A Year in Wireless

OEMs Share Their Accomplishments in 2011 & Predicitions for 2012

1. How was your business in 2011 and what is the outlook for 2012?

*John Greichen, Analog Devic*es: Despite market unpredictability, ADI had a good year in 2011. Looking ahead to 2012, the world continues to be a very uncertain place in every region of the world, and the range of possible outcomes for the year is very wide. Two-thirds of ADI's revenue comes from the industrial and communications markets and while these market areas did experience some volatility in 2011, these industry manufacturers are still expecting 2012 to be a growth year over 2011.

Svenn-Tore Larsen, Nordic Semiconductor: Nordic has been fortunate - considering the tough economic climate the whole electronics industry has been facing - to have experienced a flat year in 2011. While making predictions in such tough times is risky, the company currently sees no reason why it shouldn't make good progress in 2012.

Jan Whitacre, Agilent Technologies: Agilent experienced growth over 2010 and our fourth quarter showed a strong close to our 2011 fiscal year 2011. For most businesses, economic uncertainty remains. The challenge for us, as well as others, is to focus on our business's potential rather than dwell on the uncertainty. Over the past two years we've had a chance to prove that Agilent's Electronic Measurement Group can deliver in these challenging times. In 2012 we continue to see growth opportunities especially in emerging markets. Agilent is well positioned to take advantage of these opportunities.

Matt Desch, Iridium Communications: In 2011, driven by our strength in machine-to-machine (M2M) data, handheld voice, Netted Iridium and Iridium OpenPort customers, as well as our growing partner base, Iridium met some significant milestones across the business. Our third-quarter financial results showed total revenue grew 8 percent over Q3 of 2010, while Operational EBITDA was up 16 percent over the same period last year. We surpassed the half-million mark in the number of total billable subscribers which has grown to 508,000 worldwide, a 23 percent growth increase year-over-year.

Mark Downing, Silicon Laboratories: Silicon Labs' wireless business is expected to be up slightly in 2011, a good result given the demand weakness the sector has experienced this year due to ongoing global economic pressures. We count wireless as one of our most exciting new growth areas, and given the strong backlog of design wins secured in 2011, we would expect our wireless business to do well again in 2012.

Tim Moynihan, Empirix: Empirix had a very successful 2011 and we look forward to increased adoption of our innovative customer experience, service assurance, and analytics solutions in 2012.

Laurent Desclos, Ethertronics: Ethertronics had a successful 2011 and expects an even better 2012. Ethertronics' technology breakthroughs in the design and development of active antenna systems has garnered additional interest from OEMs to pursue business development opportunities. In 2011, Ethertronics had a number of customer wins as a result of its innovative solutions. With LTE being a top priority in 2012 for carriers and OEMs, Ethertronics will continue to provide its high-performance active antenna system solutions to support next-generation networks and devices.

Ashish Sharma, FreeWave Technologies: FreeWave continues to buck current economic challenges by continuing to grow and invest in its business – in a multitude of facets. The company grew its presence in new emerging growth markets; expanded internationally; increased its staff by more than 20 percent; and, made investments that will further its continued growth and success in 2012 and beyond. FreeWave believes that the coming year(s) will be as fruitful as before because customers are what drives its success.

Andrew J. Pease, QuickLogic: Our business in 2011 was challenging. Like most vendors, we started the year with excess inventory. In the data cards segment, a big part of our Smart Connectivity business, the market became extremely price sensitive and designers began eliminating solutions. This had a negative impact on our sales. In our Display and Visual Enhancement business, we announced significant wins at Pantech and Kyocera. We recently released our third generation Visual Enhancement Engine (VEE) family of devices, architected specifically for smartphones and tablets.

Frank Stewart and David Schnaufer, RFMD: RFMD is invested in three significant growth trends—connectivity, mobility, and energy – both in new ways of generating and conserving energy. Due to our long term focus on these trends, RFMD's business has grown throughout 2011. The outlook for 2012 and beyond suggests strong growth for a number of wireless markets. Rapidly expanding data requirements and the promise of "cloud computing" are driving network upgrades and capacity expansions. This positively affects the demand for cellular phones, WiFi networks, wireless infrastructure, fiber optic networks and cable TV infrastructure.

Dr. Mo Shakouri, Alvarion: In 2011, Alvarion concentrated and executed on penetrating the mobile coverage and capacity area. We are continuing to deliver on our strategic plan aimed at shifting from a primary focus on WiMAX-based RAN solutions to becoming a multi-technology wireless broadband solution powerhouse. We are the only vendor combining a carrier-grade, best-of-breed Wi-Fi solution with a strong DAS offering and 4G RAN capabilities to address a wide range of applications delivered over wireless broadband networks. This enables Alvarion to better serve existing customers as well as address new rapidly-growing markets.

E.L. Fox Jr., Fox Electronics: Overall, business was pretty good. Our traditional frequency control product line grew with the market somewhere in the range 5 to 7%. However, our XpressO oscillator business has been very good, with 34% growth and its gaining momentum that will carry over into 2012.

2. What vertical markets are you looking to focus on in 2012?

*John Greichen, Analog Devic*es: As mentioned, ADI has a strong position in communications infrastructure and the industrial markets and we remain strongly committed to these markets. We also have a strong focus on growth markets such as energy/metering, instrumentation, military/aerospace and automotive, with extensions to our RF, converter and signal processing product portfolio addressing the specific needs of these markets.

Svenn-Tore Larsen, Nordic Semiconductor: Nordic is a leading supplier to the PC peripherals sector (i.e. wireless keyboards and mice), and is rapidly becoming a major competitor in other sectors where designers are starting to appreciate the value of ultra low power wireless connectivity. These sectors, which will continue to be strategic targets for Nordic in 2012, include medical (e.g. wireless monitoring using ‘body area networks’), consumer (e.g. RF remote control), sports & fitness (e.g. heart rate monitors), mobile phone accessories (e.g. proximity security tags) and gaming (e.g. gaming microphones and controllers).

