Small Cell: Current and Future Market Trends

EDI CON 2015
April 15, 2015

RF, Wireless, Energy and Power Technologies
Who We Are

- Founded in 1947, a wholly-owned subsidiary of Arrow Electronics (NYSE: ARW)
- Specialized electronic component distributor with 450+ employees, serving over 12,700 customers
- Serve clients from a network of 40 sales offices and locations, 7 engineering centers and 3 logistics hubs throughout the world
- Newest products from leading suppliers of RF, Wireless and Energy Technologies
- Deep technical expertise
- Value-added services for new and existing products
From Prototype to Production…

- Latest products from the market leaders
- Global distribution with local presence
- Design support from prototype to production

Let us help turn your vision into REALITY
...A True Partner for Design Engineers

- In the search for the “best fit” and application-specific RF/microwave semiconductor device
- In the design and assembly of complete subsystems
- Diverse product offering:
  - Semiconductors to passive components
  - Connectors and cable assemblies
  - M2M and embedded solutions
Small Cells (Femto, Micro, Pico)

- Low power, wireless access points that transmit less than 10W at the antenna.
- Femtocells: Residential femtocells typically have power output of about 20mW and cover a house with a small number of users, such as a family.
- Metrocells & Picocells: These typically have a power output of 1-10W and are used in parks, city centers, tunnels, stadiums, and even mass transit systems.
• SK Telecom and Nokia Networks have produced the first commercial cellular heterogeneous LTE network (hetnet), in Gwangju, South Korea.

• Vodafone expects to install up to 70,000 small cells by March 2016 in an effort to handle rising data traffic. AT&T is implementing their plan to install 40,000 small cells by the end of 2015.

• The four primary UK mobile carriers have committed to providing voice coverage, partly by small cell deployment, to 90% of the UK land mass by the end of 2017. – Maravedis/Rethink
• Energy savings of more than 50% were seen in mobile networks with a high number of small cells compared to those comprised only of macro base stations. – Bell Labs research

• China Mobile has set up about 650,000 TD-LTE base stations in main cities around China and is expected to focus TD-LTE infrastructure construction on indoor coverage by deploying Nanocell as soon as the second half of 2015. – Digitimes Research

• Recently, the FCC approved changes to the United States’ environmental review process to make it easier to deploy small cells as well as collocated equipment. For example, not only can gear be deployed on buildings and cell towers but also on utility poles. Also, if a municipality has not addressed a deployment proposal after 60 days, then it is automatically approved and the deployment can proceed on day 61.

• Analysts, industry pundits and operators all seem to be in agreement that 2015 will see small cells evolve from current indoor deployments and move to growing outdoor deployments. – Dragonwave press release
Global **LTE Infrastructure** market is forecasted to grow at a CAGR of 15.98 percent over the period 2014-2018. – Sandler Research...but, **small cell** market shipments are forecast to reach $5.98 billion by 2019 (46% CAGR) - WinterGreen Research

The global **Femtocells Market** is expected to reach USD $4,706 million in 2019, growing at a CAGR of 37%. - Transparency Market Research

**Outdoor** small cells are forecasted to grow at a 48% CAGR through 2019. In 2015, 4G small cells will be the fastest growing small cell type in the market driven by venue and dense urban deployments. ABI Research forecasts the number of LTE small cells to double in 2015 and by a similar factor each year through 2019 where the value of LTE small cells will represent almost 70% of the small cell equipment market. – ABI Research
• By 2019, 45% of outdoor small base stations will be **backhauling wirelessly** - Mobile Experts

• The small cell **backhaul equipment** market will exceed $5 billion in 2019 – ABI Research

• Operators participating in an Infonetics Research small cell backhaul survey are looking to place over 20% of their traffic from the macro network onto small cells by 2018.
• RF amplifiers in Small Cell are dominated by GaAs

• GaN can make some inroads as ASPs comes down, particularly where relatively higher output power is needed

• Transceivers from Lime and Analog Devices have had success as a complete RF engine, which may be SiGe or CMOS
TQP9321  Qorvo
1800-2170 MHz Power Amplifier

• 30 dB Gain
• +27 dBm Avg Output Power @ -50 dBc ACLR
• High Efficiency : 27% at +27 dBm
• +5V Supply Voltage
• 3.5 x 4.5 mm leadless SMT Package
AP561-F  Qorvo
700-2900 MHz Power Amplifier

