5 Culprits that Kill Asterisk® IP-PBX Performance

...and what you can do about them
Agenda

- Goal of Webinar
- Xorcom Credentials
- The 5 Culprits
- Load Test Results
- Guidelines for Best Performance
- Questions & Answers
Common Misconception

- Choosing a high-priced server will give you the best performance

You will pay too much for an unsuitable solution
Goal of the Webinar

- Clarification
  - This discussion relates to workhorse PBX, not residential or demo systems
- Review parameters that affect performance
  - Criteria for choosing hardware
  - Ways to optimize software
- Pass along lessons learned
Xorcom Credentials

- Established in 2004
- All products are based on Asterisk
- Xorcom drivers: standard component in Asterisk since v. 1.2.4 (Feb ‘06)
- Award-winning, flexible and modular telephony interface solutions based on XPP™ technology (USB2)
- Emphasis on built-in reliability
## About IP Gateways...

<table>
<thead>
<tr>
<th>Feature</th>
<th>Astribank</th>
<th>IP Gateway</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central management via Asterisk IP-PBX</td>
<td>✔️</td>
<td>✗</td>
</tr>
<tr>
<td>LAN-independent architecture</td>
<td>✔️</td>
<td>✗</td>
</tr>
<tr>
<td>Fully Asterisk integrated</td>
<td>✔️</td>
<td>✗</td>
</tr>
<tr>
<td>Redundant power supply</td>
<td>✔️</td>
<td>✗</td>
</tr>
<tr>
<td>Reliable fax support</td>
<td>✔️</td>
<td>✗</td>
</tr>
<tr>
<td>Auto detection by Asterisk IP-PBX</td>
<td>✔️</td>
<td>✗</td>
</tr>
<tr>
<td>Auto configuration by Asterisk IP-PBX</td>
<td>✔️</td>
<td>✗</td>
</tr>
<tr>
<td>Low Cost of Ownership (COO)</td>
<td>✔️</td>
<td>✗</td>
</tr>
</tbody>
</table>
So...what are the 5 culprits?

1. CPU
2. Firmware-Motherboard Design
3. Chipset
4. Peripherals
5. Application
1. CPU

- **Speed**
  - Disable CPU Hyper-Threading when you have many Astribanks connected

- **Number of Cores**
  - Additional cores are beneficial, especially when additional applications (such as call centers) are run on top of Asterisk

- **MMU (Memory Management Unit) performance**
  - Some processors under test have demonstrated bad MMU performance
2. Firmware/Motherboard Design

- Core Workload Optimization
  - Some motherboards with multiple cores are not optimized for operation with Asterisk

- Interrupt Efficiency - Hardware Interrupt Handling Mode
  - Performance often improves when the Astribank driver is configured to perform the heaviest tasks on software interrupts instead of on the hardware interrupts
  - Interrupt handling should be evenly distributed among the cores
Unbalanced Load on CPU Cores

- Hardware interrupts

```
Tasks: 148 total, 1 running, 147 sleeping, 0 stopped, 0 zombie
Cpu0 : 14.8%us, 3.0%sy, 0.0%ni, 59.9%id, 0.0%wa, 20.2%hi 2.0%si, 0.0%st
Cpu1 : 7.7%us, 1.3%sy, 0.0%ni, 68.5%id, 0.0%wa, 22.1%hi, 0.3%si, 0.0%st
Cpu2 : 0.3%us, 0.3%sy, 0.0%ni, 99.3%id, 0.0%wa, 0.0%hi, 0.0%si, 0.0%st
Cpu3 : 0.3%us, 0.0%sy, 0.0%ni, 99.7%id, 0.0%wa, 0.0%hi, 0.0%si, 0.0%st
Mem: 2048676k total, 747660k used, 1301016k free, 164776k buffers
Swap: 779144k total, 0k used, 779144k free, 287980k cached
```

```
+----+----+----+----+----+-------+-------+++-----+----+
| PID| USER| PR | NI |  VIRT |  RES | SHS |  S | CPU | MEM | TIME+ | COMMAND |
+----+----+----+----+-------+-------+-----+----+-----+------+
| 13813| asterisk | 16  | 0   | 192m | 100m | 6680 | S   | 33.6 | 5.0   | 107:56.15 | asterisk |
| 1 | root   | 15  | 0   | 2072 | 636  | 548  | S   | 0.0  | 0.0   | 0:00.70   | init     |
| 2 | root   | RT -5 | 0 | 0   | 0S   | 0.0  | 0.0  | 0.0  | 0:00.01 | migration/0 |
| 3 | root   | 34  | 19  | 0   | 0S   | 0.0  | 0.0  | 0.0  | 0:00.00 | ksoftirqd/0 |
| 4 | root   | RT -5 | 0 | 0   | 0S   | 0.0  | 0.0  | 0.0  | 0:00.00 | watchdog/0 |
| 5 | root   | RT -5 | 0 | 0   | 0S   | 0.0  | 0.0  | 0.0  | 0:00.01 | migration/1 |
```
3. Chipset

