

WHITE PAPER

28 Ways

Sangoma Makes
Asterisk® Better



28 Ways Sangoma Makes Asterisk® Better

Sangoma is a market leader in open source telephony and has been a true pioneer, as well as an innovator, in this space for decades. Asterisk is a great product that unleashes the talent and creativity of thousands of developers around the world. We at Sangoma are proud of our contributions to making Asterisk even better, by constantly improving the scalability, reliability and functionality of Asterisk-based systems. Many of the largest capacity, highest reliability, feature-rich, Asterisk-based systems are enabled by Sangoma hardware and software. We engineer, design and manufacture the highest quality interface hardware available for Asterisk and many innovative software capabilities that extend Asterisk into new areas.

And for nearly a decade, Sangoma has been a *major* participant in the Asterisk *community*.

- We have repeatedly assisted many companies that build outstanding products using Asterisk by providing them with the industry's best hardware, software, engineering assistance (to help them with testing and development), driver knowledge, and financial support
- We have supported literally thousands of new Asterisk users to get their systems up and running, even when their challenges had nothing to do with Sangoma. One more way we contribute to the community
- We sponsor Asterisk focused events around the world, including Astricon, AsterConference Asia, Asterisk User Groups, ElastixWorld, Amoocon, and numerous others.
- Sangoma spends hundreds of thousands dollars yearly sponsoring many open source telephony projects

In these ways and several others, Sangoma has contributed extensively to the success and stability of the Asterisk framework and to the community.

While other major players have shifted their focus away from providing the best hardware for Asterisk, Sangoma remains firmly committed to this task and to your community. We continue to lead the way with more products that help push the density and reliability envelope, than any other vendor. We were the first to introduce hardware-based echo cancellation, adjustable chunk size, an 8-span digital board, and many others. And more recently, while other companies are just maintaining their existing product portfolio, Sangoma has delivered the industry's first board capable of supporting 16-spans of digital telephony in a single expansion slot, a GSM Board, and the most accurate answering machine detection software available for Asterisk.

In spite of all this, much of Sangoma's contribution to Asterisk is still not fully understood by many people. The extensive technical innovations that are part of our Asterisk-focused products have become default components of what developers and integrators now expect of Asterisk generally. Many readers may not realize just how many Asterisk-related innovations, originated at and are still only available, from Sangoma. This paper explains 28 innovations from Sangoma (grouped into 3 categories) that make Asterisk better, all with the best technical support in the industry:

- A. Making Asterisk More Scalable
- B. Making Asterisk More Reliable
- C. Making Asterisk More Functional

You and your customers demand the most of Asterisk for mission-critical solutions. You should be buying your Asterisk hardware from the company that is committed to making Asterisk better with the best hardware, software and support available in the industry.

Sangoma makes Asterisk Better

Asterisk is a great product that unleashes the talent and creativity of developers around the world. Sangoma is proud of our contributions. This paper identifies 28 ways that Sangoma products make Asterisk Better. These innovations and improvements have been grouped into three categories. We have made Asterisk more scalable, more reliable and more functional, all backed with the best technical support in the industry.

Making Asterisk More Scalable

A variety boards and software from Sangoma allow you to build bigger Asterisk systems on smaller servers.

Since its creation, Asterisk® has been known to require a lot of CPU resources when using the default DAHDI driver to communicate with installed VoIP-to-TDM interface boards. This increases the capital and operating expenses of the system.

Even with the most powerful CPU, systems can often show significant CPU load-related problems when running anything more than eight spans of digital telephony (T1/E1/J1) boards. By using multi-core servers, this number can be pushed to sixteen spans, but there is little CPU capacity to spare at this level of density.

Sangoma hardware and drivers alleviate this problem in several important ways. With Sangoma hardware, a single-chassis system running Asterisk can support up to forty-eight spans of digital telephony (1,440 simultaneous calls) without the risk of overloading the CPU. This reduces capital and operating expenses of the system.

Number One: Hardware and Drivers that support Adjustable Chunk Size

Zaptel and DAHDI have always supported adjustable chunk size, but until Sangoma developed hardware that was specifically designed to work with adjustable chunk size, no one could take advantage of this important potential for efficiency gain.

In order to make Asterisk work with TDM interfaces, audio data must be transferred between the TDM Interface Boards that are installed in a system and the DAHDI API. The size of the “bucket” that is used to move this audio data is called the “chunk size.” Each time a bucket of data needs to be moved, a CPU Interrupt is raised. An interrupt is a “call for attention” to the CPU. The more interrupts being generated by a system, the more load that is being generated on that CPU. By enabling different size buckets, up to 10 times the default bucket size, the interrupt load can be reduced by a factor of 10. Instead of 1,000 interrupts per second, Sangoma systems typically trigger 100 interrupts per second. This reduces CPU load and gives other applications a ‘smoother ride’.