• 15.8 dB Gain
• +39 dBm P1dB
• +12V Supply Voltage
• InGaP/GaAs HBT Process Technology
• 14-Pin 5 x 6 mm DFN package
AWB7127 ANADIGICS
2110-2170 MHz Small Cell Power Amplifier Module

- 30 dB Gain
- -50 dBc ACPR @ +/- 5 MHz, +24.5 dBm
- 4.2V Supply Voltage
- InGaP HBT Technology
- 7 x 7 mm Surface Mount Package
AWB7227 ANADIGICS
2110-2170 MHz Small Cell Power Amplifier Module

- 29 dB Gain
- -50 dBc ACPR @ +/- 5 MHz, +27 dBm
- 4.5V Supply Voltage
- InGaP HBT Technology
- 7 x 7 mm Surface Mount Package
MAGX-011086   MACOM
DC-6000 MHz GaN-on-Silicon 5W Transistor

• 16 dB Gain @ 2500 MHz
• +37 dBm Psat
• 28V Supply Voltage
• 4 x 4 mm plastic PQFN Package
NPT2018 MACOM
DC-6000 MHz GaN-on-Silicon 12.5W Transistor

- 17.5 dB Gain @ 2500 MHz
- +41.8 dBm Psat
- 48V Supply Voltage
- 6 x 3 mm plastic SMT Package
MMZ25332B Freescale
1800-2800 MHz InGaP HBT High Efficiency/Linearity Amplifier

• 26 dB Gain
• +33 dBm P1dB
• 5V Supply Voltage
• InGaP HBT Technology
• 3 x 3 mm QFN Surface Mount Package
MAAL-011078  MACOM
700-6000 MHz Low Noise Amplifier

• 23 dB Gain @ 1900 MHz
• +17.5 dBm P1dB
• 0.35 dB Noise Figure @ 1900 MHz
• +10 dBm Input IP3
• 3 to 5V Supply Voltage
• 2 x 2 mm 8-lead PDFN
TQP3M9037 Qorvo
1500-2700 MHz Ultra Low Noise, High Linearity LNA

- 20 dB Gain
- +20 dBm P1dB
- 0.4 dB Noise Figure
- +15 dBm Input IP3
- 5V Supply Voltage
- 8 pin 2 x 2 mm DFN package
MML09231H Freescale
700-1400 MHz Low Noise Amplifier

- 17.2 dB Gain
- +24.5 dBm P1dB
- 0.36 dB Noise Figure
- +20.2 dBm Input IP3
- 5V Supply Voltage
- Enhancement Mode pHEMT Technology
- 8-pin 2 x 2 mm DFN Package
MML20242H  Freescale
1400-2800 MHz Low Noise Amplifier

- 34 dB Gain
- +24 dBm P1dB
- 0.59 dB Noise Figure
- +5.5 dBm Input IP3
- 5V Supply Voltage
- Enhancement Mode pHEMT Technology
- 12-pin 3 x 3 mm QFN Package
SKY67153-396LF  Skyworks Solutions
700-3800 MHz Ultra Low-Noise Amplifier

- 26 dB Gain
- +21.5 dBm P1dB
- 0.25 dB Noise Figure @ 849 MHz
- +8.5 dBm Input IP3
- 3 to 5V Supply Voltage
- Technology: GaAs pHEMT
- 8-pin 2 x 2 mm DFN package
PE42820    Peregrine Semiconductor
30-2700 MHz UltraCMOS® SPDT RF Switch

• 0.4 dB Insertion Loss
• 28 dB Isolation
• +44.5 dBm Maximum Input Power
• +81 dBm Input IP3
• +1.8V control logic compatible
• Wide supply range of 2.3V to 5.5V
• 32-lead 5 x 5 mm QFN package
PE42821  Peregrine Semiconductor
100-2700 MHz UltraCMOS® SPDT RF Switch

- 0.6 dB Insertion Loss
- 28 dB Isolation
- +44.5 dBm Maximum Input Power
- +76 dBm Input IP3
- +1.8V control logic compatible
- Wide supply range of 2.3V to 5.5V
- 32-lead 5 x 5 mm QFN package
TQP4M0008  Qorvo
100-6000 MHz Low Loss Reflective SPDT Switch