- Ethernet chipset
- USB chipset
- For large installations (hundreds of analog ports), an additional PCI-based USB controller can be used to ease the load on the motherboard’s USB
4. Peripherals

- Memory speed (RAM)
- Hard disks, memory size and RAM disk
  - Insufficient RAM will adversely affect the operating system by accessing the hard disk instead (swapping)
  - Greatly reduces processing performance
  - 1GB RAM is typically sufficient for standard Elastix installation (without recording)
5. Application

- **Asterisk Stack Size**
  - Larger stack size is more stable for high loads
  - This command removes the stack size limitation:
    `ulimit -s unlimited`

- **Asterisk Optimization**
  - e.g., turn off the FOP if it’s not being used

- **OSLEC Optimization**
  - Use MMX (Xorcom-specific design)
  - Set different EC tail sizes for different ports

- **ChanMute**
  - Compile DAHDI with the OPTIMIZE_CHANMUTE enabled
XR3000 Load Tests

- **#1: XR3000 Analog**
  - (20) XR0008 devices
  - 32 FXS ports each

- **#2: XR3000 Digital / G.729**
  - (4) XR0056 devices
  - 4 E1/T1 ports each
  - G.729 SIP calls

- **#3: XR3000 Digital / G.711a**
  - (4) XR0056 devices
  - 4 E1/T1 ports each
  - G.711a SIP calls

Results are published at: [http://www.xorcom.com/load-tests/load-tests.html](http://www.xorcom.com/load-tests/load-tests.html)
Test Conditions

Software Version:
Elastix: 1.6-12
DAHDI: 2.2.1
Asterisk: 1.4.29
Codec used: Open source codec_g729-ast14-gcc4-glibc-pentium4.so

Previously noted performance improvement measures were taken.

The Asterisk extensions context was defined as follows:

```
[music-test]
exten => s,1,Answer()
exten => s,2,Playback(music-8khz-10min)
exten => s,3,Goto(2)
```
## Test #1 Results

- XR3000 with 20 XR0008 devices (32 FXS ports each)
  - FXS extensions: 640
  - IO ports: 160
  - Total DAHDI channels: 800

<table>
<thead>
<tr>
<th>Echo Canceller Tail Size (taps)</th>
<th>Maximum Number of Simultaneous Calls</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CPU: Core 2 Duo E8400 3 GHz RAM: DDR2 1 GB 800 MHz</td>
</tr>
<tr>
<td>256</td>
<td>164</td>
</tr>
<tr>
<td>128</td>
<td>280</td>
</tr>
<tr>
<td>64</td>
<td>388</td>
</tr>
<tr>
<td>32</td>
<td>488</td>
</tr>
<tr>
<td>Disabled echo canceller</td>
<td>640</td>
</tr>
</tbody>
</table>
Test #2 Results

- XR3000 with 4 XR0056 devices (4 E1/T1 ports each) connected and G.729 SIP calls.
  - E1 ports: 16
  - Total DAHDI channels: 480

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</tr>
<tr>
<td>32</td>
<td>260</td>
</tr>
<tr>
<td>Disabled echo canceller</td>
<td>280</td>
</tr>
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</table>

|                                 | CPU: Core 2 Quad Q9550 2.83GHz       |
|                                 | RAM: DDR2 4 GB 800 MHz               |
| 256                             | 260                                  |
| 128                             | 360                                  |
| 64                              | 420                                  |
| 32                              | 420                                  |
| Disabled echo canceller         | 480                                  |
### Test #3 Results

- **XR3000** with 4 XR0056 devices (4 E1/T1 ports each) connected and G.711a SIP calls.
  - **E1 ports:**
  - **Total DAHDI channels:**
  - **Add’l PCI Ethernet board EN-9230TX-32 used**

**Echo Canceller Tail Size (taps)** | **Maximum Number of Simultaneous Calls**
---|---
| **CPU: Core 2 Duo E8400 3 GHz** | **CPU: Core 2 Quad Q9550 2.83GHz**
| RAM: DDR2 1 GB 800 MHz | RAM: DDR2 4 GB 800 MHz

| 256 | 340 | 240 |
| 128 | 440 | 340 |
| 64  | 480 | 430 |
| 32  | 480 | 480 |
| Disabled echo canceller | 480 | 480 |
Load Test Conclusions

- For G.729 -> E1 calls
  - **Quad core** processor (Q9550, 2.83 GHz) provides **50%** better results

- For G.711 alaw -> E1 calls
  - **Dual core** processor (E8400, 3 GHz) provides **24%** better results

- For systems with large number of FXS:
  - **Dual core** processor (E8400, 3 GHz) is best

- **Important Note**: processing-intense applications such as call centers, conference bridges and predictive dialers will require the **more robust processor**!!!
Guidelines for Best Performance

- High CPU core speed
- Fast RAM
- Evenly distributed hardware interrupts handling between cores
- Hyper-threading should be disabled
- Delegate most work on hardware interrupts to so-called 'tasklets'

*The bottom line: it is impossible to get clear guidelines from hardware manufacturers, so test, test, and test some more...*
THANK YOU

www.xorcom.com