Jump Start
Your Small Cell Equipment Design

Freescale's solutions
from the air to the core

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Overview

Now that the first wave of LTE macrocell network buildouts is complete, wireless network operators are starting to concentrate on how to reach the next level of data capacity. Some estimates show a 66% compound annual growth rate in global wireless data traffic through the year 2018.* In order to satisfy this rising demand for wireless data, operators are turning to small cells to reduce network costs and increase wireless network capacity.

Small cells provide cost savings for operators in multiple ways. In addition to the lower CAPEX for a small cell base station, small cells also reduce operating costs. Real estate costs are much lower for small cells, because they can be mounted on street furniture or directly to buildings, rather than requiring roof space or land for a macrocell tower installation. Many small cells installations will use the public Internet for backhaul, which dramatically lowering backhaul costs compared to traditional leased lines. With the addition of self-organizing networks (SON), deployment and operation costs will also decrease. SON will allow some small cells to be installed and activated by customers, and it will decrease the amount of effort required to tune base station configurations to maintain the required network performance.

However, small cells must also grow the capacity and throughput of wireless networks. Small cells increase wireless data rates by placing the base station closer to the consumer. This effect is magnified for indoor installations, where small cells bypass the signal loss caused from passing through the exterior walls of homes or businesses. This increases the signal quality and signal strength at the mobile device, allowing higher order MIMO to be used and increasing data rates. Placing the base station closer to the user also decreases uplink electromagnetic emission from the mobile, reducing interference toward the macro base stations that are serving other users outside of the range of the small cell.

Small cells will be deployed in a variety of capacity and power ranges; this brochure provides a summary of the most popular small cell options.

Base Station Classification

Small Cell Category	Number of Active Users	Output Power (dBm)	Multimode
Femtocell	8–32 users	10–13	Single and multimode
Enterprise picocell	32–128 users	24–27	Single and multimode
Outdoor picocell	32–128 users	24–30	Single and multimode
Metrocell/microcell	100–256 users	30–37	Single and multimode

Heterogenous Network Trends
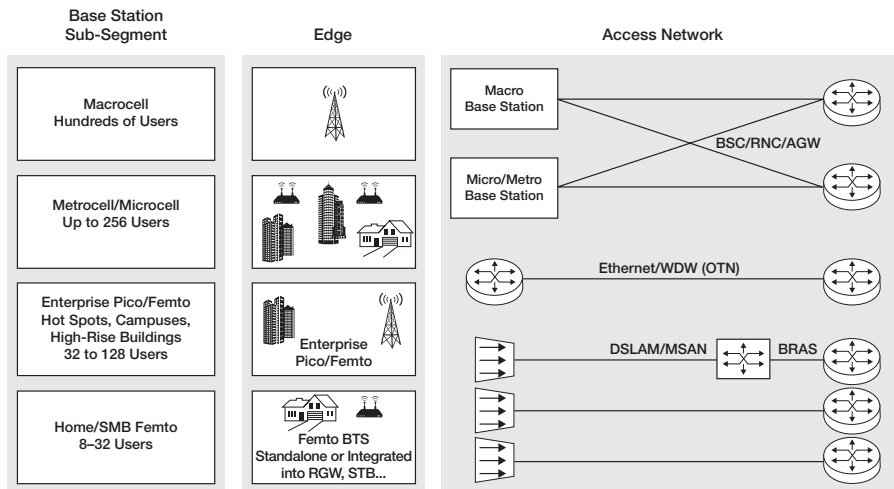
*Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2012–2018
**http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/
white_paper_c11-520862.html**

Femtocell Base Station Solutions

Femtocells are low-power wireless access points that operate in licensed spectrum and are operator-managed. Consumer femtocells provide improved cellular coverage and capacity. They are mainly used in a home or a small office environment. Femtocells facilitate a new breed of mobile service that exploits the technology's ability to detect presence and connect and interact with alternative networks. Once in operation, a consumer femtocell offloads wireless connections from the surrounding macrocell base station, using the broadband Internet connection to communicate to the network operators' core network. The implementation of consumer femtocells along with macrocells creates a heterogeneous network. Femtocells can operate in multiple bands and protocols such as 3G WCDMA and 4G LTE.

