Efficient Implementation of the bare-metal Hypervisor MetalSVM for the SCC

Public Release of MetalSVM 0.1

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Introduction

- What is MetalSVM?
- Our Progress with MetalSVM
- Main Features
- Performance
- How to Get and Use MetalSVM

What is MetalSVM?

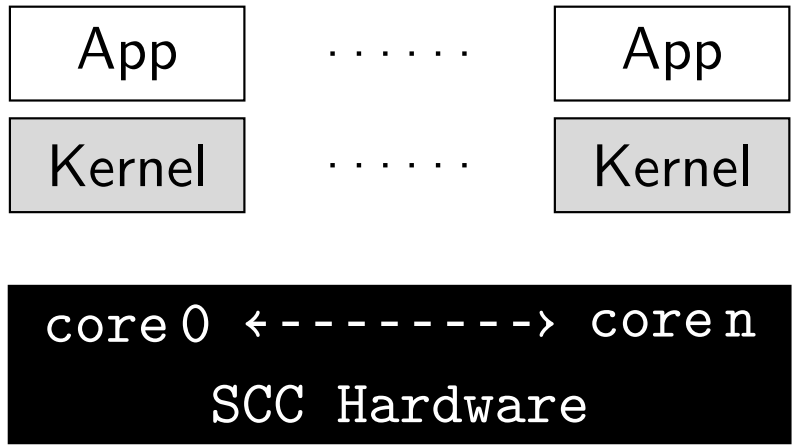
- a **minimal** operating system for the SCC
- spin-off from *eduOS* - a kernel developed at RWTH Aachen for educational purposes
- monolithic, *MULTIBOOT*-compliant 32 bit **lightweight** kernel
- **unix-like** programming interface
- sophisticated exploitation of SCC hardware
- merged with our *iRCCE* communication lib

What is MetalSVM?

- First public release
  → Version 0.1
- Free Software
  → Apache License 2.0
- Is probably a great springboard for your bare-metal programming
- great mascot
  → Mike the Ostrich

Our Progress with MetalSVM

- run apps with small efficient kernel ✓
- Integrate iRCCE for **fast** inter-core communication ✓
- Establish SVM between multiple cores ✓
- Paravirtualize Linux: One instance per core ✓
- Run one guest on multiple cores [in progress]



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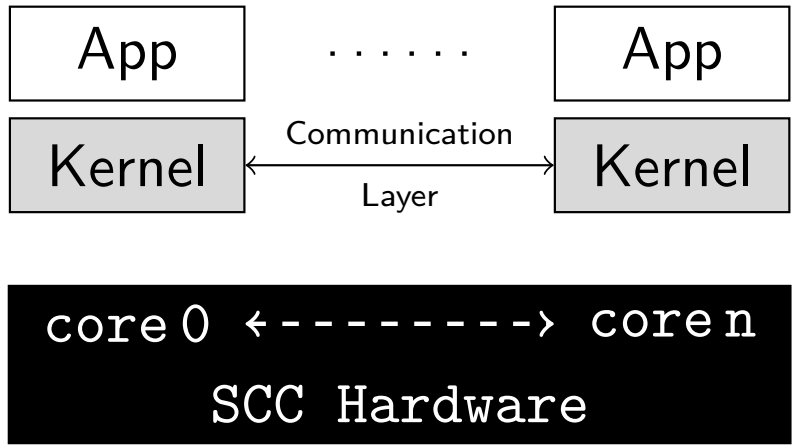

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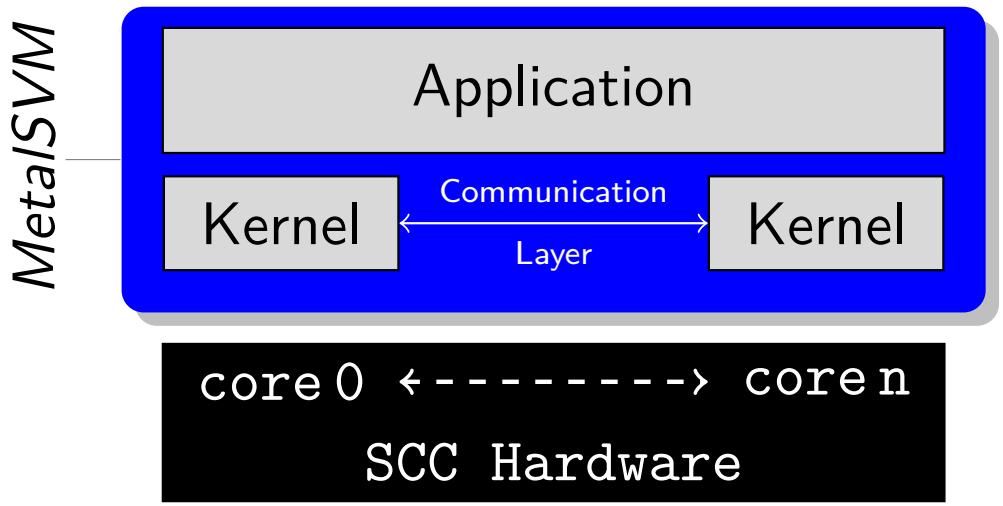

