DroidCluster: Towards Smartphone Cluster Computing

The Streets are Paved with Potential Computer Clusters

Sebastian Schildt, Felix Büsching, Lars Wolf

Technische Universität Braunschweig

PhoneCom 2012

Once upon a time...

In the beginning of 2011 we bought 6 medium class Android Smartphones for a programming lab.

LG P500, Android 2.2, 600 MHz Qualcomm MSM7227, 512 MiB RAM

The idea...

We should build a cluster out of it!

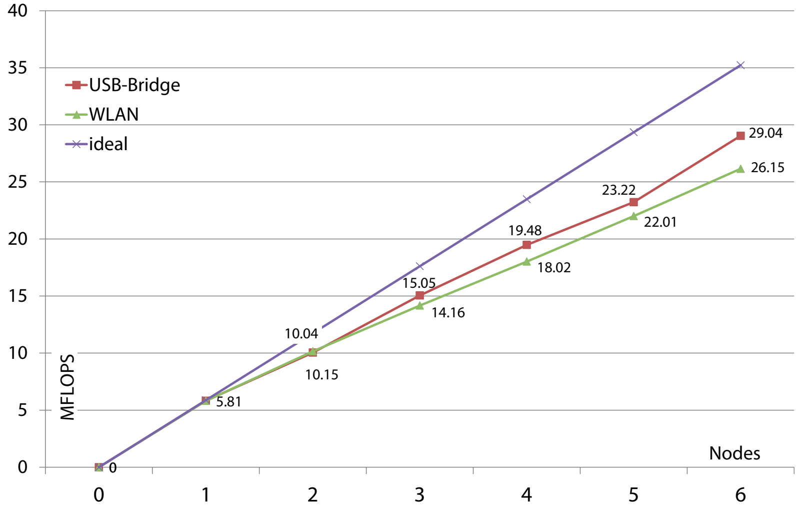
Sounds like a reasonable idea!

Architecture

Software

- Full ARM Debian installation alongside the Android OS (chroot)
- MPI-based Linpack benchmark
- Connectivity through WiFi or USB reverse-tethering
- Control PC only used for controlling and monitoring the phones, not involved in calculation

Results


40
35
30
25
20
15
10
5
0
MFLOPS
USB-Bridge
WLAN
ideal
0
5.81
10.04
10.15
15.05
14.16
19.48
18.02
23.22
22.01
29.04
26.15
Nodes
0
1
2
3
4
5
6

Our Cluster

- No specialized *mobile* application, but standard Debian distribution and standard libraries and tools
  $\rightarrow$ would not have been possible on a phone a few years ago
- Running *alongside* the normal phone applications
- Closely-coupled: Standard MPI, but over slow communication links
  $\rightarrow$ still scales reasonably

Absolute performance not that impressive

SoC Evolution: Measured Performance under Android

System	CPU	MHz	ARM Core	Android	MFLOPS
Huawei U8120	Qualcomm MSM7225	528	ARM11	2.3.7	3.7
LG P500	Qualcomm MSM7227	600	ARM11	2.2	4.0
HTC Legend	Qualcomm MSM7227	600	ARM11	2.3.7	7.5
Samsung Galaxy S	Samsung Exynos 3110	1000	Cortex A8	2.3.7	17.7
HTC Nexus One	Qualcomm QSD 8250	1000	Scorpion	4.0.3	31.0
Medion Lifetab P9514	Nvidia Tegra 2	2x1000	Cortex A9	3.2	54.4
Samsung Galaxy Nexus	Texas Instruments OMAP 4460	2x1200	Cortex A9	4.0.2	75.0

Performance drivers: Transition to multicore, out-of-order architectures, (better) FPU+SIMD units
Next big thing: OpenCL capable mobile GPUs for GPGPU offloading

Opportunities

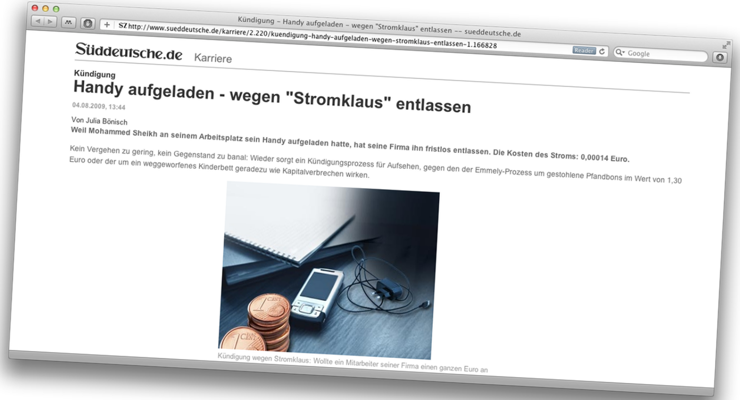
Chances for ubiquitous mobile applications, crowd sensing platforms, data distribution networks based on mobile phones.
You can

- put computation back from the backend into the users device
- form Ad-Hoc groups to cooperatively solve a problem
- consider the best tradeoff between closely-coupled cooperation (e.g. MPI) and loosely-coupled cooperation (BOINC, "seti@home")

"If I am collecting temperature and pressure data, why shouldn't I also calculate the weather report?"

An example...

Employee Charges Phone - Fired for Stealing Electricity!


Kündigung – Handy aufgeladen – wegen "Stromklaus" entlassen -- sueddeutsche.de

SZ http://www.sueddeutsche.de/karriere/2.220/kuendigung-handy-aufgeladen-wegen-stromklaus-entlassen-1.166828

Süddeutsche.de Karriere

Kündigung

Handy aufgeladen - wegen "Stromklaus" entlassen

04.08.2009, 13:44

Von Julia Bönisch

Weil Mohammed Sheikh an seinem Arbeitsplatz sein Handy aufgeladen hatte, hat seine Firma ihn fristlos entlassen. Die Kosten des Stroms: 0,00014 Euro.

Kein Vergehen zu gering, kein Gegenstand zu banal: Wieder sorgt ein Kündigungsprozess für Aufsehen, gegen den der Emmely-Prozess um gestohlene Pfandbons im Wert von 1,30 Euro oder der um ein weggeworfenes Kinderbett geradezu wie Kapitalverbrechen wirken.

Kündigung wegen Stromklaus: Wollte ein Mitarbeiter seiner Firma einen ganzen Euro an

Proposal: distcc for Android

Distribute compilation of larger projects over different nodes

1. During the day employees put their phone into a USB port of their computer for charging
2. Phone registers at the company Phone-Cloud control server
3. Phone will be automatically provisioned with the necessary compilation environment and registered to the distcc system

Benefits

- Users can charge phones without risking being fired
- Bring-Your-Own-Device: Companies can leverage hardware already paid for by their employees

Conclusions

- Many mobile phones today are faster than desktop computers from 10 years ago
- The architectural evolution of mobile SoCs follows those of traditional desktop and server CPUs
- But SoCs are catching up: Programmable GPUs, SIMD units, ...
- This gives some room for innovative research applications
- Levering existing smartphones' processing power is environmentally sustainable, as their SoCs are quite energy efficient
- It is necessary to find a trade-off between tapping the computing power and draining the battery

Thank you!