Jan Whitacre, Agilent Technologies: Our focus on wireless is on those technologies that support the increased demand for higher data rates. Those include LTE and LTE-Advanced. With the deployment of LTE there continues to be new designs that have to be tested, such as VoIP LTE. And of course manufacturing is just beginning to ramp up. Plus operators are already announcing LTE-Advanced plans. With each new technology roll out there is also the need to test compatibility, such as LTE and LTE Advanced with 2/3G. There is also significant involvement in WLAN and its newer technologies 802.11ac and 802.11ad (WiGIG, 60 GHz) will be critical to the market along with enhancing current 3G designs.

Matt Desch, Iridium Communications: The aviation sector will be a key focus in the coming year as we work to provide enhanced connectivity solutions for aircraft operators and passengers alike. Opening the door to that is the continued progress we’ve made on expanding services to air transportation with the FAA announcement that it will authorize airlines’ use of Iridium for data services in the cockpit. Also, we look forward to new broadband service offerings for the maritime sector, further deployment of netted satellite radios for military use and the rollout of new personal satellite location and messaging devices for the M2M market.

Mark Downing, Silicon Laboratories: Leveraging our sub-GHz transceiver, transmitter and wireless MCU portfolios, Silicon Labs will continue to focus on home automation, lighting control, security, portable medical, smart metering, asset tracking, sensor network and remote keyless entry (RKE) applications. We also will continue to address the 40-million-unit-per-year market for wheel-tuned, digital-display consumer radio products with our single-chip Si484x AM/FM/shortwave

receiver family. Finally, we will serve the automotive infotainment market with our Si475x/6x multiband receivers designed for automotive head-units and AM/FM car radios.

Tim Moynihan, Empirix: In 2012, Empirix will work with providers deploying and managing VoLTE solutions as well as the content distribution network.

Laurent Desclos, Ethertronics: In 2012 Ethertronics will continue to focus on the development and design of active antenna system solutions for wireless devices such as smartphones, tablets and laptops. Our solutions will also provide new ways of thinking in the Healthcare and M2M industries. We already had a few design wins and will continue to grow our business in these areas as we did in the mobile space.

Ashish Sharma, FreeWave Technologies: FreeWave Technologies will continue focusing on its top markets in 2012, including government & defense, oil & gas, and utilities. Specifically, the company will be focusing more efforts in markets such as electric power/smart grid and water/wastewater. The company will also continue ongoing efforts in manufacturing, precision agriculture, environmental monitoring and Golf/ Automated Vehicle Location Systems.

Andrew J. Pease, QuickLogic: Our focus continues to be in the areas of smart connectivity and display visual enhancement for the mobile market. In the smart connectivity area, we will be introducing a new second generation smart connectivity platform that will significantly expand our efforts in data cards and in the mobile enterprise segment. On the display side, our focus is on Smartphones and tablets, with Pico Projectors and in-car entertainment systems as new adjacent segments with which we see opportunities in 2012.

Frank Stewart and David Schnaufer, RFMD: RFMD is a leader in smartphones, tablets, notebook PCs and other computing devices, basic feature and entry cellular phones, M2M (Machine-2-Machine), Smart Energy AMI, WiFi, wireless infrastructure, point-to-point backhaul radios, and CATV infrastructure; we also leverage our compound semiconductor and high power GaN expertise to service the power conversion market and the solar industry. These markets offer exciting growth opportunities and we will continue our focus across these markets in 2012.

Dr. Mo Shakouri, Alvarion: Alvarion’s multi-technology platform is well suited for the integrated connectivity requirements of Smart Cities, Smart Utilities, Homeland Security, Businesses and Industry and WISPs. Our solutions offer a multiplicity of options to create the broadband wireless access solution that best fits the unique business needs of each vertical. Our solutions support the vast range of applications needed in each vertical market such as remote video surveillance, traffic flow management, back-up for disaster recovery, leased line replacement, various forms of backhaul and other public safety uses.

E.L. Fox Jr., Fox Electronics: We are primarily focused on communication applications, LTE, cloud computing, networking, and automotive markets.

3. What were some of the most notable products you introduced this year?

*John Greichen, Analog Devic*es: ADI continued to deliver high performance RF ICs that feature breakthrough integration and combine multiple RF functions on a single chip. Furthermore, these solutions maintain the high level of RF performance that designers are accustomed to with discrete devices, while reducing external circuitry as well as BOM cost. These notable products include our new ADL5811/ADL5812 RF mixers, ADRF6806/ADRF6807 quadrature demodulators, ADRF6516 VGA and ADF7023-J RF transceiver.

Svenn-Tore Larsen, Nordic Semiconductor: The introduction of the µBlue nRF8001 Bluetooth low energy solution – one of the first Bluetooth low energy chips on the market - was a significant moment for the company. Nordic has been involved in the development of Bluetooth low energy since the concept of using a mobile phone as a 'hub' connecting to a range of peripherals with ultra low power wireless connectivity was put forward by Nokia in 2006. An enhanced version of the chip (nRF8001 Build D) was introduced in December. The introduction of the nRF2460 audio streaming IC for mono wireless applications was also a welcome addition to the proprietary nRF24L Series, and the nRFready Smart Remote Reference Design – while not a 'product' as such – will be very helpful in getting designers started with RF remote control.

Jan Whitacre, Agilent Technologies: From a test equipment perspective, it is exciting to see the continued blending of hardware and software to address the rapid demands of evolving technologies. Throughout our 70-year history, we have amassed significant measurement expertise and built unique test and measurement solutions that address both current and future market needs. We continue to add to our 30 years of experience in EDA design with new software for LTE, LTE-Advanced, WLAN, MIMO and Digital Pre-distortion designs. We blend this capability with our new hardware capabilities for signal generation and signal analysis for all of these technologies. Our functional/ feature-rich 89600 VSA software can quickly address the RF testing of these same current emerging technology standards along with adding features such as multi-test capability for new MSR standard radios and Wireless Link Analysis to look at protocol.