For more information, visit **freescale.com/BSC9131RDB**, **freescale.com/BSC913XRF**.

Baseband Processing

Function	Description	Part Number
Baseband and network processing	L1 baseband processing, processing for L2/L3, integrated peripherals for metrocell application	BSC9131
VortiQa L1 software	LTE FDD and TDD L1 software with cell search support	

Low Noise Amplifiers

Frequency Range (MHz)	Gain (dB)	Noise Figure (dB)	OIP3 (dBm)	Package	Part Number
700–1000	21.3 (900 MHz)	0.5	32.6	2 mm DFN	MML09211H
1800–2200	18.6 (2100 MHz)	0.65	33	2 mm DFN	MML20211H
2300–2700	18.1 (2700 MHz)	0.85	33	2 mm DFN	MML20211H

Linear Power Amplifiers

Frequency Range (MHz)	P_{avg} (dBm)	P1dB (dBm)	Package	Part Number
700–1000	19 (WCDMA) 16 (LTE)	29.6	3 mm QFN	MMZ09312B
1800–2200	19 (WCDMA) 16 (LTE)	30.5	3 mm QFN	MMA20312BV
2300–2700	18 (WCDMA) 17 (LTE)	30	3 mm QFN	MMA25312B

Femtocell Specifications

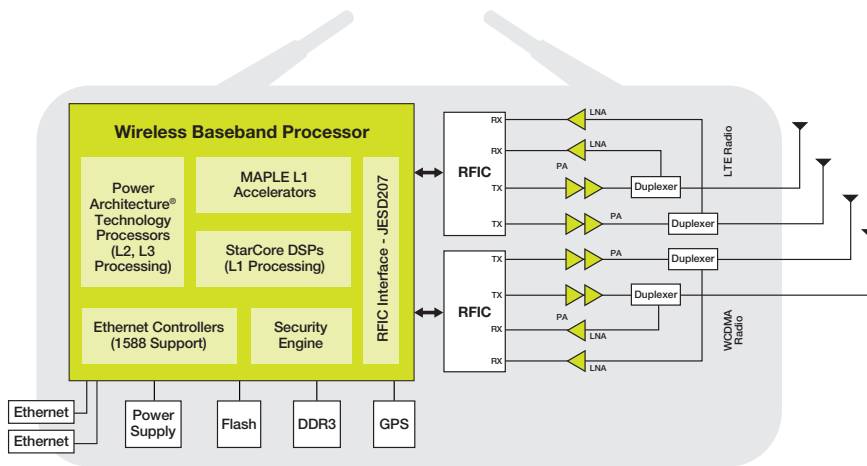|	
Capacity	8–32 active users
Range	Up to 100 meters
Output Power	10–13 dBm at antenna port
Radio Access Technology	Single mode and multimode support for LTE, WCDMA/HSPA, and CDMA2000
Antenna Configuration	2 x 2 MIMO

Femtocell Base Station Block Diagram

■ Freescale Technology

Enterprise Picocell Base Station Solutions

Picocells are low-power wireless access points that operate in licensed spectrum and are operator-managed. Enterprise picocells provide improved cellular coverage and capacity tailored for the enterprise environment. They facilitate a new breed of mobile service that exploits the technology's ability to detect presence and connect and interact with existing networks. Once in operation, an enterprise picocell offloads wireless connections from the surrounding macrocell base stations. Compared to consumer picocells, enterprise picocells can handle higher user count and a wider coverage radius. The implementation of an enterprise picocell along with macrocells creates a heterogeneous network. Enterprise picocells can operate in multiple bands and protocols such as 3G WCDMA and 4G LTE.

