

**System Reference Design** **Product Brief**  
**PC8530 OFDMA (IEEE802.16e) Basestation PHY**

**Description**

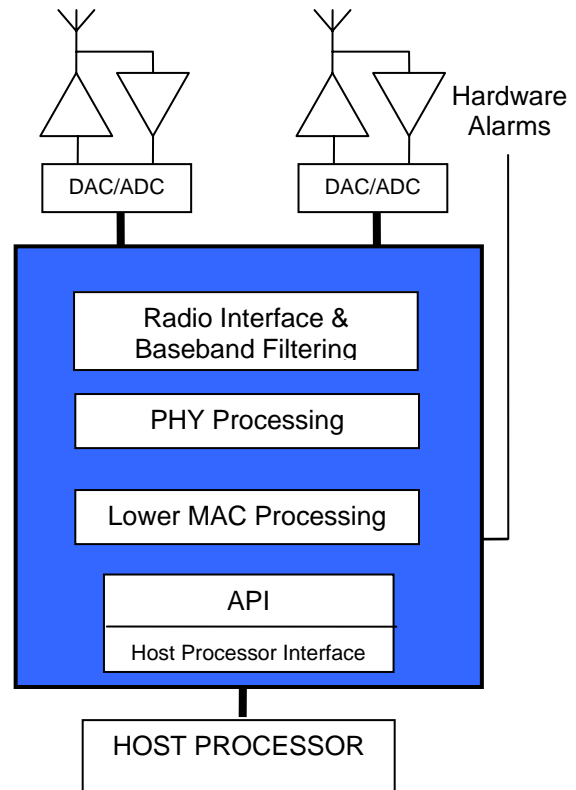
PC8530 system reference design provides a complete software-defined implementation of the WiMAX IEEE 802.16e OFDMA PHY and lower MAC with “carrier-class” reliability and performance for nomadic and mobile applications. PC8530 is specified to support all mandatory features of WiMAX Forum MTG R1.0 profile [3].

The reference design supports all the mandatory features of the 802.16e OFDMA PHY together with additional features, including optional CTC and HARQ.

Channel bandwidths of up to 10MHz are supported with payload data rates up to 37Mbps.

The design is completely software-based which allows rapid customization with customer IP, optimisation of algorithms for enhanced performance or feedback into the design from deployment experience.

An application programming interface (API) is provided which interfaces the upper MAC to the picoChip scalable OFDMA PHY and lower MAC. A host processor interface carries the control and data messages associated with the API.



**Figure 1: PC8530 Context Diagram**

**1 PC8530 Product Features**

- Efficient PHY baseband: typically 2 x PC102 or 1 x PC203, depending on selected features.
- Full 802.16e Scalable OFDMA PHY.
- FFT size: 1024, 512, 128.
- Complies with WiMAX forum release 1 profile for 802.16e systems.
- Flexible picoArray based architecture allows provision for IO-BF & IO-MIMO via Arraycomm
- Meets WiMAX Forum SPWG performance requirements up to 120km/h true mobility [4].
- Convolutional Turbo Code support (CTC).
- Open, flexible API simplifies PHY/MAC integration.
- Based upon proven PC7218 complete hardware reference design for baseband processing, power supplies and analog interfaces.
- Flexible radio interface: Zero-IF, OBSAI RP3-01
- Complete suit of powerful easy to use tools and associated training/documentation included.

