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January 18, 2010

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**Linear Signal**

January 18, 2010



Linear Signal is an early-stage fabless semiconductor startup pioneering an ultra low-cost beamforming RFIC technology. The roots of the company go back to September 2007 when IPTV veterans began exploring business opportunities with a focus on aiding large edge IP network operators, such as apartment buildings, hospitals and motels effectively become their own cable/telecom providers. They determined a new satellite television antenna was needed to replace large reflectors.

Linear Signal was seed funded by angel and private investors. Additional strategic corporate investors are being considered.

The principal founders of the company are [Gregory Mockett](#) and [Karl Warnick](#). In addition to the core group in Provo, Utah, a team of Washington State University (Pullman, Wash.) researchers performs the beamformer chip development. First chips are being developed on a .18um SiGe platform at Jazz Semiconductor (now TowerJazz) and will be packaged in a flipchip configuration at Maxtek Components Corporation.

Mockett, who serves as president, is a veteran web software and IPTV entrepreneur. He was a founder of numerous companies, including Orangatango, acquired by iEntertainment, and ICentral, acquired by Open Market. While at Orangatango, he became a leading authority on market driven internet privacy and security solutions, consulting US Senators and Congressmen. At ICentral, Mocket designed a unique "shrinkwrap" strategy for the ShopSite™ eCommerce storefront engine, making the product a first in Internet channel marketing.



Gregory Mockett

Warnick, the company's chief scientist, invented the core adaptive analog beamforming technologies at the heart of Linear Signal's Ad-A-Beam™ family of semiconductor products and leads the company's technology development. He is a professor in the Department of Electrical and Computer Engineering at Brigham Young University. Warnick is served as Technical Program Co-Chair for the 2007 IEEE International Symposium on Antennas and Propagation. His radio astronomy array research and background contribute significantly to Linear Signal's antenna system, low noise performance, and beamforming requirements.

Market and economic forces made alternative satellite and wireless television programming sources highly desirable for the target market, but the high costs of existing downlink receiver technologies with sufficient flexibility were not practical. Prohibitively expensive phased array antennas were needed.. Linear Signal's founders set out to develop novel beamforming chips and other technologies to significantly drive down the cost of implementation.

After doing initial feasibility analysis, Linear Signal was incorporated in February 2008 and the team began fine tuning their ideas for an adaptive analog RF-CMOS beamforming chip. The goal was to address core beamforming cost drivers: reducing electronics costs (including numerous phase shifters, amplifiers, and combiners) and numbers of antenna elements required.

A low cost, analog/digital beamforming chip was designed that performs both phase and amplitude shift functions. This hybrid solution combines analog beamforming with the capability for digital control and drastically reduces the costs of beamforming for both wideband and many-element array applications. The company's patent-pending technology, dubbed Ad-A-Beam™, offers positive cost impacts to many wireless products and services beyond those originally contemplated for linear media delivery.

Linear Signal tackled the job of bringing down the cost of phased arrays with a three-pronged approach:

- Optimize antennal elements to reduce parts count
- Reduce beamformer parts costs by more than 10x
- Integrate chips and element panels (tiles to assemblies) to reduce engineering time and drive parts volume

**INDUSTRY EVENTS**

January 2010

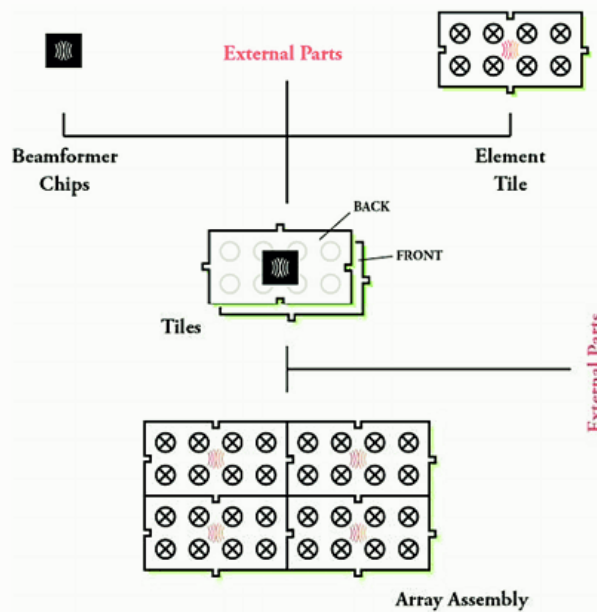
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Product Hierarchy

Linear Signal will collaborate with antenna manufacturers to deliver phased array antennas into reflector markets. The company will offer value-added engineering, beamforming algorithm and sales support to aid adoption of phased array solutions. The company is working with several key customer-development partners as it gets its initial product suite ready in 2010.

The satellite antenna market is estimated at about \$600 million to \$800 million with various price points from high-end in-motion marine and aero applications to low-cost segments such as RV/SUV and residential markets. The company plans to start moving into the higher-end markets and migrate down the chain as it scales production and brings costs down.

Linear Signal is pioneering an integrated solution (chips, tiles, and assemblies), which does not yet exist. As such, it makes the product proposition riskier than traditional solutions but with potentially big payoffs. No direct replacement competitors exist, but there are partial RF chip replacements (single-channel, single phase shifter chips) from semiconductor suppliers such as Hittite, Triquint, and Teltron. Other vendors use a plethora of discrete components to develop the arrays. These discrete components are big, heavy and expensive and come from Spectrum Microwave, Microwave Components, RF Micro, and dozens of other microwave components entities.

Additional [marketing and technology whitepapers](#) can be viewed at the company's website.

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