Enterprise Picocell Specifications

Capacity	32–128 active users
Range	Up to 500 meters
Output Power	24–27 dBm at antenna port
Radio Access Technology	Single mode and multimode support for LTE and WCDMA/HSPA
Antenna Configuration	2 x 2 MIMO

Baseband Processing

Function	Description	Part Number
Baseband and network processing	L1 baseband processing, processing for L2/L3, integrated peripherals for metrocell application	BSC9132
VortiQa L1 software	LTE FDD/TDD and WCDMA L1 software with cell search support	

Low Noise Amplifiers

Frequency Range (MHz)	Gain (dB)	Noise Figure (dB)	OIP3 (dBm)	Package	Part Number
700–1000	18	0.36	37.4	2 mm DFN	MML09231H
1500–2300	17	0.45	33.5	2 mm DFN	MML25231H*
2300–2700	15.5	0.55	34.5	2 mm DFN	MML25231H*
700–1000	21.3	0.5	32.6	2 mm DFN	MML09211H
1800–2700	18.6	0.65	33	2 mm DFN	MML20211H

*Preliminary

Linear Power Amplifiers (P_{avg} @ $_{ant}$ = 250 mW)

Frequency Range (MHz)	P_{avg} (dBm)	P1dB (dBm)	Package	Part Number
725–950	24 (WCDMA) 23 (LTE)	36	5 mm QFN	MMZ09363B*
1900–2200	24 (WCDMA) 23 (LTE)	36	5 mm QFN	MMZ20363B*

*Preliminary

Linearizer

Frequency Range (MHz)	BW_{SIG} (MHz)	Linearization	Power Supplies	Size	Part Number
698–2700	1.2–20	Dual Linearizer EVM ≤1% ACLR ≤-50 dBc Correction ≤28 dB PA Rating (Class A/AB) 500 mW–5 W	1.8 V P_{DC} = 0.5 W_{AVG} (per linearizer)	11 x 11 mm QFN 20 x 25 mm PCB area for dual paths*	SC2200** (Scintera)

*Includes delay line   **Preliminary

Enterprise Picocell Base Station Block Diagram

Outdoor Picocell Base Station Solutions

Outdoor picocells help to fill coverage gaps macrocells or metrocells cannot reach. They may be deployed with very small form factors that can be mounted on utility poles or even strand mounted on utility cables. With low-impact deployment options and lower price points, outdoor picocells can be used to provide service for areas currently without coverage or for areas with very limited data rates.

Baseband Processing

Function	Description	Part Number
Baseband and network processing	L1 baseband processing, processing for L2/L3, integrated peripherals for metrocell application	BSC9132
VortiQa L1 software	LTE FDD/TDD and WCDMA L1 software with cell search support	

Low Noise Amplifiers

Frequency Range (MHz)	Gain (dB)	Noise Figure (dB)	OIP3 (dBm)	Package	Part Number
700–1000	18	0.36	37.4	2 mm DFN	MML09231H
1400–2300	17	0.45	33.5	2 mm DFN	MML25231H*
2300–2700	15.5	0.55	34.5	2 mm DFN	MML25231H*
700–1000	21.3	0.5	32.6	2 mm DFN	MML09211H
1800–2700	18.6	0.65	33	2 mm DFN	MML20211H

*Preliminary

Outdoor Picocell Base Station Block Diagram
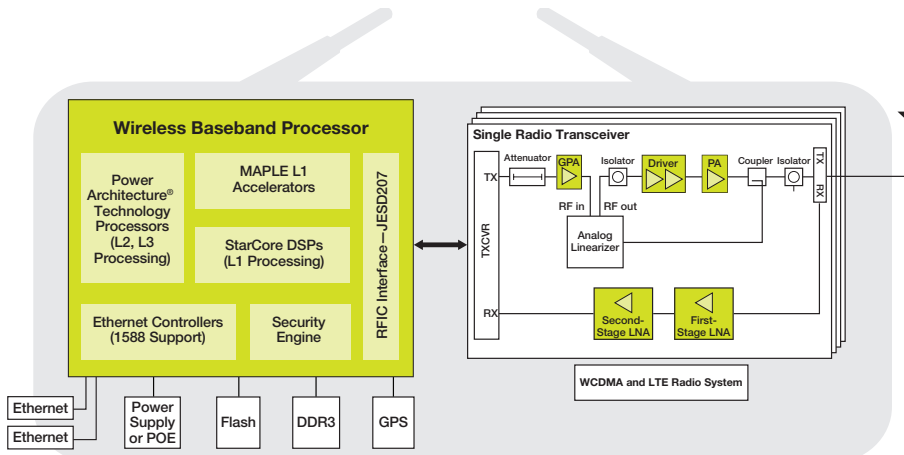
Outdoor Picocell Base Station Solutions (cont.)