- 0.35 dB Insertion Loss
- 30 dB Isolation
- +33 dBm Maximum Input Power
- +56 dBm Input IP3
- CMOS compatible Dual Voltage Control
- 6-pin 2 x 2 mm package
MASW-000834  MACOM
50-6000 MHz PIN Diode SPDT 50 Watt Switch

• 0.4 dB Insertion Loss
• 49 dB Isolation
• 50 W Maximum Input Power
• +65 dBm Input IP3
• 4 x 4 mm PQFN package
MASW-008543    MACOM
10-4000 MHz GaAs SPDT High Isolation Switch

- 0.7 dB Insertion Loss
- 65 dB Isolation
- +33 dBm Maximum Input Power
- +53 dBm Input IP3
- 3 x 5 mm MSOP-8-EP Package
TQM969001  Qorvo
1930.5-1989.5 MHz (downlink) & 1850.5-1909.5 MHz (uplink) PCS Duplexer

- Peak power handling of +38 dBm
- Insertion Loss of 1.32 dB (uplink) / 1.52 dB (downlink)
- Over 50 dB Attenuation
- 3-Pin 3.8 x 3.8 mm LGA package
AD9234  Analog Devices
12-Bit, 1000 MSPS Dual Analog-to-Digital Converter

- SFDR = 79 dBFS at 340 MHz
- 1.25V to 3.3V output supply
- 2000 MHz Full Power Bandwidth
- Noise Density: -151 dBFS/Hz
- 1.5 W total power per channel at 1 GSPS
- Serial Port Interface
- 9 × 9 mm LFCSP
AD9136  Analog Devices
Dual, 16-Bit, 2.8 GSPS DAC

- 2.12 GSPS Data Rate
- SFDR: -76 dBc @ 150 MHz Fout
- Noise Density: -163 dBm/Hz @ 150 MHz Fout
- 1.4 W @1.6 GSPS
- 3.3V power supply
- 12 x 12 mm LFCSP package
LMS7002M    Lime Microsystems
Multi-band Multi-standard MIMO Transceiver with Integrated Dual DACs and ADCs

- Integrated high performance 12-bit ADC and DAC
- Frequency range: 30 to 3800 MHz
- 0 dBm Output Power
- 2.5 dB Noise Figure
- +4 dBm Input IP3
- Low voltage operation, 1.25, 1.4 and 1.8V
- Serial port interface
- 11.5 x 11.5 mm QFN package
AD9361 Analog Devices
RF Agile Transceiver

- RF 2 x 2 transceiver with integrated 12-bit DACs and ADCs
- Frequency range: 70 to 6000 MHz
- +8 dBm Output Power
- 2 dB Noise Figure
- -18 dBm Input IP3
- Supports TDD and FDD operation
- Dual receivers: 6 differential or 12 single-ended inputs
- 10 x 10 mm 144-ball chip scale package ball grid array
MMDS20254H and MMDS25254H  Freescale Advanced Doherty Alignment Module (ADAM)

- Frequency range: 1800 to 2200 MHz, and 2300 to 2700 MHz respectively
- Maximum input power: +25 dBm
- Low Loss Power Splitter
- Single 5 Volt Supply
- 12 mA Supply Current
- 50 Ohm Operation (no external matching required)
- TTL/CMOS/SPI Interface (1.8V, 3.3V Logic)
- 32-Pin 6 x 6 mm QFN Package
Monoblock Ceramic Dielectric Duplexers  CTS
Four families each targeting different power handling/performance

- Max Input Power (at antenna): From 1.5W avg/12.5W peak to 20W avg/200W peak
- Max Insertion Loss: 0.7dB to 3.0dB
- Tx-Ant Attenuation: 20dB to 80dB
- Ant-Rx Attenuation: 20dB to 74dB
- Return Loss: 14dB
- Temperature Range: -40 to +85°C
- Footprints: 15 x 8mm, 62 x 20mm, 44 x 20mm, and 60 x 54mm
- Each family covers all 3GPP bands with universal footprint
8.5mm Isolators  Skyworks Ireland
Four families each targeting different power handling/performance

• Frequency Range: 1800 – 2700MHz
• Maximum Insertion Loss: 0.30dB
• Minimum Isolation: 23dB
• Minimum Return Loss: 14dB
• IMD3: 64dB Typical (2x15W CW, 5MHz)
• Reverse Power Handling: 30W