Asics can make sense in rf

Ultra low power mixed signal and rf asics enable new opportunities.
By **Hans-Erik Backram**.

Ask a typical selection of engineers why they do not use mixed signal or rf asics for their projects and it's almost certain that their responses will focus upon four primary perceptions – long development time, risk, expense and the need for very high volume.

Yet, as the Gershwins' classic song famously says, 'it ain't necessarily so'. Given the right production partner, today's development flows and fabrication logistics render these perceptions redundant. Moreover, the advantages that asics confer in terms of circuit optimisation, size reduction, and power efficiency improvements are universally attractive, while making possible some projects that a discrete component approach simply cannot match. It's also attractive for some customers simply to specify the functionality that they require and leave the circuit design to the asic house, freeing the customer's in house team to concentrate on the core development work where they add most value.

While fpgas and SoCs from mainstream semiconductor vendors continue to displace digital asics, the situation is very different within the mixed signal market as there is next to nothing available off the shelf that can compete with an asic – and nothing at all when it comes to combining custom rf stages with measurement and control circuitry. In any case, it's rare for any off the shelf solution to match an asic's ability to tailor the circuitry precisely to the application.

These points are often critical when the application demands the lowest possible power consumption and the smallest possible form factor. In addition, invaluably for some markets, asics enforce high levels of copy protection that are rarely economically viable to undermine.

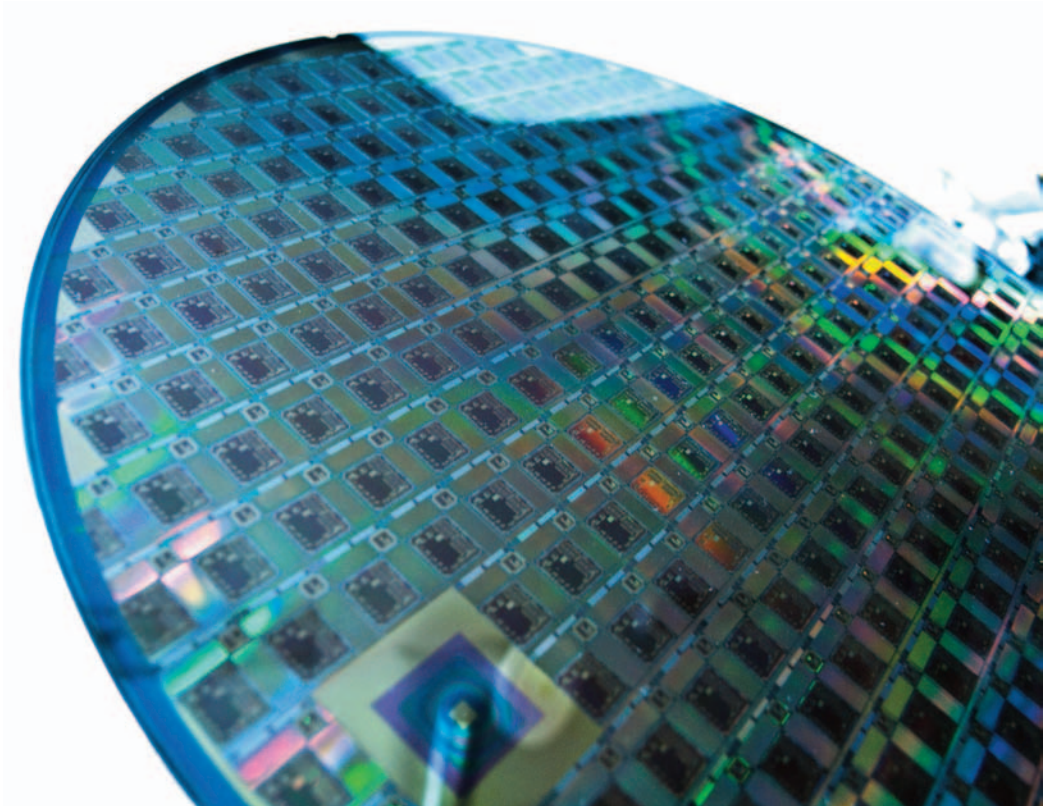
Traditionally, the ability to replace numerous discrete ics and passive components with a single slice of silicon is the dominant factor in the economic justification for selecting an asic. Improved reliability is a key benefit, but others include inventory reduction and less need for testing, as what are now complete subsystems are fully tested prior to delivery.

In some circumstances, it might be attractive to replicate or even reverse-engineer an existing design and port it to an asic in order to introduce new functionality within a much smaller form factor while preserving backward compatibility. This approach can preserve existing design investment while bestowing equipment with a new lease of life.

Real excitement

But, from an engineer's viewpoint, the real excitement lays with the fresh opportunities that asics offer. ShortLink is a development company specialising in the field of low power portable electronics and wireless communications. Specifically, the company's expertise in ultra low power rf and mixed signal asic technologies enables products that address widespread needs within consumer, industrial, and medical applications. For the most part, the common thread is the requirement for minimal form factor, power consumption and circuit noise. This basic set of attributes suits real world products as diverse as automatic welding visor controls and sensors in sportswear, where small size and light weight are paramount.