Parameter	Value
Channel	3.5, 5, 7, 8.75 & 10MHz FDD (H-FDD)/TDD
Radio Interface	Zero-IF Optional OBSAI RP3-01 I/F in conjunction with Filtronic Upgrade to IO-BF & IO-MIMO via Arraycomm
Additional features	Scalable OFDMA PHY (128, 512 & 1024 FFT) Lower MAC functions (HCS, CRC) Two-branch receive antenna diversity (MRC) Transmit STC PUSC, FUSC, AMC(2*3) Convolutional Turbo Code H-ARQ

**Table 1: PC8530 Product Features Summary**

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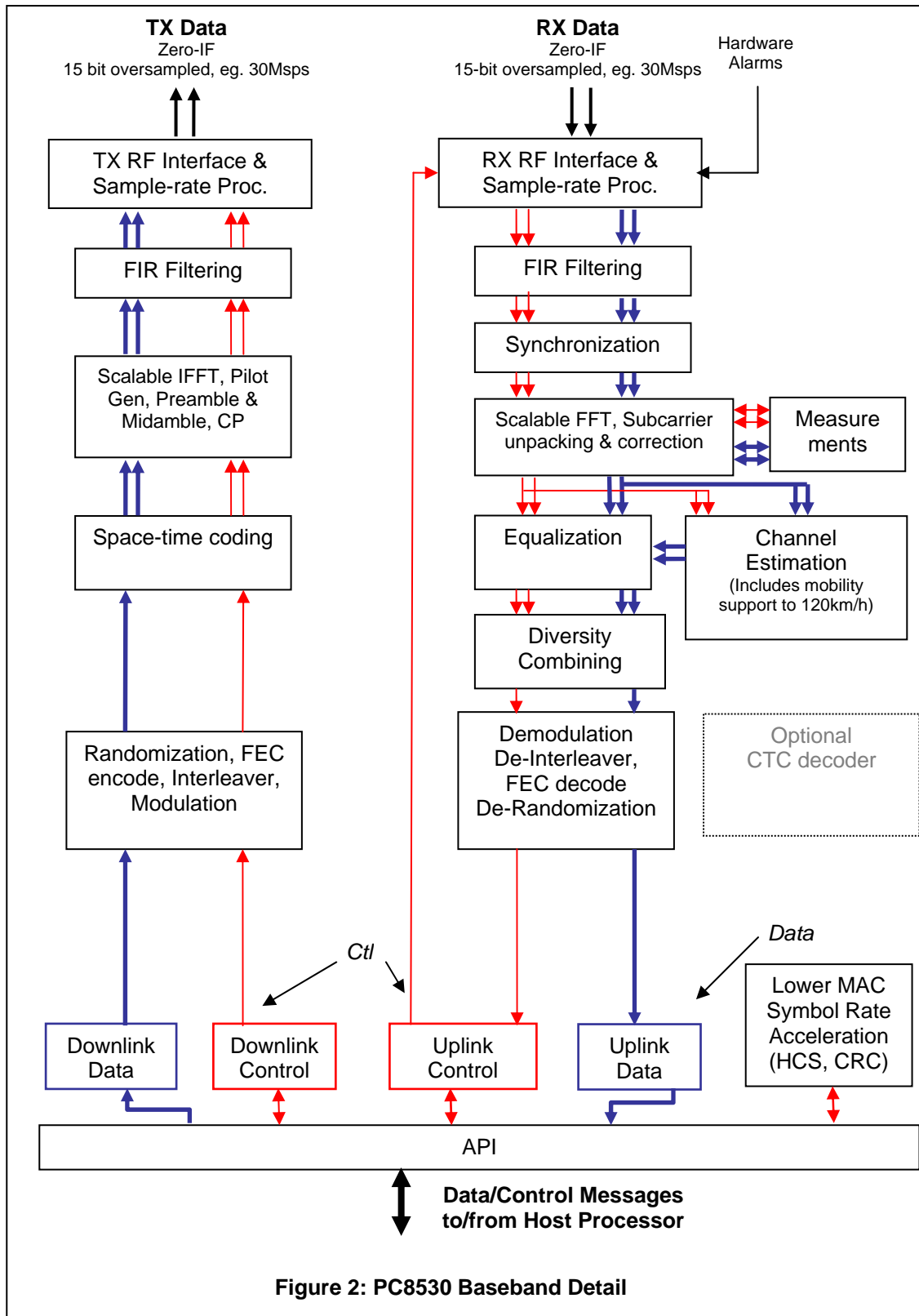


Figure 2: PC8530 Baseband Detail

## **2 System Components**

### **2.1 Code Library**

The PC8530 system reference design includes a complete validated code library implementing the IEEE802.16e-2005 OFDMA PHY [1][2]. The code library is fully optimized to execute on the picoChip PC102 and PC203 picoArray processors.