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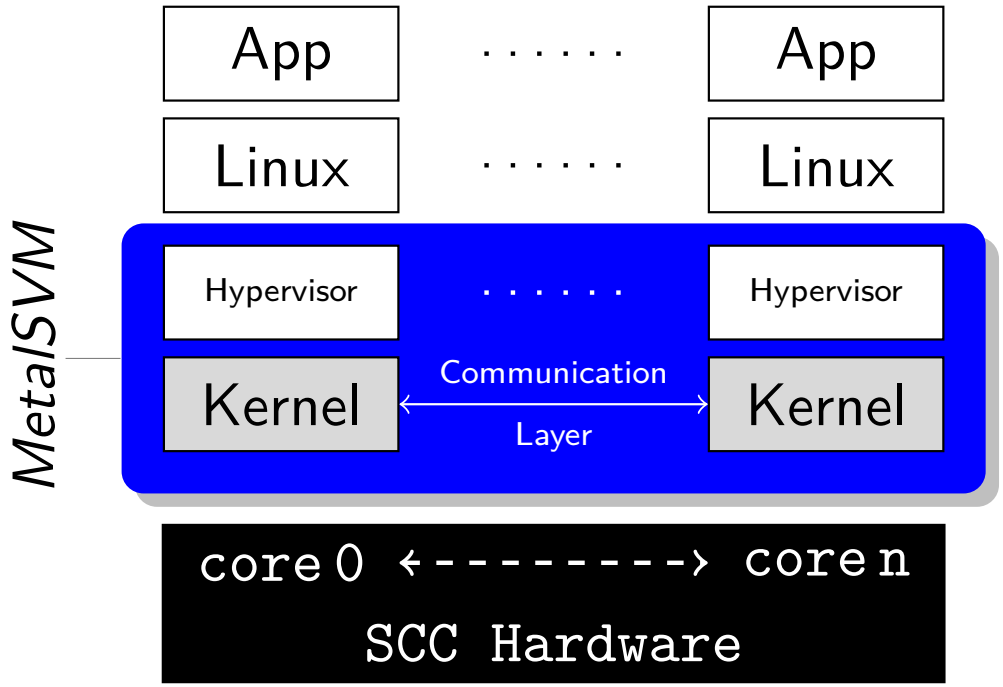

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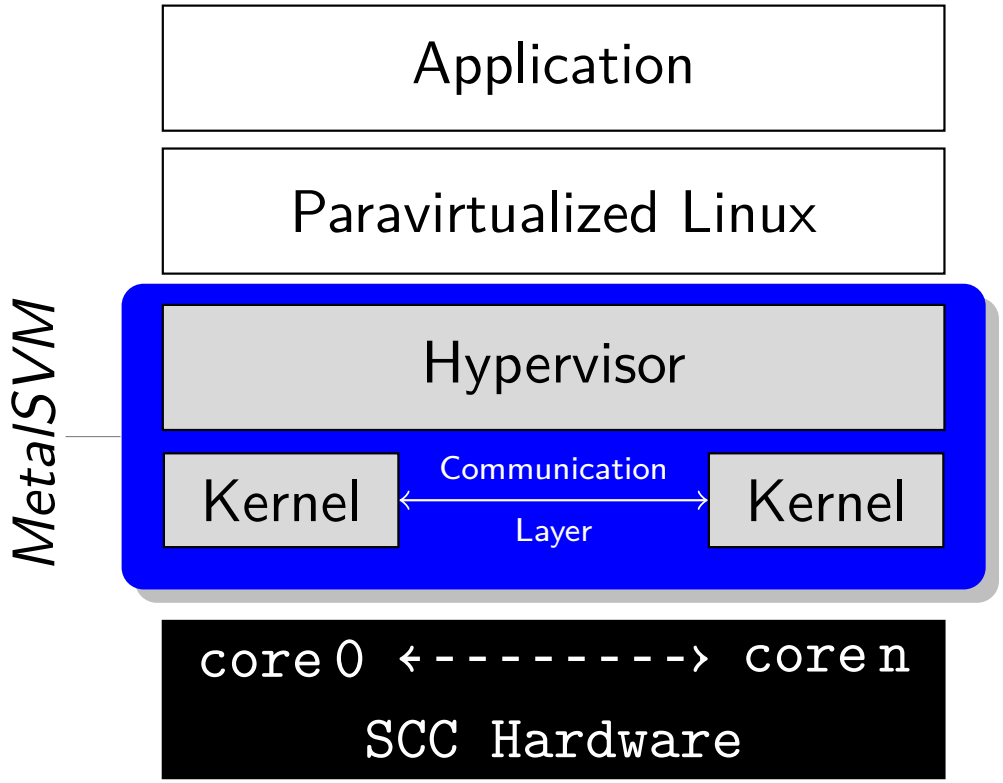