Matt Desch, Iridium Communications: The launch of Iridium Force – our vision for the future of personal mobile satellite communications – saw the introduction of several new Iridium products including:
• Iridium Extreme™ handset – the most advanced, rugged, global satellite phone on the market today
• Iridium AxcessPoint® – a suite of products including a portable and lightweight Wi-Fi hotspot accessory, downloadable application and email and web software
• Iridium Core 9523® – the next-generation new voice and data module packaged into a small and cost-effective platform for partners to embed into new handheld and integrated solutions

Mark Downing, Silicon Laboratories: In 2011, Silicon introduced three wireless/RF products: the Si484x AM/FM/shortwave receiver family for wheel-tuned, digital-display consumer radio products; the Si476x multiband automotive receiver family for high-performance, multi-tuner car radio applications; and the Si102x/3x wireless

MCU family for power-sensitive, battery-operated home and building automation, security system, portable medical device and smart metering applications. We also announced several sub-GHz wireless platform initiatives with key development partners including CEL, Hope Microelectronics and Telit.

Tim Moynihan, Empirix: In 2011, announced Empirix xCentrix analytics for mobile networks, which enables providers to better understand and strategically enrich how customers experience voice, video and data applications. Later in the year we enhanced its data correlation capabilities to give operators end-to-end visibility across the network.
During the year, Empirix also announced video monitoring capabilities for its service assurance solutions.

Laurent Desclos, Ethertronics: As part of its active antenna systems portfolio, the main ones would be the inclusion of solutions that leverage both Band Switching and Active Impedance Matching techniques. Ethertronics' EtherSmart LTE 1.0™ Phone Adaptive Antenna solution used in the Samsung Galaxy S II LTE SC-03D launched in November 2011, allowed a 50% reduction in physical antenna volume while meeting the NTT DOCOMO specs. Another example was the first automatic antenna tuning system for critical medication inventories now in hospital trials.

Ashish Sharma, FreeWave Technologies: FreeWave released its new line of GX radios, which transmits data in the 2.4 GHz spectrum for international use and is designed to provide OEMs with the performance, reliability and quality they have come to know and expect from FreeWave products. FreeWave also released a suite of IO Expansion products that increase the degree of monitoring, control and optimization in communications networks. These modules offer customers the most flexible and easily expandable wired and wireless IO available in the market today.

Andrew J. Pease, QuickLogic: Our most notable product is our recently introduced ArcticLink III VX solutions platform. This third generation of our VEE/DPO (Display Power Optimization) technology, based on proprietary cores from Apical Ltd., adapts an image to the viewing environment based on a human vision model. Our DPO technology enables system developers to save as much as 50% of the overall system power. Our VEE/DPO solutions are targeted at the next generation, very high-resolution Smartphones and tablets.

Frank Stewart and David Schnaufer, RFMD: We delivered myriad noteworthy products in 2011, including some in categories not usually supplied by RFMD. Our innovations include GaN-based products for CATV, military, and other markets; PowerSmart™ cellular platforms for the handset and M2M markets; digital step attenuators, six new types of digital variable gain amplifiers; laminate VCO modules with hybrid noise performance in a MMIC footprint; and microwave chip sets, including upconverters and downcoverters for X-band and Ku-band point to point radios.

Dr. Mo Shakouri, Alvarion: Alvarion introduced two ground-breaking products this year expanding our multi-technology wireless broadband offering for carrier and vertical customers: BreezeCELL™ – True in-building capacity with TrueActive™ DAS.

BreezeCELL eliminates black spots and provides a high speed data connection to multiple devices no matter where users are connecting from within the building. BreezeCOMPACT - A single box, all-outdoor, small footprint compact base station. BreezeCOMPACT is super-fast wireless broadband in a small box that's built for the next decade.

E.L. Fox Jr., Fox Electronics: A 25 ppm version of our XpressO product line in the 3.2 x 2.5ppm package at both 3.3V and 2.5V with an operating temperature range of -20 to 70°C. The best our competitors can do is basically 50 ppm at -20 to 70°C. Plus Fox offers 1 week delivery for the 25pm part, compared to 8 to 10weeks for a 50 ppm part from other manufacturers.

4. What announcement(s) made in 2011 surprised the company as far as how the industry responded, both positively and negatively?

*John Greichen, Analog Devic*es: The industry responded very well to many of ADI's product introductions such as the ADL5811/ADL5812 RF mixers which represented a novel design approach and architecture as well as our recently announced ADF41020 18 GHz PLL. In addition to these new products, the industry has also responded well to ADI's agreement with Richardson RFPD, a distributor specialized in RF and microwave to sell our RF ICs and other products worldwide.

Svenn-Tore Larsen, Nordic Semiconductor: The Bluetooth SIG's decision to extend its board by an additional two members came as a surprise to companies in the ultra low power and low power RF sector, particularly as this was something the SIG had not done for many years. The SIG said the move was in order to drive forward the platform development and ultra-low power sensor silicon for Bluetooth technology. And it was quite a pleasant surprise for us that the SIG selected someone from Nordic, a relatively small company compared to the others on the board, to fill one of the positions. An Apple employee took the other board position.

Jan Whitacre, Agilent Technologies: The rapid adoption of LTE-Advance is incredible, although we were well positioned to address it with the industry's first to market test products and our industry experts.

Matt Desch, Iridium Communications: The unveiling of Iridium Force, our vision for the future of personal mobile satellite communications, has been very well received. This vision uses the power of the world's furthest reaching network to:
• Extend beyond satellite phones - enabling communications where people need them most through devices they already use daily
• Simplify connections - making Iridium technology more accessible and cost-effective for partners to develop Iridium-embedded products
• Drive innovation - licensing Iridium core technologies and its network to expand solutions into new markets
• Enable location-awareness - integrating GPS location-based services into new Iridium products
• Perform without compromise – continue to provide reliable mobile devices and services that work everywhere on the surface of the planet

Mark Downing, Silicon Laboratories: We were surprised by the exceptional developer interest generated by our Si484x receiver announcement. The wheel-tuned, digital-display radio market is relatively large and stable. Primarily manufactured in China, these radio products include tabletop and portable radios, stereos, boom boxes, clock radios, docking stations and toys. Our Si484x receiver family sparked developer interest because it is disruptive technology. These receivers offer unmatched integration in CMOS, reducing radio component count by more than 70 percent, streamlining manufacturing and reducing labor cost.

