Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**Additional SC Requirements for the 802.16 TG3/4 SC PHY**
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Re:	**Task Group Review of IEEE 802.16ab-01/01** **IEEE 802.16 Task Groups 3 and 4** **PHY and MAC Layers for IEEE P802.16a/P802.16b**
Abstract	The single channel (SC) physical layer specification for 802.16 TG3/4 is further delineated into basic RF/IF link, modulation, and environmental requirements.
Purpose	For consideration for inclusion in the TG3/4 PHY working document
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Additional SC Requirements for 802.16 TG3/4

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1 Introduction

This document is provided to motivate additional specifications for the 802.16 TG3/4 proposed single channel (SC) PHY signal chain performance and environmental parameters. Performance requirements are affected within transmission equipment at the baseband, IF and RF elements. It is intended to extend those requirements found in IEEE 802.16ab-01/01 and to clearly identify additional requirements that have a direct impact on the performance of compliant systems. OFDM parameters are not covered in this document, but additional considerations should be applied where applicable. It is recommended that these requirements be added after section 8.3.5.3 (starting as 8.3.5.4) in IEEE 802.16ab-01/01.

Any values provided below are suggestions for each specification. Further discussion on final values is anticipated and should be considered prior to ratification of the final standard.

2 Temperature Range

The basestation radio components shall operate within an operational environment of (TBD_{min}) to (TBD_{max}) degrees. The subscriber radio components shall operate within an operational ambient environment of (TBD_{min}) to (TBD_{max}) degrees with a solar loading of (TBD) watts/m^2. Requirements may also be used from Bellcore standards where applicable.

3 Device Requirements

3.1 Channel Frequency Accuracy

The RF channel frequency accuracy for subscriber shall be within +/- 15 parts per million (ppm) of the selected RF carrier over a temperature range of –40 to +65 degrees C operational and up to 5 years from the date of manufacture of the equipment manufacture.

The basestation can support the use of highly stable ovenized and/or disciplined oscillators. The frequency accuracy for basestation shall be within +/- 4 parts per million (ppm) of the selected RF carrier over a temperature range of –40 to +65 degrees C operational and up to 10 years from the date of manufacture of the equipment manufacture.

3.2 Carrier Phase Noise

The transmitter for the downlink shall meet an integrated double sideband (DSB) carrier phase noise of (TBD) degrees RMS from 10 kHz to 2 MHz. The uplink DSB carrier phase noise shall be (TBD) degrees RMS from 10 kHz to 2 MHz. These values should be suitable to meet the detection requirements for the respective highest mandatory modulation indices for the downlink and uplink (downlink is 64-QAM, uplink is 16-QAM).
[NOTE: This section assumes modifying Table 7 in IEEE 802.16ab-01/01 section 8.3.3.3.1 to make 64QAM for SC uplink optional.]

3.3 Symbol Rate

The symbol rate includes considerations for carrier frequency stability, analog filtering/response, and root-raised-cosine (RRC) alpha, as well as spectral mask considerations. The table below identifies the minimum and maximum symbol rates versus RF frequency bandwidth. The assumed RRC filter alpha is 0.25.

Channel Bandwidth	Minimum Symbol Rate	Minimum Symbol Rate
7 MHz	(TBD) Msps	(TBD) Msps
6 MHz	(TBD) Msps	(TBD) Msps
3.5 MHz	(TBD) Msps	(TBD) Msps
3 MHz	(TBD) Msps	(TBD) Msps
1.75 MHz	(TBD) Msps	(TBD) Msps
1.5 MHz	(TBD) Msps	(TBD) Msps

Table 2.3-1: Maximum Symbol Rates

3.4 Symbol Timing Jitter

The minimum-to-maximum difference of symbol timing over a 2-second period shall be less than 2% of the nominal symbol period. This jitter specification shall be maintained over a temperature range of –40 to +65 degrees C, operational. Additional short-term stability figures can be added for completeness.

3.5 Transmitter Minimum SNR and EVM

The transmitted signal shall have an SNR of no less than (TBD) dB at the antenna feed point. The transmitter EVM shall be no greater than (TBD)%.