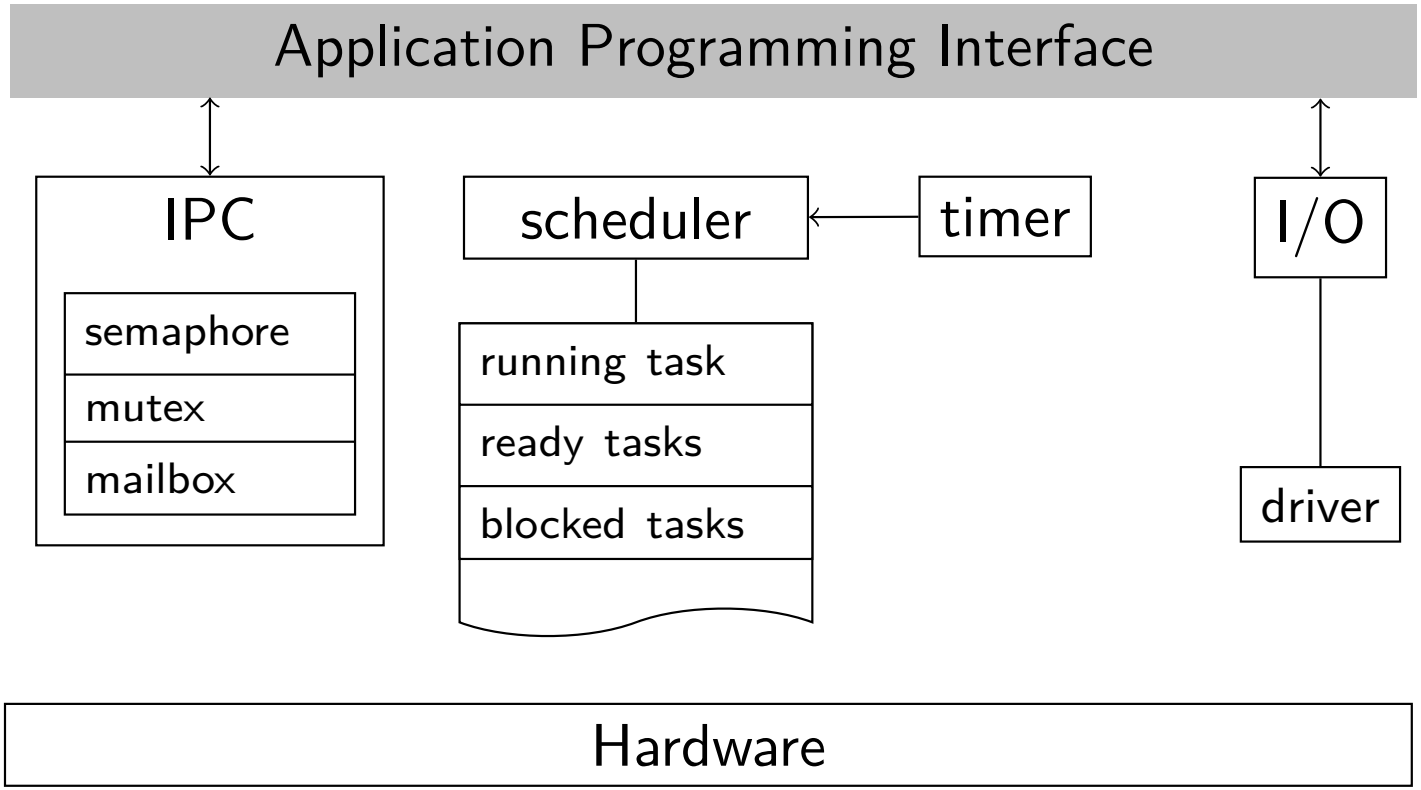
Main Features

- running apps on MetalSVM is like running them **bare-metal** $\rightarrow$ but not without the comfort of an OS!
- fast familiarization due to imitated aspects of Unix-like systems
- *iRCCE* included: **fast** communication
  - core $\leftrightarrow$ core
  - functionality of *RCCE* + **non-blocking** message-passing
  - **event-driven** *Mailbox* extension
- lwIP included: **TCP-IP** communication
  - core $\leftrightarrow$ core
  - SCC $\leftrightarrow$ MCPC
  - use BSD sockets in your user space app
- **SVM** system
  - PGAS-like functions (explicit `svm_alloc()`, etc.)