Power Amplifiers (P$_{avg}$ @ $_{ant}$ + with or without linearization)

Frequency Range (MHz)	P$_{avg}$ (dBm)	P1dB (dBm)	Bias Voltage	Linerization	Package	Part Number
725–950	27	29.6 40	5 12	Y	3 x 3 mm QFN PLD-1.5	MMZ09312B + MRFG35010AN
725–950	27	41.9	28	N	8 X 8 PQFN	MW7IC915N
1800–2200	27	30.5 40	5 12	Y	3 x 3 mm QFN PLD-1.5	MMA20312B + MRFG35010AN
1800–2200	27	30.5 38.5	5 28	N	3 x 3 mm QFN TO-270	MMA20312B + AFT20S015N
2300–2700	27	33 40	5 12	Y	3 x 3 mm QFN PLD-1.5	MMZ25332B + MRFG35010AN
2300–2700	27	24 38.5	5 28	N	SOT-89 TO-270	MMG15241H + AFT20S015N
725–950	30	29.6 45	5 12	Y	3 x 3 mm QFN TO-270	MMZ09312B + AFT09MS031N
1800–2200	30	30.5 38.5	5 28	Y	3 x 3 mm QFN TO-270	MMA20312B + AFT20S015N
1800–2200	30	24 40.8	5 28	Y	SOT-89 TO-270	MMG15241H + MD7IC2012N
2300–2700	30	33 38.5	5 28	Y	3 x 3 mm QFN TO-270	MMZ25332B + AFT20S015N
2300–2700	30	24 44	5 28	Y	SOT-89 TO-270	MMG15241H+ MW7IC2725N

Linearizer

Frequency Range (MHz)	BW$_{SIG}$ (MHz)	Linearization	Power Supplies	Size	Part Number
225–3800	1.2–75	EVM ≤1% ACLR ≤-50 dBc Correction ≤28 dB PA Rating (Doherty and Class A/AB) 1–80 W	1.8 V and 3.3 V P$_{DC}$ = 0.6 W$_{AVG}$	9 x 9 mm QFN 3.0 x 2.5 mm PCB area*	SC1894 (Scintera)

*Includes delay line

Metrocell/Microcell Specifications

Capacity	100–256 active users
Range	Up to 2 kilometers
Output Power	30–37 dBm at antenna port
Radio Access Technology	Support for LTE and LTE-Advanced
Antenna Configuration	4 x 4 or 2 x 2 MiMO

Metrocell/Microcell Base Station Solutions

Metrocells will play a key role in providing higher data rates to LTE users in dense urban environments. They will incorporate most of the features available in today's macrocells but can be placed much closer to end users due to their smaller form factor. This will enable lowering operators' operating costs and enhance end user experience. Metrocells will provide service to 100–256 active users and exist in either single-cell, dual-cell or in carrier aggregation configurations.