### **2.2 Radio Interface & Baseband Filtering**

The PC8530 architecture supports a wide variety of interface modes, to make it possible to connect to different radio architectures. The inclusion of software defined digital filtering enables fast and flexible adaptation to specific radio implementations.

The standard configuration supports two transmit antennas (STC) and two receive (MRC) for diversity gain. However, the I/O arrangement can be extended to allow multiple antennas for IO-BF or IO-MIMO applications. (Note: This would require additional code from picoChip partner Arraycomm to implement the specific algorithms, and will require additional picoArray devices).

Optional OBSAI RP3-01 interfacing is supported in conjunction with picoChip partner Filtronic. OBSAI RP3-01 represents a standardised digital interface allowing inter-connect to remote multi-element radio heads. More details are available upon request.

### **2.3 PHY Performance**

PC8530 will be simulated with the following ITU channel conditions as per the WiMAX Forum SPWG mobility profile requirements [4]:

- Stationary environment with AWGN channel model.
- Pedestrian environment with 3Km/h speed, and Ped A channel model.
- Pedestrian environment with 3Km/h speed using Ped B channel model.
- Vehicular A channel model with a speed of 60Km/h.
- Vehicular A channel model with a speed of 120Km/h.

### **2.4 Lower MAC Processing**

Lower MAC acceleration is provided in order to optimise the processing requirements on the MAC host processor. MAC HCS and CRC operations are performed on the picoArray via the PC8530 API. With both HCS and CRC operations being computationally intensive, this offloads processing burden from the host processor.

### **2.5 PC8530 API**

The PC8530 is provided with a clearly defined software MAC/PHY API. This API has been developed to allow simplified integration of MAC protocol stacks onto the PHY layer and is independent of the MAC hardware platform. The API addresses both control and data plane functions such as MAC PDUs and notifications of error conditions from the PHY.

## 2.6 Development Tools

Delivered as part of the complete system reference design, picoChip tools provide an easy to use development environment. Source code can be developed in ANSI C or assembler, and then compiled and executed either on hardware (either picoChip or customers' own platform) or the cycle accurate simulation engine.

## 2.7 PC7218 Baseband Hardware Reference Design

The PC7218 forms a complete baseband reference design platform, allowing a stable platform for system level testing and debug. The platform comprises of an MCP8560 PowerPC host processor to support MAC functions along with two PC102 picoArrays for PHY level processing. A comprehensive set of interfaces are included for simple connection to various radio solutions. Please contact picoChip for more details & pricing.

## 3 PC8530 Basestation PHY Profile Specification

PC8530 supports a flexible PHY architecture implemented completely in software. This flexible architecture allows seamless support and migration between evolutions of standards.

picoChip PC8530 PHY layer is designed to conform to WiMAX Forum Release 1 profile [3]. The profile can be summarised as follows, for a complete specification please contact picoChip.