  - strong and lazy release consistency models

Main Features (2)

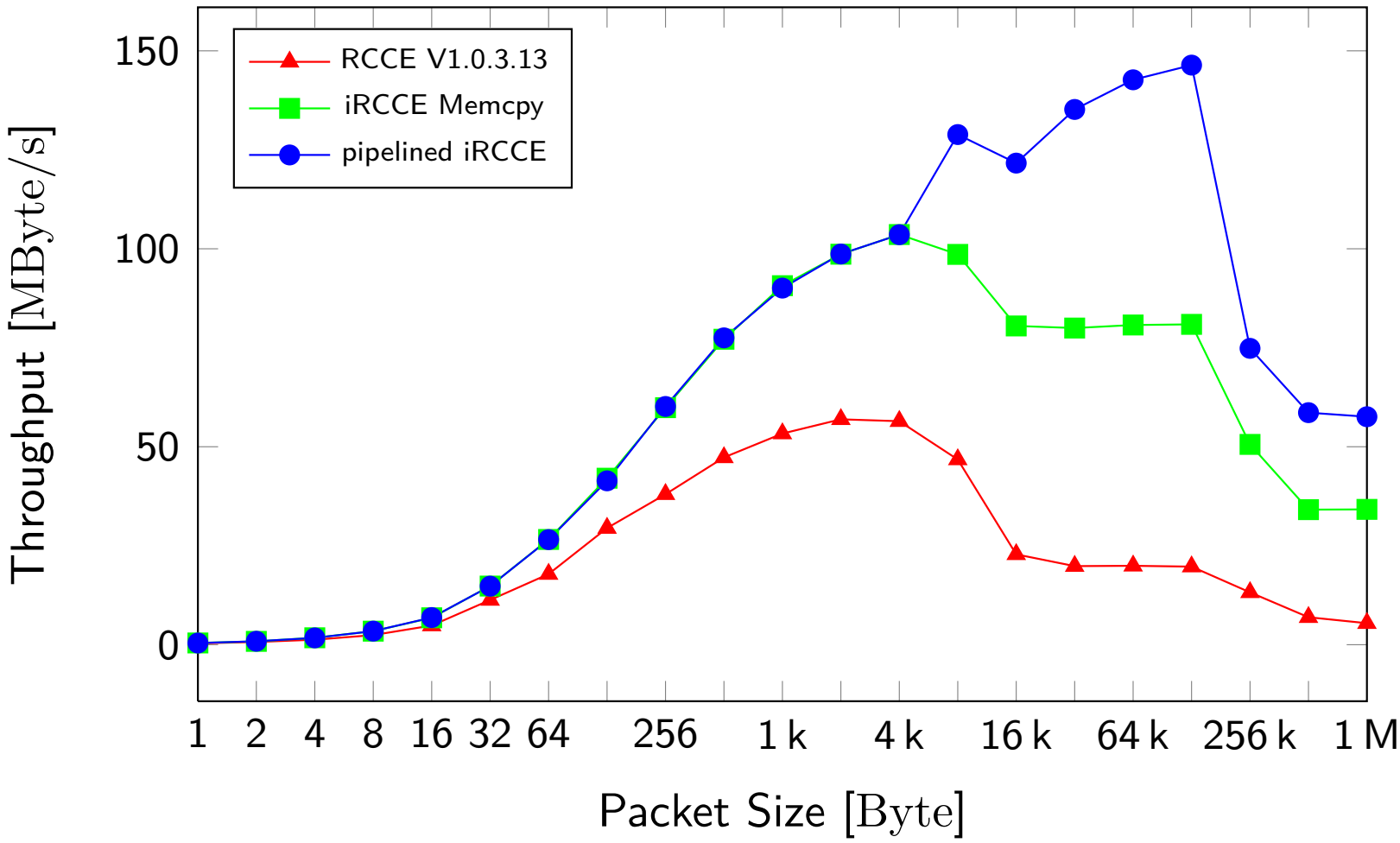
- low-latency **synchronization** layer utilizing SCC-specific *test and set-* & *atomic increment* registers
- fast scheduling
  - Round-Robin based with **priority** support
  - configurable as timeslice based or **tickless**
- device drivers
  - use your own **character devices** from user space
- basic file system
  - populated from **initial ramdisk**
  - easily customizable `/dev` interface for devices
- *newlib* **C library** for user space included
- **SMP** support (not on SCC)
- `x86_64` version in progress