Baseband Processing

Function	Description	Part Number
Baseband and network processing	L1 baseband processing, processing for L2/L3, Digital Front End Processing, integrated peripherals for metrocell application	B3421
Baseband and network processing	L1 baseband processing, processing for L2/L3, integrated peripherals for metrocell application	B4420
VortiQa L1 software	LTE FDD and TDD L1 software with cell search support	

Low Noise Amplifiers

Frequency Range (MHz)	Gain (dB)	Noise Figure (dB)	OIP3 (dBm)	Package	Part Number
700–1000	18	0.36	37.4	2 mm DFN	MML09231H
1400–2300	17	0.45	33.5	2 mm DFN	MML25231H*
2300–2700	15.5	0.55	34.5	2 mm DFN	MML25231H*
700–1000	21.3	0.5	32.6	2 mm DFN	MML09211H
1800–2700	18.6	0.65	33	2 mm DFN	MML20211H

*Preliminary

Metrocell/Microcell Base Station Block Diagram
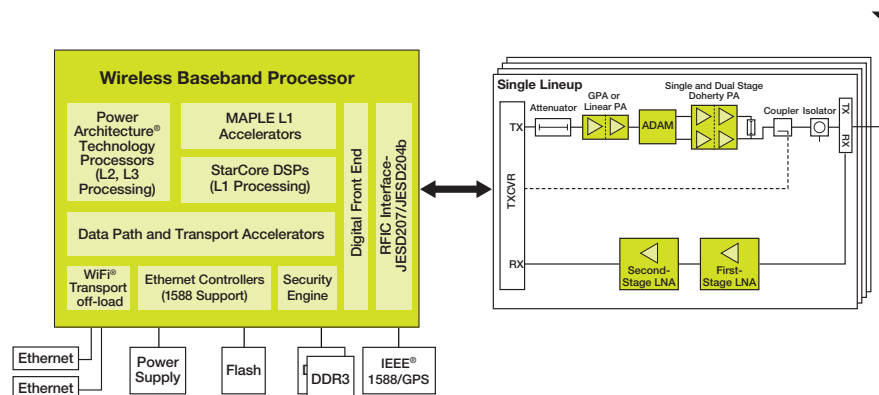
Freescale Technology

Metrocell/Microcell Base Station Solutions (cont.)

Power Amplifiers (P$_{avg}$ @ $_{ant}$ = 5 W with linearization)

Frequency Range (MHz)	P$_{avg}$ (dBm) (WCDMA/LTE)	P1dB (dBm)	Bias Voltage	Package	Part Number
725–950	37	24 49	5 28	SOT-89 TO-270	MMG15241H + MD8IC970N
725–950	37	33 46.2	5 28	3 x 3 mm QFN TO-270	MMZ09332B* + MRF8P9040N
1800–1900	37	24 47.8	5 28	SOT-89 TO-270	MMG15241H + MD7IC2050N
1800–2100	37	33 49	5 28	3 x 3 mm QFN NI-780	MMZ25332B + MRF8P20100H
2000–2100	37	24 47.3	5 28	SOT-89 TO-270	MMG15241H + MD7IC2250N
2300–2400	37	33 44.8	5 28	4 × 4 mm QFN NI-780	MMZ25332B4* + MRF8P23080HS
2300–2400	37	33 44.8	5 28	3 x 3 mm QFN TO-270	MMZ25332B + MD7IC2755N
2500–2700	37	33 47	5 28	3 x 3 mm QFN TO-270	MMZ25332B + MD7IC2755N
2500–2700	37	33 49.4	5 28	4 × 4 mm QFN NI-780S	MMZ25332B4* + AFT26P100-4WS
2500–2700	37	33 46.2	5 28	4 × 4 mm QFN NI-780S	MMZ25332B4* + AFT26HW050S

*Preliminary

Linearizer

Frequency Range (MHz)	BW$_{SIG}$ (MHz)	Linearization	Power Supplies	Size	Part Number
225–3800	1.2–75	EVM ≤1% ACLR ≤-50 dBc Correction ≤28 dB PA Rating (Doherty and Class A/AB) 1–80 W	1.8 V and 3.3 V P$_{DC}$ = 0.6 W$_{AVG}$	9 x 9 mm QFN 3.0 x 2.5 mm PCB Area*	SC1894 (Scintera)