3.6 Transmitter Maximum EIRP

3.6.1 Basestation Output Power

The recommended maximum output power is given in the table below for the given bands. The output power is effective isotropic radiated power (EIRP). These values assume a backoff for the minimum modulation index, 4-QAM. It is also assumed that the signal bandwidth is 6 MHz. As a practical matter, the RF output power from a basestation should be such that it can overcome cable and other losses in a tower deployment. It should not be significantly more powerful than the subscriber; otherwise the air interface would be drastically uplink limited. The subscriber side of the air interface is driven by economics that dictate lower cost and power. This would necessitate a lower power PA (as described in the next section).

Band of Interest	EIRP (120 deg sector)	EIRP (90 deg sector)	EIRP (60 deg sector)
2.15-2.162, 2.5-2.69 GHz	(TBD) dBm	(TBD) dBm	(TBD) dBm
3.5 GHz	(TBD) dBm	(TBD) dBm	(TBD) dBm
5.25-5.35 GHz	(TBD) dBm*	(TBD) dBm*	(TBD) dBm*
5.725-5.825 GHz	(TBD) dBm*	(TBD) dBm*	(TBD) dBm*
10.5 GHz	(TBD) dBm ((TBD) dBm from 10.6 to 10.68 GHz).	(TBD) dBm ((TBD) dBm from 10.6 to 10.68 GHz).	(TBD) dBm ((TBD) dBm from 10.6 to 10.68 GHz).

Table 2.6-1: Recommended Basestation Maximum EIRP
*(*FCC EIRP limit.)*

3.6.2 Subscriber Output Power

The subscriber must be economically reasonable which in turn requires that total output power should be constrained so that thermal and primary power designs are reasonable in cost and complexity. The table below itemizes the proposed subscriber EIRP requirements for each band. These values assume a backoff for the minimum modulation index, 4-QAM.

Band of Interest	EIRP (120 deg sector)	EIRP (90 deg sector)	EIRP (60 deg sector)
2.15-2.162, 2.5-2.69 GHz	(TBD) dBm	(TBD) dBm	(TBD) dBm
3.5 GHz	(TBD) dBm	(TBD) dBm	(TBD) dBm
5.25-5.35 GHz	(TBD) dBm*	(TBD) dBm*	(TBD) dBm*
5.725-5.825 GHz	(TBD) dBm*	(TBD) dBm*	(TBD) dBm*
10.5 GHz	(TBD) dBm ((TBD) dBm from 10.6 to 10.68 GHz).	(TBD) dBm ((TBD) dBm from 10.6 to 10.68 GHz).	(TBD) dBm ((TBD) dBm from 10.6 to 10.68 GHz).

Table 2.6-2: Recommended Subscriber Maximum EIRP
*(*FCC EIRP limit.)*

3.7 Transmitter Power Level Control

The transmitter shall provide up to (TBD (~50dB)) of power level control with a tolerance of +/- 3 dB.

3.8 Receiver Sensitivity

The maximum sensitivity value for the receiver, referenced to the receiver input, is identified in the following table.

Channel Bandwidth	Data Rate (Mbit/s)	Receiver Sensitivity (dBm)
7	(TBD)	(TBD)
7	(TBD)	(TBD)
7	(TBD)	(TBD)
7	(TBD)	(TBD)
6	(TBD)	(TBD)
6	(TBD)	(TBD)
6	(TBD)	(TBD)
6	(TBD)	(TBD)
3.5	(TBD)	(TBD)
3.5	(TBD)	(TBD)
3.5	(TBD)	(TBD)
3.5	(TBD)	(TBD)
3	(TBD)	(TBD)
3	(TBD)	(TBD)
3	(TBD)	(TBD)
3	(TBD)	(TBD)
1.75	(TBD)	(TBD)
1.75	(TBD)	(TBD)
1.5	(TBD)	(TBD)
1.5	(TBD)	(TBD)

Table 2.6-1: Receiver Sensitivity Values

3.9 Receiver Maximum Input Signal

The basestation shall be capable of receiving a maximum on-channel operational signal of –40 dBm and shall tolerate a maximum input signal of 0 dBm without damage to circuitry. The subscriber shall be capable of receiving a maximum on-channel operational signal of –20 dBm and shall tolerate a maximum input signal of 0 dBm without damage to circuitry.