Kernel Structure



kernel structure of *eduOS/MetalSVM*

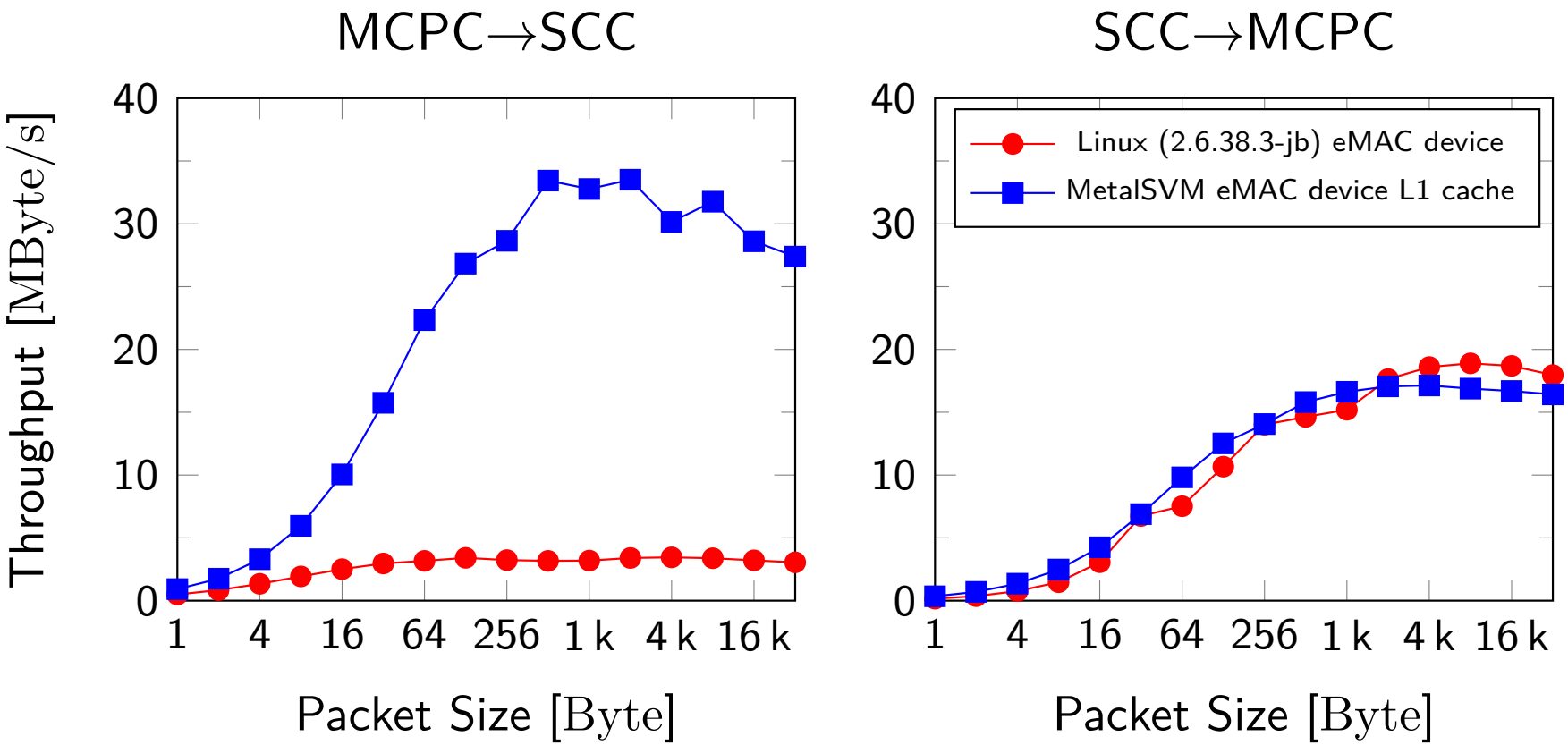
iRCCE Performance



Comparing *RCCE (V1.0.3.13)* and *iRCCE*

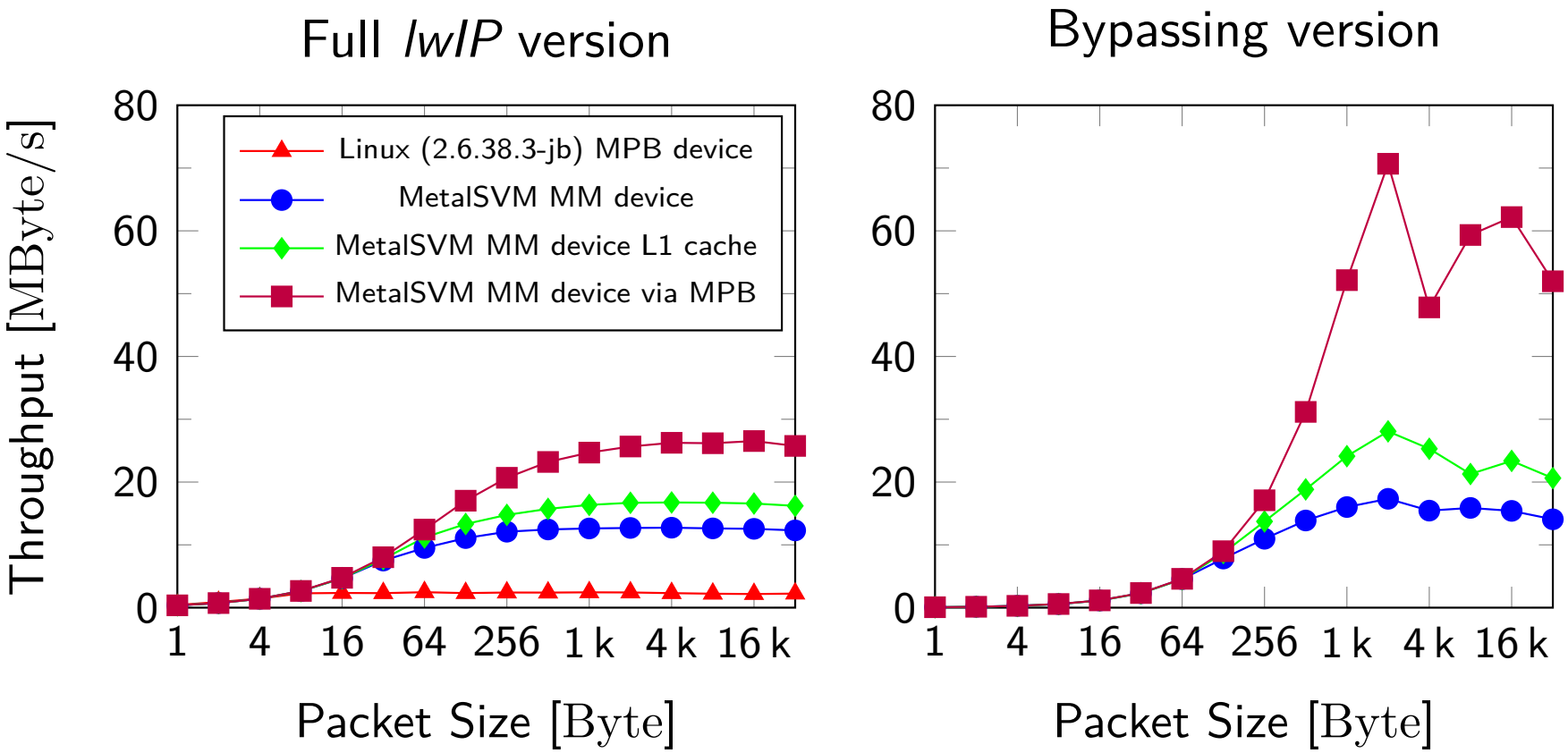
Source: iRCCE documentation

eMAC Device Driver Performance



Source: *The Path to MetalSVM: Shared Virtual Memory for the SCC*

Memory Mapped IP Driver Performance

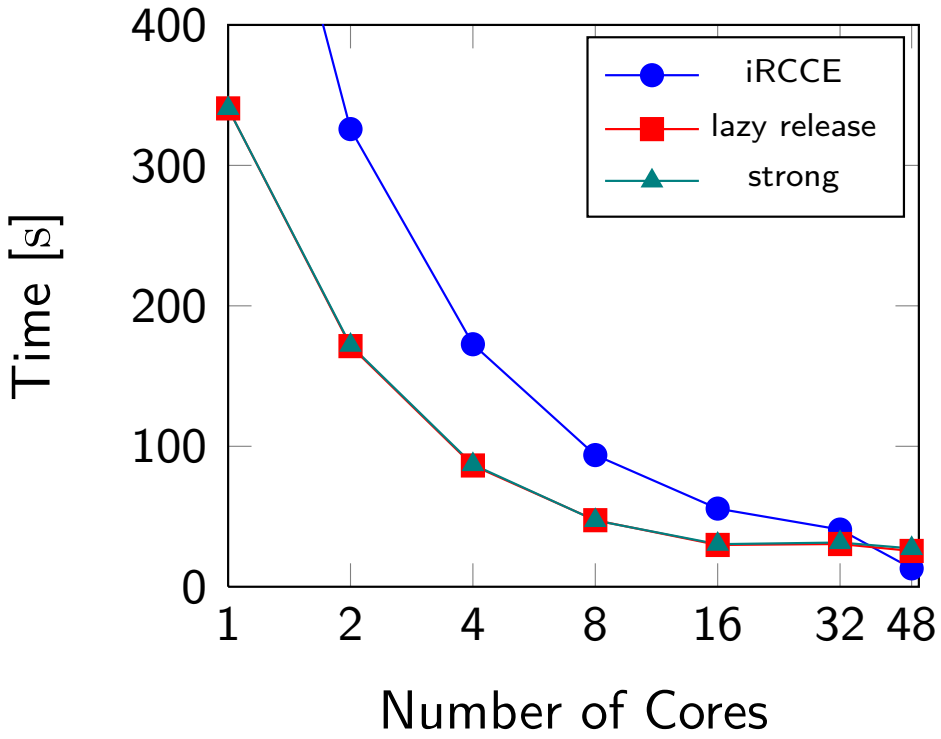


Sending packets from tile 0 to tile 1

Source: *The Path to MetalSVM: Shared Virtual Memory for the SCC*

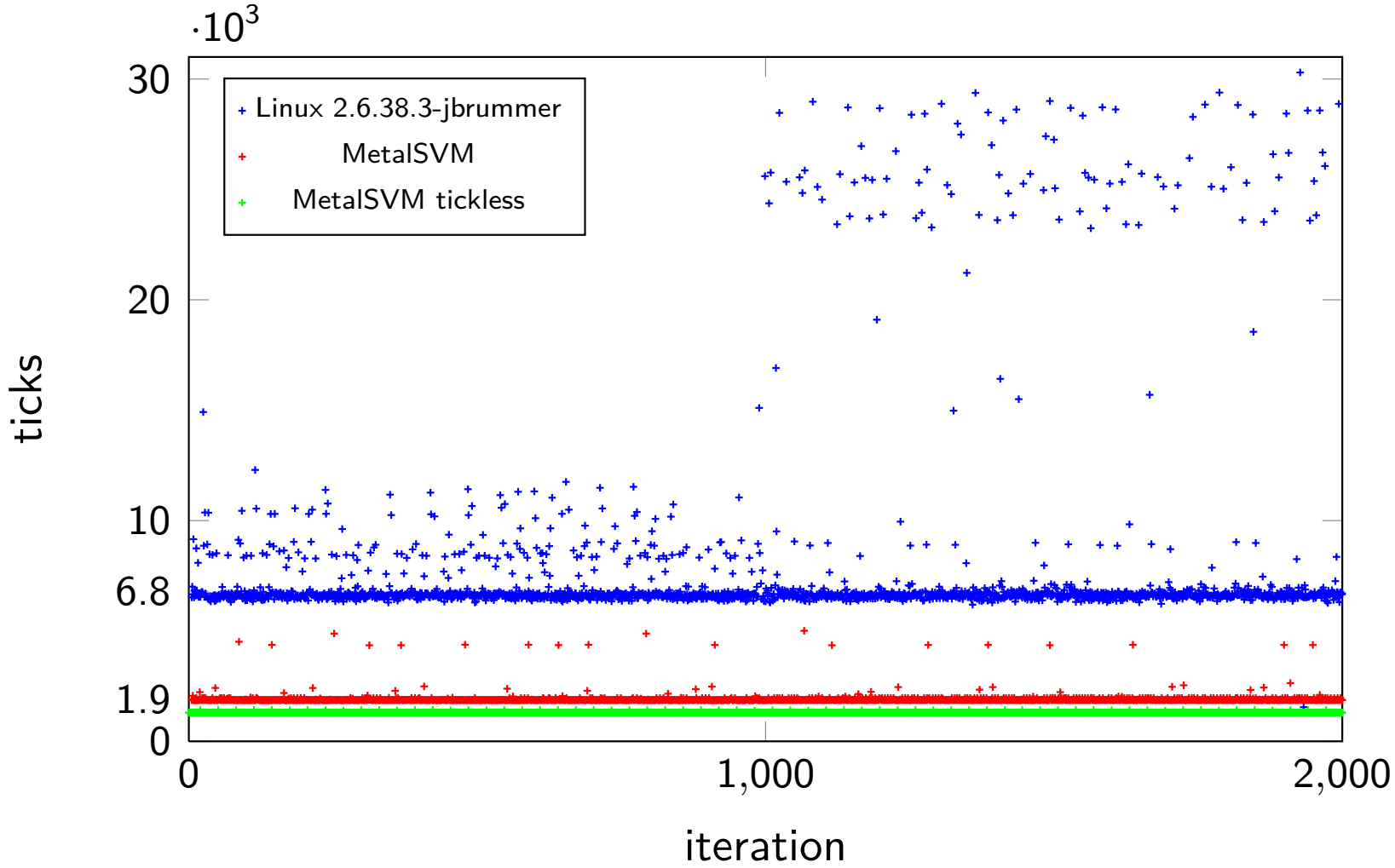