Tim Moynihan, Empirix: We have seen tremendous reaction to the Empirix xCentrix announcement. For the first time, service providers can truly leverage the vast amount of data floating around in their networks to solve important business issues. Almost every department – operations, planning, marketing – has found a use for this type of advanced analytics.

Laurent Desclos, Ethertronics: The introduction of networks supporting higher data rates, with LTE, and seamless access to data, the cloud, introduced a new way of thinking and associated challenges. Mobility and continual access to productivity tools are therefore critical. Our EtherSmart LTE™ solutions solve these challenges by using band switching techniques allowing devices to dynamically tune from one band to another taking into account the environment. The solution went from R&D to production in record time showing the accuracy of our forward thinking.

Ashish Sharma, FreeWave Technologies: FreeWave announced a new smart grid customer, Oklahoma Gas &Electric, which gained a lot of traction within the smart grid industry. This greatly enhanced the company's visibility with key influencers within the industry. It was surprising to see how many smart grid organizations didn't know about FreeWave's technology. Another announcement worth mentioning was the one millionth flight hours milestone at the annual AUVSI conference. FreeWave received a lot of positive feedback from both partners and potential customers at the show.

Andrew J. Pease, QuickLogic: What surprises me is how little impact Android has had in the tablet space. Android-based smartphones have done a very good job of encroaching on the iPhone market share, yet Apple continues to dominate the tablet market. There is no question that tablets have a place in the industry.

Frank Stewart and David Schnaufer, RFMD: RFMD's PowerSmart™ cellular platforms are so innovative, some in the industry were skeptical that it would work. PowerSmart™ started production shipments in March, and is already inside three of the top five smartphone OEM's devices. We've also been pleasantly surprised with the industry's reception of our GaN products in the CATV market. In just 12 months we've gone from introducing our first production-ready GaN products, to having customers requesting GaN as an option for consideration, to having GaN-based products required for their network solutions.

Dr. Mo Shakouri, Alvarion: Alvarion entered the mobile coverage and capacity area this year, with the acquisition of two companies, Clariton and Wavion. These companies created technologies that are designed to serve the most demanding

applications of both public and private networks. Our most recent announcement for the first successful TD-LTE trial in Canada was positively acknowledged in the marketplace.

E.L. Fox Jr., Fox Electronics: We expanded our sales offices in to Canada and the Silicon Valley, with a very positive response and we plan on expanding more in the near future.

5. Can you specify any new technologies in 2011 that resulted in new applications?

John Greichen, Analog Devices: The ADL5511 envelope and TruPwr™ rms power detector helped enable our power amplifier customers to continue and enhance research and development around envelope tracking topologies to improve power amplifier efficiency. Our new ADF7023-J RF transceiver offers a complete radio solution that has been optimized for the ARIB STD-T96 standard and features the performance, integration and low power consumption required to ensure the transfer of critical data for the growing Japanese smart grid market.

Svenn-Tore Larsen, Nordic Semiconductor: Bluetooth Version 4.0 (which includes Bluetooth low energy as a hallmark feature) is perhaps the biggest new technology officially launched this year. It is now becoming available in applications that link ultra power wireless-equipped peripherals to the cell phone – realizing Nokia's vision. This is the first time such devices have been linked without an external dongle. Apple's iPhone 4S, for example, is among the first devices to sport a Bluetooth v4.0 chip and Nordic µBlue Bluetooth low energy chips can already be found in a range of peripheral devices such as sports watches from Casio and heart rate belts from Dayton Industrial. It's important to note that ANT+, a competing ultra low power wireless technology from Dynastream Innovations and supported by Nordic, is also becoming available in cell phones, particularly models from Sony Ericsson.

Jan Whitacre, Agilent Technologies: Multi-Standard Radio (MSR) emerged as part of 3GPP. It will give the operators the base stations what they need to manage all the newest technology challenges. LTE-Advanced allows more movie downloads, video downloads, file sharing, etc than ever experienced before. WLAN 802.11ad will allow users to do very high data streaming within a home or business environment. Another aspect is the new CMOS IC technology that operates at 60GHz and beyond.

Matt Desch, Iridium Communications: The Iridium Core 9523 is Iridium's smallest and most advanced voice and data modem. The Core 9523 will be licensed to select value-added partners to provide the building blocks in the development of innovative Iridium-embedded voice and data communication devices and solutions to serve a wide range of industries.

Mark Downing, Silicon Laboratories: The basic car radio continues to evolve into a sophisticated infotainment system that includes multiple tuners to deliver FM phase diversity reception, receive RDS data for info-navigation systems and support HD Radio technology from iBiquity Digital Corporation, as well as Digital Audio

Broadcasting (DAB/DAB+), the most prevalent digital radio standard outside the US. The rise of multi-tuner radio systems that support digital radio has been particularly exciting. Silicon Labs' new Si476x multiband automotive receivers are well suited for these demanding automotive infotainment applications.

Tim Moynihan, Empirix: The proliferation of mobile devices and applications that span multiple services (voice, video, data) has created tremendous need for more holistic service assurance solutions that can monitor the complete customer experience, from end-to-end.

Laurent Desclos, Ethertronics: In 2011, consumers proved there is a strong demand for LTE-enabled sleek and slim smartphones packed with numerous features and functionalities. To enable these devices, Ethertronics developed EtherSmart LTE 1.0™ Phone Adaptive Antenna solution. A 50-percent reduction of the antenna's physical volume, allows the device's design to be compact and thin as well as freeing some space for more features. Hence, it allows devices integrating this solution to deliver the multi-megabit speeds that consumers and business users expect from LTE.