Section	Item	Description	Reference	WiMAX Forum resolution	picoChip Compliance
				BS Req.	Compliance
<b>4.1.1.1 PHY Mode</b>					
	1	OFDMA	8.4	Y	Y
<b>4.1.1.3 Sampling Factor</b>					
	1	If channel bandwidth is a multiple of 1.75MHz then n=8/7 else if channel bandwidth is a multiple of any of 1.25, 1.5, 2 or 2.75 MHz then n=28/25 else if not otherwise specified then n=8/7.	8.4.2.3	Y	Y
<b>4.1.1.4 Cyclic Prefix</b>					
	1	1/4	8.4.2.3	N	Y
	2	1/8	8.4.2.3	Y	Y
	3	1/16	8.4.2.3	N	Y
	4	1/32	8.4.2.3	N	Y
<b>4.1.1.5 Frame Length</b>					
	1	20 msec	8.4.5.2	N	Y
	2	12.5	8.4.5.2	N	Y

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3	10	8.4.5.2	N	Y
4	8	8.4.5.2	N	Y
5	5	8.4.5.2	Y	Y
6	4	8.4.5.2	N	Y
7	2.5	8.4.5.2	N	Y
8	2	8.4.5.2	N	Y

4.1.1.6 TTG/RTG

1	TTG	8.4.5.2	Y	Y
2	RTG	8.4.5.2	Y	Y

4.1.1.7 DL and UL Ratios

1	DL ratio	8.4.4.2	Y	Y
2	UL ratio	8.4.4.2	Y	Y

4.1.2 Subcarrier Allocation

4.1.2.1 DL Subcarrier Allocation

1	PUSC	8.4.6.1.2.1	Y	Y
2	PUSC w/ all subchannels	8.4.6.1.2.1	Y	Y
3	PUSC w/ dedicated pilots	8.4.6.1.2.1, 8.4.5.3.4	IO-BF	Y
4	FUSC	8.4.6.1.2.2	Y	Y
5	FUSC w/ dedicated pilots	8.4.6.1.2.2, 8.4.5.3.4	N	N
6	Optional FUSC	8.4.6.1.2.3	N	N
7	O-FUSC w/ dedicated pilots	8.4.6.1.2.3, 8.4.5.3.4	N	N
8	AMC 1x6	8.4.6.3	N	N
	AMC 2x3	8.4.6.3	Y	Y
	AMC 3x2	8.4.6.3	N	
	Default Type	8.4.6.3 and 6.3.2.3.43.2	N	N
9	AMC 1x6 w/ dedicated pilots	8.4.6.3, 8.4.5.3.4	N	N
	AMC 2x3 w/ dedicated pilots	8.4.6.3, 8.4.5.3.4	IO-BF	Y
	AMC 3x2 w/ dedicated pilots	8.4.6.3, 8.4.5.3.4	N	N
10	PUSC-ASCA	8.4.6.4.1	N	N

4.1.2.2 UL Subcarrier Allocation

1	PUSC	8.4.6.2.1	Y	Y
2	Optional PUSC	8.4.6.2.5	N	N
3	AMC 1x6	8.4.6.3	N	N
	AMC 2x3	8.4.6.3	Y	Y
	AMC 3x2	8.4.6.3	N	N
4	Mini-subchannel	8.4.6.2.4	N	N

## 4 PC8530 Conformance

PC8530 will be taken through WiMAX Forum plug fests & certification in conjunction with MAC and radio solutions as soon as conformance facilities are operational. In the meantime, the solution is extensively tested by picoChip and its partners, including extensive 3<sup>rd</sup> party private IOT testing.

Contact picoChip ([www.picochip.com](http://www.picochip.com)) for detailed information available under NDA.

## 5 References

All references within this document have been made based upon the IEEE std 802.16-2004 & IEEE std 802.16e-2005 baseline standards.

- [1] IEEE std 802.16-2004
- [2] IEEE std 802.16e-2005
- [3] WiMAX Forum MTG Mobile WiMAX System Profile v1.0
- [4] WiMAX Forum SPWG Mobility Profile Requirements v1.0

More details on Arraycomm can be found at [www.arraycomm.com](http://www.arraycomm.com)

More details on Filtronic can be found at [www.filtronic.com](http://www.filtronic.com)

More details on WiMAX can be found at [www.wimaxforum.org](http://www.wimaxforum.org)

More details on IEEE802.16 can be found at [www.wirelessman.org](http://www.wirelessman.org)