Number Two: Hardware-based Echo Cancellation

Sangoma was first to offer hardware based echo-cancellation.

Sangoma was the first to introduce hardware based echo-cancellation. By offloading this CPU-intensive task to hardware designed for this task, call quality increases and call density per server expands.

Number Three: Hardware-assisted TDM-Multiplexing

TDM (Time Division Multiplexing) requires that data from individual calls be placed in the appropriate timeslot at the transmission end (multiplexing), and that data from each timeslot be extracted and forwarded to the correct VoIP channel at the receiving end (de-multiplexing). Data transfer and multiplexing/de-multiplexing takes significant CPU cycles to accomplish.

Sangoma uses hardware-based TDM multiplexing and de-multiplexing. This conserves valuable CPU cycles, allowing the server to handle more calls. Sangoma was the first to introduce hardware-based de-multiplexing.

Number Four: Sangoma Driver DMA ZERO Copy

Direct Memory Access (DMA) is a method that enables input and output to and from the main memory of a system without assistance from the CPU. Sangoma hardware uses DMA to directly transfer timeslot data to and from DAHDI buffers. This zero copy driver design saves more CPU power to handle other calls.

The Sangoma DMA chain also provides a buffer to absorb the unavoidable delays in processing, of up to 10 ms, introduced by Linux. This buffering prevents data loss and associated audio quality problems.

Number Five: No Interrupt Issues. Put as many boards as needed in a single server

Sangoma engineers have been thinking about scalability since day one. Sangoma boards have always been designed to properly share interrupts so that there is never a conflict. There can be as many Sangoma boards as necessary to support the required density or functionality in a single server, without interrupt issues.

By combining adjustable chunk size, DMA transfers, hardware echo cancellation, and an efficient interrupt system, Sangoma hardware greatly reduces CPU load and increases the capacity of the server to handle high-quality calls. By absorbing processing latency, call quality is preserved. This makes a high-density Asterisk-based system possible. It also allows CPU-intensive applications to coexist with Asterisk powered systems.

Making Asterisk More Reliable

Sangoma has developed a range of features designed to improve field reliability. We back that claim by offering a life-time warranty on our A-series boards.

Number Six: Unbreakable Firmware

Keeping hardware in the field up-to-date can be a major challenge for systems providers. One key task in this process is updating the firmware on the telephony boards installed in a system.

However, updating firmware in the field can be risky. If problems occur during the upgrade process, such as a corrupted firmware update file, or interrupted power during the upgrade process, the board can become damaged (sometimes called “bricked”) in such a way that it usually has to be returned to the manufacturer for repair.

Not so with Sangoma boards. Unbreakable Firmware means an upgrade can always be restored to the board in the field, even if the upgrade was unsuccessful.

Every Sangoma board carries a copy of its “factory default firmware” in a protected space. In the event that disaster strikes and the active copy of the firmware becomes corrupt, the board can be flash-reloaded to the default firmware and instantly be ready to be put back into service.

Number Seven: Error Free Faxing over Digital Connections

When connecting a fax machine to an Asterisk-based PBX or IP-PBX that sends faxes over a digital connection (E1, T1, J1, BRI) there are often issues of reliability because the analog connection to the fax machine is not properly synchronized with the digital connection.

Sangoma has solved this issue by enabling the FXS module into which the fax machine is connected to receive its clock from the digital board connected to the PSTN. This ensures that the clock is synchronized across all boards and all devices, delivering error free faxing. This feature is patented by Sangoma, although other vendors have copied the idea.

Number Eight: VoiceTime

To properly digitize voice, systems need an accurate and precise clock source. In systems where there is a PSTN interface board, the clock is supplied by the PSTN via the board. However, as systems have moved to “All VoIP,” they no longer need these PSTN boards and therefore have no such clock source. While a system can run for long periods of time without a clock source, eventually (and specifically under load), “clock slips” start occur and voice quality is impacted.

In direct response to this issue, Sangoma created the VoiceTime USB Module. This eliminates “clock slips” and helps to ensure the highest voice quality possible from an Asterisk system.