Medical applications are another good example: for instance, a recent x-ray sensor project includes an asic that's capable of measuring single photons using a conventional silicon diode as the sensor while being able to run continuously from a single coin cell for five years. This is in stark contrast with the performance that a typical discrete design achieves, where it's essential to power down as much of the circuitry as possible for as long as possible, only waking it up when necessary. Even if the discrete design could match the asic's size, its relatively high current demand at turn-on would almost inevitably require a larger battery.



The ability to integrate rf stages alongside measurement and control circuitry extends the possibilities yet further to address most telemetry applications, with representative projects ranging from automatic meter readers to traffic toll collection systems to hearing protectors for the US military. With more than 25 years of experience in designing mixed signal and rf circuitry, building blocks for asics that ShortLink has developed include:

- microcontrollers and dsp functions
- analogue support circuits (such as op amps and voltage references)
- ultra low power rf front ends and transceivers
- oscillators and phase locked loops
- a/d and d/a converters
- low noise microphone amplifiers
- audio speaker drivers (analogue and digital)

Being immediately available for new design projects, these ready made building blocks slash development times but as a full service design house, ShortLink also has the expertise to develop customer specific system on silicon hardware. The company can also develop any dsp algorithms that may be essential to implementing complex functions, such as multitap filters and modulators/demodulators. Where necessary, it's possible to include third party digital IP blocks such as memories to construct virtually any kind of mixed signal device. To help with verifying designs, ShortLink also maintains test laboratories equipped to handle work from dc to 18GHz, with particular emphasis on rf capabilities.

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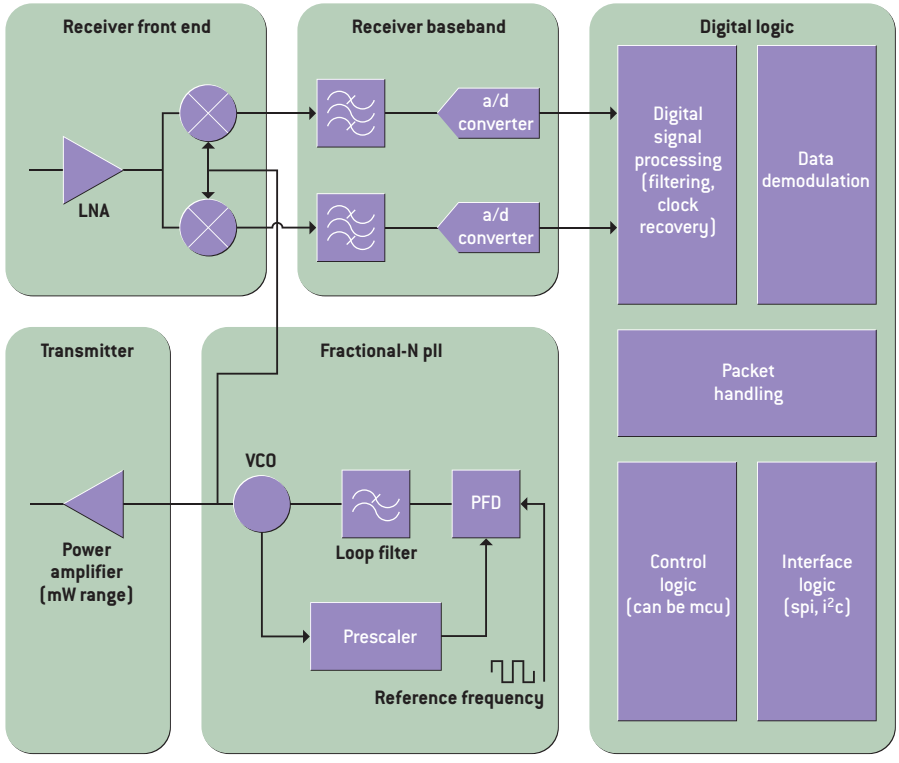
The company can access a range of fabrication processes, including 0.5μm and 0.35μm processes. These suit most analogue circuits, which do not benefit from downscaling process geometries in the same way as digital circuits. It also has access to 0.18 and 0.15μm processes that especially suit both rf and digital circuitry. As well as minimising design risk and maximising yield, these mature processes slash static power consumption as their leakage currents are much lower than many of today's fine line geometries. Because the design rules are well known and fully characterised, mature processes are also significantly cheaper to implement, both in terms of NRE and final manufacturing costs.

Despite their clear technical advantages, volume and logistics continue to dominate much thinking around asics. Clearly, high volume production always helps to amortise costs, but ShortLink's experience demonstrates that it can be viable to consider asics for volumes as small as 10,000 pieces. This modest quantity allows their use in markets such as medical equipment that often involve relatively low volumes but have stringent demands on performance, device size, reliability and battery life.

In addition, as mainstream semiconductor makers continue to chase ever finer process geometries, more production capacity becomes available for less demanding line widths. As a result, asic production costs are continually falling. Furthermore, the company offers second source wafer fabrication and component packaging facilities that minimise production risks and assure timely deliveries. Crucially for many customers, ShortLink manages the entire production lifecycle, from initial design through scheduling production to delivering fully-tested components to the customer's premises – removing these responsibilities to allow OEMs to concentrate on innovation rather than logistics.

Fig 1: Example transceiver topology



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