Ashish Sharma, FreeWave Technologies: FreeWave's IO Expansion modules really opened the door for new and innovative uses for wireless IO across multiple industries, especially within the smart grid and oil & gas markets. The majority of wireless IO systems being deployed today are used for data acquisition, but increasingly more users are implementing wireless IO in control applications. Some new applications that FreeWave's IO Expansion modules will serve include power transformer monitoring, circuit breaker monitoring and the monitoring and control of variable frequency drives.

Andrew J. Pease, QuickLogic: We finally are starting to see that pico projectors can be a real market. They were introduced two years ago, but were not ready for prime time. The work the light engine manufacturers have done since then to reduce both power and cost could make this an interesting market in 2012. Our previously mentioned VEE/DPO technology will have a significant impact on pico projectors by greatly increasing both the viewability as well as the effective lumens without consuming more power.

Frank Stewart and David Schnaufer, RFMD: RFMD's PowerSmart™ platforms enable cellular modems with world HSPA+ and LTE capability to be included in a range of new devices and allow for all the frequency band coverage needed for world coverage into those devices. We also launched RFSA4013 and RFSA4023, fully monolithic analog temperature compensating attenuators featuring exceptional linearity over their entire gain control range. Revolutionary circuit architecture solves a long-standing industry problem with regards to attenuator architecture: high IP3, low DC current and broad bandwidth.

Dr. Mo Shakouri, Alvarion: Recently Alvarion acquired Wavion Wireless Networks. Wavion is a technology leader in carrier grade Wi-Fi market with a family of advanced outdoor Wi-Fi base stations, operating in 2.4 and 5 GHz unlicensed bands. With Wavion portfolio added, Alvarion now offers powerful Wi-Fi solutions for

applications such as cellular data offloading, Wi-Fi metro zones, and Wi-Fi for government and enterprise applications.

E.L. Fox Jr., Fox Electronics: XpressO is now being used in automotive applications. This has been a real breakthrough for Fox in 2011. It's incredible how well received it' been for this application.

6. How do you differentiate yourself from your competitors?

*John Greichen, Analog Devic*es: As the industry's broadest supplier of RF ICs for the entire signal chain, ADI has of over 1,000 RF parts, including functional building blocks such as PLLs, detectors and mixers to highly integrated ISM transceivers and places great emphasis on high performance and integration. Our RF ICs are also complemented by the world's best data converters and a full range of signal processing and conditioning solutions and supported by many design resources including tools, technical support communities, reference designs, etc.

Svenn-Tore Larsen, Nordic Semiconductor: Nordic has specialized in ultra low power wireless connectivity for over a decade. This is all the company does. We believe this gives us an established market and customer base, and depth of expertise in this unique technology that is difficult for competitors to match. We spend a significant proportion of revenue on R&D and this has helped us develop some of the lowest power consumption RF chips in the world. The spec sheet doesn't lie. But we will never be arrogant or complacent. There are some very good companies in ultra low power wireless and the competition is good for Nordic because it drives innovation and helps grow this exciting technology sector.

Jan Whitacre, Agilent Technologies: We are the industry leader in test bringing solutions to the latest next-generation markets including LTE-A, WLAN, etc. Our solution set is the broadest within the wireless product life cycle from design simulation, SW to RF parametric, signaling, manufacturing, verification and conformation. For us the differentiation really become apparent when you couple our sophisticated software offering with our leadership in hardware, from handhelds, SMUs, PXI and AXIe, to bench/rack instruments. The result is unmatched test capabilities from design through manufacturing, providing engineers incredible insight and power for their electronic product development.

Matt Desch, Iridium Communications: First of all, the global coverage, low latency and unmatched network reliability of the Iridium network is what differentiates us from the competition. Another key difference is Iridium's approach of continually working with new partners to form opportunities in expanding markets. We have thrived in the M2M sector because we offer connectivity through low-cost, small, two-way global transceivers to our partners who license for tracking and monitoring capabilities. In the personal communications space, we're now re-entering the consumer market through partners who develop innovative new devices specifically for consumer use. And with the Iridium Force announcement, we're opening up Iridium's development platform, licensing core technology, and integrating location-based services into the portfolio, making Iridium products and services more accessible, cost effective and functional. With the innovation of our ever-expanding

partner ecosystem, Iridium is more than just a single company.

Mark Downing, Silicon Laboratories: As an industry leader in the innovation of high-performance, analog-intensive, mixed-signal ICs, Silicon Labs has consistently outperformed the competition in the wireless market by developing mixed-signal RF products implemented in standard CMOS that simplify the design process, reduce component count and BOM cost, and speed time-to-market. We also provide our customers with comprehensive development tools that make it easy for embedded designers with little or no RF expertise to add wireless connectivity to their applications.

Tim Moynihan, Empirix: Empirix is the only company that can provide end-to-end visibility into customer experience, application performance and operations, regardless of service delivery method or network protocol.

Laurent Desclos, Ethertronics: Looking to the future, Ethertronics is an antenna system company introducing a new approach to solve network and device challenges arising from consumer consumption and demand. Ethertronics is re-architecting the antenna/RF system instead of sticking to a 20+ year legacy of design that competitors are still following. Ethertronics introduced its active antenna system solutions for integration in devices to deliver increased data throughput for faster network speeds, design flexibility for faster time-to-market, and appealing thin designs to meet consumer satisfaction.

Ashish Sharma, FreeWave Technologies: FreeWave offers a two- year warranty for every product and a one-of-a-kind trade-in program to better improve our customers ROI and total cost of ownership. We also focus on differentiating core competencies with our radio designs, including the lowest power consumption, unparalleled signal performance in noise-congested environments, backwards compatibility and the most versatility of any data radio on the market. Every single FreeWave radio is also 100% designed, manufactured, tested and tuned in our manufacturing facility in Boulder, CO.