Number Nine: High Availability

One of the objections to using Asterisk in carrier solutions has been the difficulty in creating a truly fault-tolerant, high-available system. Sangoma boards provide a solution for overcoming this important roadblock. Sangoma hardware can be configured in a “tristate” mode. This configuration allows Sangoma digital hardware to receive but not transmit, even when data is being generated by the board. This allows two Asterisk systems to run in parallel, complete with telco interfaces. While one remains active, the other is in hot standby mode. Should the active server fail, the hot standby server can instantly be brought into service, simply by enabling outputs and IP transmission. Competing systems require external line splitting hardware to achieve the same function.

Making Asterisk More Functional

Sangoma continues to build the highest density and most advanced boards for Asterisk. While other have stopped innovating and are just providing the “same old products” year-after-year, Sangoma continues to push the envelope, developing new, high density, high functionality products for Asterisk.

Sangoma also continues to develop advanced software modules that continue to enhance the functionality of Asterisk.

Number Ten: Higher Density Hardware

In June of 2012, Sangoma released the A116 sixteen-span board for a single PCIe slot. Sangoma’s eight-span digital board was on the market for three years before our competitors finally decided to build one.

Number Eleven: More Network Interfaces

In January of 2012 Sangoma released the W400 to provide GSM connectivity for Asterisk based IP-PBXs. This expands our portfolio of over a dozen telecom interface boards to suit every application.

Number Twelve: Self-Identifying Boards

Analog boards “self-identify” without having to open the server.

Keeping track of wires, connectors and ports in a phone closet can sometimes become a “spaghetti” nightmare especially when nearly every board and machine has multiple RJ45 jacks available. On the Analog series of Sangoma boards, FXO modules glow RED and FXS modules glow GREEN.

Number Thirteen: Software Configurable Boards

While competitors’ boards still need configuration using jumpers, Sangoma boards can quickly and easily be configured and verified using the GUI interface. This saves time, reduces the chance of making a mistake, and makes such mistakes easier to correct when they do happen.

Number Fourteen: Software Based Port Mapping

Rather than guessing which logical DAHDI span maps to which physical port, Sangoma drivers allow the user to specify how DAHDI spans map to physical ports. Sangoma was the first to introduce this feature and DHADI has since copied this functionality into their own tools.

Sangoma introduced the integrated configuration wizard for Zaptel and DAHDI. DHADI has since followed suit with `dahdi_scan` and `dahdi_getconf`.

Sangoma's Latest drivers conform to DAHDI configuration and operation. There is no requirement for special Sangoma configuration files.

Number Fifteen: Truly Universal Hardware

Every Sangoma board auto detects 3.3V or 5V.

This feature allows systems integrators, developers and OEMs to order a single board type and let the board itself adapt to its environment. It also eliminates one more worry should a switch of server platforms become necessary. Jumpers and special ordering are obsolete, yet some manufacturers are still using this cumbersome and outdated technology.

Number Sixteen: Sangoma boards are guaranteed to work with ANY motherboard.

Compliance to a standard means compliance without exceptions. Sangoma boards are truly 100% PCI/PCIe compliant and will work with every compliant backplane or server on the market. Sangoma was the first to bring PCI-Express support across all product lines.

Number Seventeen: Half-high brackets for compatibility with more servers.

As servers shrink in size, full height boards negate the density advantages offered by smaller servers. Every Sangoma boards ship with both full-height and half-height brackets.

Number Eighteen: Use of Linux Network Interface

Sangoma drivers interface to the network interface stack. By exposing each TDM span through the Linux network interface, nothing is hidden. Each span appears as an Ethernet network interface.

This allows standard Linux tools to provide statistics without making any changes to the system. *ipconfig* provides information about each TDM span, which in turn enables third party tools such as *iptraf* to provide statistics. *ipconfig* can provide network interface information such as Tx/Rx packet count DMA errors, PCI errors, latency errors, overruns and under-runs. If the telco clock is bad, if there are clock slips or lost packets, each instance will be recorded and displayed by *ipconfig*.

Sangoma spans are automatically supported by Linux SNMP. If a TDM link goes down or interrupts stop working, the Linux management information base (MIB) will detect it.

Troubleshooting has been designed into Sangoma boards as well. T1/E1 boards are designed to detect clock issues. Board alarms will not clear if there is not clock from the telco. Competing boards automatically switch to an internal clock if the telco clock is missing, but this provides false information that can lead to audio quality problems due to a bad clock or having multiple clocks on one line.

Diagnostic systems at the board level allow *ipconfig* to report a bad telco clock, as well as every clock slip and every lost packet.