3.10 Receiver Linearity

The receiver at the basestation and subscriber shall have a minimum input intercept point (IIP3) of (TBD (~0)) dBm.

3.11 Receiver Signal Power Measurement

The basestation and subscriber shall be able to determine input signal power to within a tolerance of (TBD) dBm, with a resolution of 1 dB.

4 Cell Requirements

This section describes the concepts of the standard cell and the extended cell. This section may be added outside of the SC section, as it is universal to OFDM as well as SC. Perhaps it can be contained within section 8.3.2 or 8.3.3.

4.1 Frequency Reuse

Frequency reuse shall be (TBD) for 3 sector cells, (TBD) for 4 sector cells, and (TBD) for 6 sector cells.

4.2 Standard Cell Structure

The standard cellular structure represents the bulk of the deployments to serve residential, SOHO and SME subscribers. In this deployment scheme, typical basestation and subscriber antennas are used. Antenna heights are assumed to be roughly 100 feet for the basestation antennas and 20 feet for the subscriber. This deployment would be used in higher density deployments such as urban, suburban and perhaps small towns. The cell radii are given below for each of the SUI link model categories.

		Cell Radius		
Band of Interest	**# Sectors**	**SUI Category A**	**SUI Category B**	**SUI Category C**
2.15-2.162, 2.5-2.69 GHz	3	(TBD) km	(TBD) km	(TBD) km
	4	(TBD) km	(TBD) km	(TBD) km
	6	(TBD) km	(TBD) km	(TBD) km
3.5 GHz	3	(TBD) km	(TBD) km	(TBD) km
	4	(TBD) km	(TBD) km	(TBD) km
	6	(TBD) km	(TBD) km	(TBD) km
5.25-5.35 GHz	3	(TBD) km	(TBD) km	(TBD) km
	4	(TBD) km	(TBD) km	(TBD) km
	6	(TBD) km	(TBD) km	(TBD) km
5.725-5.825 GHz	3	(TBD) km	(TBD) km	(TBD) km
	4	(TBD) km	(TBD) km	(TBD) km
	6	(TBD) km	(TBD) km	(TBD) km
10.5 GHz	3	(TBD) km	(TBD) km	(TBD) km
	4	(TBD) km	(TBD) km	(TBD) km
	6	(TBD) km	(TBD) km	(TBD) km

Table 4.1-1: Sector Radii for Standard Cells

4.3 Extended Cell Structure

The extended cell structure would be used for deployments where subscriber densities are lower, or where cell fringes move from moderate populations to more sparse populations (outskirts of town). In this deployment, basestation antenna heights of 300 feet would be used to support less obstructed link paths. Subscriber antennas would be place as high as practical but shouldn't differ much from the standard cell structure. To support the increased link distance, higher gain antennas (>21 dBi) could be used on the subscribers, and spatially diverse

(beamforming) antennas could be used at the basestation. Narrower bandwidth signals could also be used for the fringe subscribers, provided proper filtering is properly employed. These cells could support greater than twice the standard cell radius. The minimum cell radii are given in the table below.

		Cell Radius		
Band of Interest	**# Sectors**	**SUI Category A**	**SUI Category B**	**SUI Category C**
2.15-2.162, 2.5-2.69 GHz	3	(TBD) km	(TBD) km	(TBD) km
	4	(TBD) km	(TBD) km	(TBD) km
	6	(TBD) km	(TBD) km	(TBD) km
3.5 GHz	3	(TBD) km	(TBD) km	(TBD) km
	4	(TBD) km	(TBD) km	(TBD) km
	6	(TBD) km	(TBD) km	(TBD) km
5.25-5.35 GHz	3	(TBD) km	(TBD) km	(TBD) km
	4	(TBD) km	(TBD) km	(TBD) km
	6	(TBD) km	(TBD) km	(TBD) km
5.725-5.825 GHz	3	(TBD) km	(TBD) km	(TBD) km
	4	(TBD) km	(TBD) km	(TBD) km
	6	(TBD) km	(TBD) km	(TBD) km
10.5 GHz	3	(TBD) km	(TBD) km	(TBD) km
	4	(TBD) km	(TBD) km	(TBD) km
	6	(TBD) km	(TBD) km	(TBD) km

Table 4.2-1: Minimum Sector Radii for Extended Cells