Andrew J. Pease, QuickLogic: Unlike many companies that make the claim, we are truly a solutions company. We generate our revenue through the sale of silicon, but we provide our customers with fully integrated silicon and software solutions. We take ownership of our products to make sure they work in our customers' systems. In doing so, we become part of our customers' R&D departments.

Frank Stewart and David Schnaufer, RFMD: RFMD differentiates itself from competitors on the basis of product performance, technology, large-scale manufacturing and customer service. We have a 20-year legacy of innovation that influences the decisions we make, how we work internally, and how we interact with our customers. During the past 20 years, we have invested more on RF component development than anyone else in the world as we seek to create disruptive technologies that obsolete what we have done in the past–we go after game changers.

Dr. Mo Shakouri, Alvarion: The explosion of broadband data usage is creating an

ever-growing set of coverage and capacity challenges that cannot be addressed effectively by any single technology. Alvarion leverages its years of experience in providing carrier-grade solutions to create a unique combination of multiple wireless technologies that meets a diverse range of connectivity, capacity and coverage challenges. Our solutions are based on multiple technologies that provide opportunities for growth while providing the flexibility to overcome the challenges in increasingly complex wireless broadband networks.

E.L. Fox Jr., Fox Electronics: We have developed our own semiconductor technology where as our competitors are using a third parties semiconductor technology. It's a significant competitive advantage to have in-house expertise for both the semi side and the quartz side.

7. How much of a support role do you play with your customers?

*John Greichen, Analog Devic*es: ADI plays a very strong support role with our customer and support has become increasingly important as our products become more integrated across RF and digital domains. In the past year, we have continued to roll out new versions of our popular design tools such as ADIsimRF™, ADIsimPLL™ and more, as well as new design resources such as Circuits from the Lab™ reference circuits and EngineerZone™ online technical support forums.

Svenn-Tore Larsen, Nordic Semiconductor: RF engineering is a tricky business and no company can expect to get away with just providing chips and then letting customers get on with their own development. That's why a significant proportion of our business is dedicated to supporting customers so that they can get their RF designs working in the quickest possible time. We ensure customers have the RF silicon & software, development tools and reference designs to help them in the design process, and then we offer comprehensive support via website or phone, in addition to a team of highly experienced RF application engineers. Our distributors also provide a vital role in customer support.

Jan Whitacre, Agilent Technologies: Our top priority has and continues to be our customers' satisfaction. To meet that priority, we work daily to ensure that every aspect of our company—from sales, marketing and R&D to operations—is focused on customer success. 110 countries have an Agilent presence. We also closely work together with the wireless industry's leading players in standard bodies, research and test labs. Our customers are facing many of the same challenges that we face and they want to invest in the best measurement tools they can to improve their productivity and win. That is our goal as well and it is what we are great at—partnering with customers to give them measurement expertise, which in turn gives them faster time-to-insight into their product development and subsequent product deployment.

Matt Desch, Iridium Communications: Iridium provides technical and engineering support for partners integrating Iridium core technology into their products. We maintain a rigorous product testing and certification process for new Iridium-embedded products and solutions. In addition, we provide strong marketing support to our partners and host an annual partners conference.

Mark Downing, Silicon Laboratories: Customers have fewer design resources at their disposal and also may not have the luxury of maintaining an RF expert in house. To support our customers, Silicon Labs offers comprehensive wireless application development solutions including software/firmware, online selection utilities, antenna selection support/documentation, and reference designs and modules designed to make adding wireless connectivity to embedded applications straightforward and cost-effective.

Tim Moynihan, Empirix: Empirix works very closely with its customers to fully understand their needs. In this way we are better able to provide solutions that preempt issues from impacting their customers, ensure that their applications are performing at peak levels and predict new ways to increase satisfaction, control profitability and find new revenue opportunities.

Laurent Desclos, Ethertronics: The Ethertronics team works closely with OEMs worldwide during the design process to ensure end devices provide the best connectivity and performance. In some cases, the Ethertronics team works in-house with OEM design teams to create the next generation of phones and tablets. Design centers are strategically located around the world to provide customer support 24-hours a day. Ethertronics then becomes an integral part of the OEM's team both in thought and actions.

Ashish Sharma, FreeWave Technologies: The support FreeWave provides each and every customer makes its radios just a single element in the success equation. FreeWave offers hands-on training, held in Boulder and in cities around the globe, which ensures its customers gain the greatest return and performance from their investment. FreeWave has a renowned RapidResponse™ customer support program that includes 24x7 access to specialists for both routine and emergency situations. FreeWave also supports customers throughout the installation process with free path study and network design services.

Andrew J. Pease, QuickLogic: Our stated purpose here at QuickLogic is to deliver winning customer experiences. We do this by delivering a complete solution to our customers. We take total ownership of any issues that may arise and work with our customers all the way through production and shipping. We're very tuned in to our customers' needs.

Frank Stewart and David Schnaufer, RFMD: RFMD prides itself on stellar customer service, supporting customers with a team of field applications engineers, customer quality engineers, a variety of reference designs, and a global field sales network to assist customers at every step from design to production. In many cases, our customers rely on us to make the RF section of their devices work. Significant expertise is needed to accomplish a high performance RF solution, and most of our customers rely on us to provide that expertise.

E.L. Fox Jr., Fox Electronics: A lot of support is given up front when the customer is designing their new product, selecting the right frequency control solution and going through the reliability testing and qualification process. Expanding our sales

offices this year was also to ensure we can give our customers the highest level of support throughout their entire project cycle.

8. Do you have any predictions for 2012 that you would like to share?

*John Greichen, Analog Devic*es: Massive ongoing desire for mobile data driven by the need to move video wirelessly across the network will continue unabated and will drive demand in the wireless sector.

Svenn-Tore Larsen, Nordic Semiconductor: Predictions are risky, especially against the backdrop of a difficult global economy, but if recent history is a guide, the ultra low power wireless sector is set to show healthy growth next year. The technology is still in its infancy and as consumers get more exposure to devices such as RF remote control with advanced user interfaces and sport & fitness monitors that link to their cell phones, they will demand more. And one of the key advantages of ultra low power wireless technology – the fact that it can run from coin cell batteries for many months or even years – makes it relatively simple to add to almost any product.