Number Nineteen: Enhanced Statistics and Logging

The Wanpipemon debugging utility provides a low-level view of T1/E1 alarms and analog voltage levels. It can also provide detailed performance statistics for each interrupt type and driver path. Developers can extract a complete picture of what the driver is doing at all times, gaining deep insight into the driver and hardware level of the system. Examples of available statistics: count interrupts per second: count DMA, timer, TDM, Watchdog, BottomHalf, Rx/Tx paths per second.

If quality issues on a specific span are problematic, an individual span can be disabled on the fly, without reconfiguring Asterisk. The full diagnostic package can be brought to bear on the channel, including displaying all alarms, analogue voltage levels, setting up various loop-back modes, etc. Network and clock issues can be isolated and resolved. Once the issue has been resolved, the span can be put back into service.

Number Twenty: Wireshark Tracking

Sangoma drivers and tools deliver the power to seamlessly capture TDM signaling channels into Wireshark-compatible format. Sangoma was first to introduce this feature. Wireshark is the de facto standard network capture tool for IP and VoIP networks, allowing IT administrators to debug signaling and network issues

Number Twenty-One: Auto-Configuration in the top Asterisk Distribution

Sangoma is all about making it faster and easier to install and provision our products. We have worked very closely with the sponsors of many of the world's top Asterisk distributions. We have funded development, provided engineering support and all the hardware needed to make sure that when a Sangoma product is detected during the installation of one of these distributions, it installs properly every time. Examples are Elastix and FreePBX.

Number Twenty-Two: Hardware Agnostic GSM Framework

Most recently, Sangoma created the Libwat library that encapsulates the protocols used to communicate with wireless GSM modules. It is designed to work with Sangoma boards, or any other board whose manufacturer chooses the Libwat library to interface with Asterisk. This hardware agnostic

library provides GSM functionality to any GSM-enabled board through a standard interface, allowing hardware developers to integrate their GSM boards into Asterisk without modifying Asterisk. Although not yet part of the Asterisk standard release, it is available as a patch on the Sangoma wiki site.

Number Twenty-Three: Software-Based Tapping Framework

Sangoma has developed a tapping framework for Asterisk, eliminating the need for physically tapping the line by law enforcement officers. It also makes call recording features easy to develop alongside Asterisk. This framework is freely available to all vendors.

Number Twenty-Four: Highest Accuracy Answering Machine Detection

The Lyra Answer Machine Detection (AMD) for Asterisk improves accuracy over the built-in version. The native AMD module for Asterisk is about 70% accurate. The Lyra Asterisk software application from Sangoma provides the most accurate and resilient AMD engine available. With an accuracy of 95%, fast and reliable real-time call classification is possible for mobile and fixed lines, driving the efficiency and quality of automated calling applications to unmatched levels. This puts more dollars in outbound call center operators' pockets.

Number Twenty-Five: MFC/R2 Library

This 1950's-era signaling system is still widely used in digital format. Sangoma founded the OpenR2 project, sponsored it, and is the primary contributor to it. MFC/R2 is available to all Asterisk users.

Number Twenty-Six: USBFx0

The USB FXO device was created in direct response to customer needs. For those who need a low-cost development tool (or who do development on a laptop) the 2-Port FXO is another Sangoma innovation, making it faster and easier to develop Asterisk-based solutions.

Number Twenty-Seven: Modular Boards for Maximum Flexibility

Many of Sangoma's products are modular, offering maximum flexibility. This enables the developer to order exactly the combination of FXS and FXO lines as needed for any particular application.

Number Twenty-Eight: The Best Warranty in the Industry

We rigorously test all boards to ensure that every board meets our demanding standards. This commitment is backed by our lifetime warranty for replacement and repair from the date of purchase on all of Sangoma's "A" series hardware. As long as the buyer has registered the board online and can show proof-of-purchase from an Empowered by Sangoma partner, that board will be repaired, replaced or returned for credit.

Please visit http://www.sangoma.com/support/warranty_and_return_policy.html for more details and conditions on this one-of-a-kind warranty.

Conclusion

Sangoma is a market leader in the open source telephony community, and has been a pioneer and innovator for decades in this space. Asterisk is a great product that unleashes the talent and creativity of developers around the world. Sangoma is proud of our contributions to making Asterisk even better, by constantly improving the scalability, reliability and functionality of Asterisk-based systems. Many of the largest capacity, highest reliability, feature-rich, Asterisk-based systems are enabled by Sangoma hardware and software. We hope you have found this whitepaper, and the 28 ways that Sangoma makes Asterisk Better, to be useful and informative.

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To find out more about how we can help you make your Asterisk based system even better, please contact Sangoma or our global network of partners. You can reach us in any of the following ways:

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