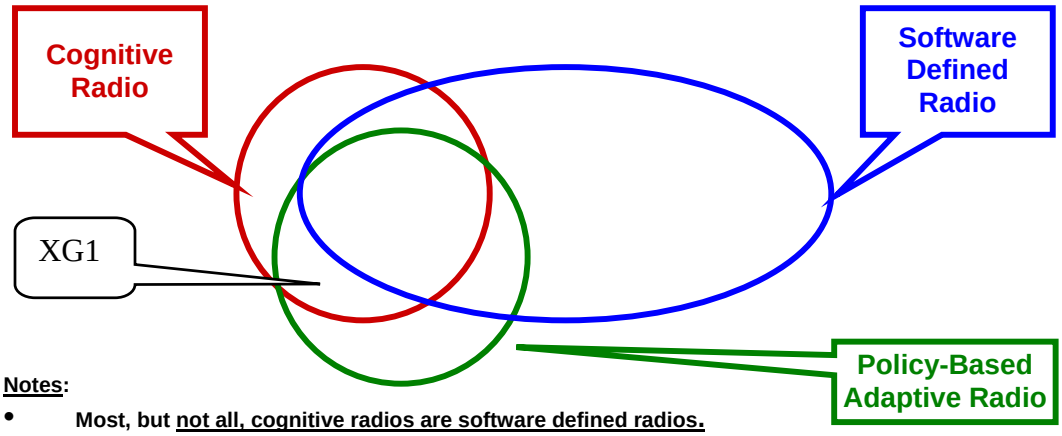
Fourthly, the operator may block channels within the authorized band to assist with determining the source of an interference complaint. The block-out function further restricts use within the authorized band. (Note: An operator can only block or unblock a channel that is within the authorized band).

With reference to the portion of this question regarding the Spectrum Analyzer" screen shown in the installation manual:

> **This screen provides a snapshot visual representation of the radio's real-time spectral analysis. The display is not tied to a user control since the actual real-time spectral analysis occurs many times per second. The display should be considered a snapshot visual statistic representing band usage. An operator might use the display to verify that the radio's view of the present band occupancy is similar to that of an external spectrum analyzer. Since this is only a display (and not a control), it can not affect usage within or outside of the authorized band.**

ATTACHMENT D
BACKGROUND INFORMATION
REPONSE TO QUESTION 1

VENN DIAGRAM
(Directly out of IEEE P1900.1)



Notes:

- **Most, but not all, cognitive radios are software defined radios.**
- **Most, but not all, cognitive radios are policy-based adaptive radios.**
- **Most, but not all, policy-based adaptive radios are software defined radios.**
- **Theoretically, both policy-based adaptive radios and cognitive radios can be implemented in hardware; however, this is not usually a practical implementation.**
- **Essentially all radios are policy-based; a policy-based radio must be adaptive in order to achieve the goal of more efficient use of the spectrum.**

***Software defined radio* [2]. (FCC Definition)** A radio that includes a transmitter in which the operating parameters of frequency range, modulation type or maximum output power (either radiated or conducted), or the circumstances under which the transmitter operates in accordance with Commission rules, can be altered by making a change in software without making any changes to hardware components that affect the radio frequency emissions.

***Software defined radio [3]*: (ITU-R Definition)** A radio in which RF operating parameters including but not limited to frequency range, modulation type, or output power can be set or altered by software, and/or the technique by which this is achieved.
NOTE 1 – Excludes changes to operating parameters which occur during the normal pre-installed and predetermined operation of a radio according to a system specification or standard.
NOTE 2 – SDR is an implementation technique applicable to many radio technologies and standards.
NOTE 3 – Within the mobile service, SDR techniques are applicable to both transmitters and receivers.

Flag added by Adapt4 to indicate functional area of XG1