Jan Whitacre, Agilent Technologies: The uncertainty of global economy will most likely remained in 2012, however Agilent is positioned to l keep developing the test solutions to address the next wave of emerging technologies. We will see more internet connections in more areas of our life. For instance in the world of wireless, it’s all about data delivery. Customers and their applications are demanding more and more data. According to a recent report from Cisco, mobile broadband data traffic will increase by 39 times between 2009 and 2014. WLAN will play an interesting delivery partnership with cellular. Within each of these technologies, developments like MIMO and new chipset designs are being eyed to make them even more efficient. We are very encouraged by these trends geared toward improving data delivery in the commercial wireless market because we have test solutions to address each of these areas.

Matt Desch, Iridium Communications: In 2012, we expect to make a number of hosted payload announcements for our next-generation satellite constellation, Iridium NEXT. We’ll likely see new enhancements in communications options for maritime and aviation. We expect M2M to continue to grow and we’ll likely see more partnerships with traditional cellular companies to bring seamless connectivity around the globe. And of course, in the year ahead, Iridium plans to continue to expand our partner base to provide voice and data communications to an ever-increasing range of new and emerging markets across the globe.

Mark Downing, Silicon Laboratories: In 2012 we expect to see several exciting RF-intensive technologies and applications make the transition from hype to practical reality. These developments include the rise of “Internet of things” (IoT) applications such as iPhone-enabled home automation and security monitoring, the availability of white space radio for long-range wireless services and M2M communications, and the use of wireless sensor nodes powered by harvested energy sources (including scavenged RF energy) for applications ranging from residential lighting control and security systems to infrastructure monitoring.

Tim Moynihan, Empirix: As operators gain a deeper understanding of how customers are really using mobile applications, they will begin to develop a new business models to drive revenue generation.

Laurent Desclos, Ethertronics: The year 2012 will be when LTE networks mature and are rolled out more widely to support a global, wireless ecosystem. Consumers' awareness of what LTE translates to beyond "faster speeds" will inevitably increase its demand. Ethertronics' experience and forward thinking has allowed the company to position itself as an industry leader in the active antenna and RF system space to support LTE networks and devices, and with it, have solutions for its challenges.

Ashish Sharma, FreeWave Technologies: Demand for wireless solutions for industrial automation applications will continue to grow as companies look for cost-effective, technically feasible ways to implement secure, reliable data communications technology. Many diverse and dynamic markets, such as oil and gas, public utilities in electric power and water, manufacturing and more, will continue to look for ways to streamline their operations and automate their processes. There will be exciting, new innovations for addressing issues previously deemed cost-prohibitive, not technically feasible or lacking in sufficient reliability.

Andrew J. Pease, QuickLogic: In 2012, people will start to see pico projectors out in the consumer market. I also believe that the Android tablet guys will finally come out with a competitive product that will encroach on Apple's market share. As strong as Apple is, the fact that they are a closed system is contrary to what the market demands of the market share leader.

Frank Stewart and David Schnaufer, RFMD: We see 2012 as a big year for LTE, both in device deployment and network deployment in additional markets. RFMD has been quite bullish on LTE adoption rates, and we believe 2012 will meet or exceed our bullish forecasts. As a result, we see significant growth in 2012 for LTE-based smartphones and tablets on the device side. For the cellular backhaul market, we see an acceleration of growth in point-to-point and remote radio heads. 2012 will be bigger and better than 2011!

Dr. Mo Shakouri, Alvarion: We believe that unlicensed spectrum and Wi-Fi are crucial to providing customers with broader wireless access solutions. "As we enter a new era, driven by an abundance of multi-mode devices and data-intensive users, Alvarion's strategy of supporting multi-technology, carrier-grade solutions will better serve our customers' needs," states Dr. Mo Shakouri, Corporate Vice President of Strategy at Alvarion. "Gone are the days of spending billions of dollars to build a single network, and hoping that the devices and customers come."

E.L. Fox Jr., Fox Electronics: If you have a unique product that the market wants, business will be just fine. If you don't have an exciting product that differentiates you, it's going to be a tough year.

Innovation Reaches Far & Wide in 2011

1. What technology was announced in 2011 that was significant to the industry as a whole?

*John Greichen, Analog Devic*es: In the past, wireless system engineers have had the choice of either using high performance building block components or giving up performance to make their design smaller. Our integration of high performance RF building block components have allowed them to get the integration they want while keeping the performance they need. We took a big step forward in integration this year: Modulators with PLL and VCO, Mixers with PLL and VCO, PLL's with high voltage charge pumps, Digital Step Attenuators with Amplifiers, Power Detectors with Envelope Detectors, VGA's with power Detectors, VGA's with tunable filters, Mixers with Tunable Baluns and Filters. The added integration not only allows our customers to reduce the size of their components without giving up performance but also reduces design time and risk because we have integrated many of the difficult interfaces between components. All in all, we have made the development of wireless systems easier.

Svenn-Tore Larsen, Nordic Semiconductor: I would say Bluetooth Version 4.0 (which includes Bluetooth low energy as a hallmark feature). But again it is important to note that while Bluetooth v4.0 does extend Bluetooth technology to a new range of peripheral products, it's not the first ultra low power wireless technology on the market. Proprietary technology, such as Nordic's nRF24L Series, and other interoperable technologies such as ANT+, has served this market for many years. ANT has shipped 25 million chips, and Nordic has shipped 500 million chips into the ultra low power wireless technology sector since the company started. Bluetooth v4.0 technology's ability to wirelessly connect peripherals to cell phones is an important advance, but don't forget that ANT can do this too.