*Includes delay line

General Purpose Amplifiers

Frequency Range (MHz)	Gain (dB)	P1dB (dBm)	OIP3 (dBm)	Package	Part Number
700–2700	19.5 (2140 MHz)	24.5	37	SOT-89	MMG20241H
700–2700	14.4 (2600 MHz)	24	39.4	SOT-89	MMG15241H
700–2700	15 (2000 MHz)	25.8	40.5	SOT-89	MMG3014N
1800–2700	16 (2000 MHz)	27.5	43.1	SOT-89	MMG20271H9

Advanced Doherty Alignment Module

Frequency Range (MHz)	Test Frequency (MHz)	I.L. (dB)	Attenuation Step Size (dB)	Attenuation Control Range (dB)	Phase Step Size (º)	Phase Control Range (º)	IIP3 (dBm)	Package	Part Number
700–1000	900	5.5	0.5	7.5	7	49	40	6 mm QFN	MMDS09254H
1800–2200	2140	5.5	0.5	7.5	7	49	40	6 mm QFN	MMDS20254H
2300–2700	2650	5.5	0.5	7.5	7	49	40	6 mm QFN	MMDS25254H

Software, Tools and Ecosystem

VortiQa Layer 1 Baseband Software

VortiQa Layer 1 (L1) baseband software is commercially available and deployable on the QorIQ Qonverge family of wireless base station processors. These processors are silicon-on-chip (SoC) solutions with cutting-edge architecture and technology-specific accelerators to achieve desired performance. VortiQa L1 baseband software is designed to support state-of-the-art wireless technologies like 4G LTE and 3G UMTS that are heavily deployed in cellular networks all over the world. Commercial-grade software is available for femtocells and enterprise picocells. Reference libraries enabling commercial-grade L1 solutions are available for both metrocell/microcell and macrocell solutions.

Layer 1 baseband software for femtocells and picocells is fully tested and end-to-end qualified with commercial RF and partner-provided L2/L3 stack solutions. It is also optimized to work with the QorIQ Qonverge family of processors for maximum performance. The L1 baseband software is tightly integrated with the Application-Specific Fast Path module that offers Linux® kernel optimizations to enable LTE level throughputs, latency and capacity. This is validated with VortiQa IPsec. The software stack is also validated with commercial handsets operating in bands suitable for deployment

in North America, Europe, Asia and Latin American markets. The VortiQa L1 offers an integrated cell search solution for femtocells and picocells that enables the access point to discover neighboring access points (both small and large cells) in order to acquire vital system information for appropriate configuration and operation. Cell search is enabled on each access point during startup and also on-demand by network control. The cell search module supports search of 4G LTE and 3G UMTS base stations.

Application Specific Fast-Path (ASF) Software

Freescale provides ASF software to enable faster packet processing by accelerating data throughput in the network. Most network packet processing protocols can be broken down into two paths: fast path and slow path. Fast path, also known as the data path, requires quick and efficient switching/routing of packets whereas slow path, also known as the control path, requires more processing and has more inherent latency than the data path. ASF software provides optimized implementation for data path processing that is customized for platforms to achieve higher throughput for specific applications by leveraging hardware functionality such as hashing, checksum calculation, cryptography, classification and scheduling.

Freescale's Ecosystem of Partners—Freescale Connect

Freescale delivers complete solutions for the QorIQ Qonverge platform with ready-to-go software and services, a broad ecosystem and comprehensive development platforms to ease development and speed time to market. The QorIQ and QorIQ Qonverge portfolios are supported by a large and established third-party ecosystem for the wireless infrastructure market. Our Freescale Connect Preferred Partners, including Enea, Green Hills Software, Mentor Graphics and Wind River Systems provide integrated solutions optimized for maximum performance on QorIQ platforms.

The Freescale Connect Partner Program is your essential source for embedded designs based upon Freescale solutions. The program comprises a global network of independent engineering companies that offer the vital tools, software, technology, engineering services and training to speed your design process. From reference boards to optimized software, Freescale Connect provides a powerful and comprehensive ecosystem that partners with you in making the world a smarter, more connected place.

For more information, visit
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