Jan Whitacre, Agilent Technologies: From our perspective within cellular LTE-Advanced. Its capabilities along with the increasing speeds within WiFi is really driving a convergence which we believe will result in an "Internet of things," as capacity and network speeds continue to increase. This will give even more immediate personal connectivity anywhere and anytime, with access to information and the ability to manage and move information becoming pervasive, intuitive and expected. This will enable a much broader industry of product connectivity then we have ever experienced. Wireless connectivity will be everywhere for everything. For example, mobile, patient-attached, continuous information devices that provide remote medical personnel with full real-time heath information and alerts could be used to maintain constant medical monitoring of heath critical individuals, while helping to reduce health care costs. On-shelve product monitoring devices could be used for inventory control/management, something particularly important for product recalls. Additionally, devices providing instant access to current information within transportation (e.g., shipping, automobiles, airplanes) could be used for geo-location, capacity and safety.

Matt Desch, Iridium Communications: All the products that we introduced as part of the Iridium Force vision are revolutionizing personal communications. The Iridium Extreme is the most advanced, rugged, global satellite phone on the market today. And the Iridium AxcessPoint suite of products are a first in the industry, enabling

smartphones and laptops to work anywhere in the world. In addition, we recently announced that the Iridium AxcessPoint Mail & Web App is now available for Apple operating system (iOS) devices. This makes it possible for the more than 250 million iPhone, iPad and iPod Touch users to connect via email and Internet anywhere in the world, over the world's furthest reaching communications network. Iridium products and services are shaping the future of personal communications.

Mark Downing, Silicon Laboratories: From our perspective, the most significant wireless announcement in 2011 concerns the availability of commercially viable energy harvesting technologies for wireless sensor node applications, such as home and building automation, security systems, industrial control, medical monitoring, asset tracking, and infrastructure and agricultural monitoring systems. Although systems powered by harvested energy have existed for years, developers have been challenged to implement wireless sensor nodes within nano-amp power budgets. Silicon Labs met this design challenge with an energy harvesting system based on our ultra-low-power wireless MCUs combined with a thin-film battery and solar cell. In addition to being environmentally friendly and virtually inexhaustible, harvested energy provides a cost-effective alternative to batteries, which can be expensive and inconvenient to replace in large-scale wireless sensor networks. Energy harvesting simplifies these applications by eliminating the inconvenience of replacing batteries in inaccessible locations while reducing the quantity of depleted batteries for recycling or dumped in landfills.

Tim Moynihan, Empirix: Although it was announced previously, the implementation of LTE has had significant impact on the industry in 2011. By enabling "multi-tasking" at the device level, it has enabled a greater number of applications – and a greater integration of mobile communications in daily life. This of course puts a tremendous strain on bandwidth and requires providers to assure Quality of Experience across an evolving set of technologies and services. Organizations that master these complexities will prosper in 2012 and beyond.

Laurent Desclos, Ethertronics: LTE network launches across the globe have significantly impacted the industry. As a result of the marketing hype around these 4G networks, consumers are now expecting high-performance devices running on lightning-speed networks. Ethertronics has developed antenna system solutions allowing OEMs to deliver the wireless devices and experience that consumers want. Ethertronics' introduction of active antenna and RF system solutions to the wireless industry has opened opportunities for continued innovation. By applying several applications of its technologies, such as Active Impedance Matching and Band Switching techniques, Ethertronics' solutions can be integrated into devices to allow for the highest levels of performance -- from improved connectivity to networks and the ability to retune themselves to changing environments to being able to offset hand and head effects that typically result in antenna de-tuning and dropped calls. In addition, Ethertronics' Band Switching techniques pave the way for addressing multi-band environments to support LTE.

Ashish Sharma, FreeWave Technologies: FreeWave Technologies is the only provider of expandable IO devices that offer universally configurable IO channels for analog input, analog output, digital input, digital output and sensor power.

FreeWave has taken IO Expansion one step further by allowing users to customize their networks and select the ideal number of isolated digital inputs and isolated relay digital outputs for their specific application. Additionally, the IO Expansion products carry the same measurement accuracy of analog inputs and can connect to any serial communication device, thereby leveraging customers' existing hardware investments. FreeWave's GXM radio is one of the smallest form factors in the industry (1.4" x 2") that gives users a long range wireless data solution and enables OEMs to leverage their existing designs for international markets where 900 MHz spectrum is unavailable. The GXM is ideally suited for applications where space is a premium and has full ETSI, FCC, IC, RoHS, and UL Class 1 division 2 Certifications.

Andrew J. Pease, QuickLogic: I don't think any significant technology was announced in 2011, unless you count the hype that accompanied the iPad 2. That excitement substantiated that the tablet is absolutely a market. The introduction of the iPad 2 left all the other major OEMs scrambling to address that market. The problem that the Android people have had is that they are fragmented and no one has emerged as a real leader.

Frank Stewart and David Schnaufer, RFMD: GaN technology for CATV and cellular infrastructure and PowerSmart™ cellular platforms for smartphones, tablets, and M2M have revolutionized their respective industries. GaN technology has been developing for some time, and 2011 was a breakthrough year with more than 20 new GaN amplifiers released by RFMD. The GaN technology has received the industry "green" technology label, due to its ability to operate with reduced current consumption and improved thermal management, while maintaining performance levels equal to or better than competing semiconductor technologies. Flat gain over a wide frequency range, high power efficiency and high power density make GaN amplifiers ideal for a number of RF applications. RFMD's PowerSmart™ cellular platforms are providing a complete RF chipset to device OEMs that is dramatically smaller and more highly integrated, with tunability never seen before in an RF platform. With a solution size 50% smaller than legacy architectures, PowerSmart™ enables cellular modems with world coverage to go into a wide array of new M2M, consumer electronics, and mobile data and computing devices.

E.L. Fox Jr., Fox Electronics: Although MEMS oscillators received a lot of attention in 2011 with several products being introduced, but to date, we have not seen MEMS have any real success or gain any traction in the market. Our customers are checking out this new technology, though, sort of like kicking the tire, but we are hearing over and over that the performance they need is just not there. Crystal oscillators are still holding true.

Posted by Janine E. Mooney, Editor

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