SVM Performance

- Jacobi Over Relaxation algorithm
- Problem size 1024×512
- SCC Platform running with 533 MHz core and 800 MHz memory/mesh



Source: *Revisiting Shared Virtual Memory Systems for Non-Coherent Memory-Coupled Cores*

Scheduling Overhead



Source: *Efficient Implementation of the bare-metal Hypervisor MetalSVM for the SCC*

How to Get and Use MetalSVM

Okay, I am interested!
What now?

How about getting a copy and playing with it?

Get it

Just **clone** MetalSVM from our official git repository...

```
$ git clone git://git.lfbs.rwth-aachen.de/metalsvm.git
```

...do initial **setup**...

```
$ cd metalsvm
$ cp Makefile.scc Makefile
$ (cd include/metalsvm; cp config.h.scc config.h)
```

...**build**...

```
$ make
```

...and **run** on SCC:

```
$ (cd tools; make SCC && sccBoot -g obj)
$ sccReset -r
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Get it (2)

Connect and send commands:

```
$ telnet rck00 4711
```

Build documentation:

```
$ doxygen
```

→ see `documentation/html/index.html`

Configure it

`include/metalsvm/config.h`

configure if you want to include support for
PCI, lwIP, VGA, software-UART, Keyboard, Multiboot/SCC,
change timeslice size, enable tickless scheduling, etc.

`Makefile`

Depending on wether you run MetalSVM in qemu/on SCC
$\rightarrow$ set compiler, etc.

Customize it

The most important files and directories

`apps/`	kernel space apps
`newlib/examples/`	user space apps
`apps/tests.c`	the init “daemon”
`drivers/char/`	character device drivers
`tools/`	mostly SCC-specific build stuff

Conclusion

With MetalSVM as a framework for **your** research on the SCC, you get:

- **fast**, bare-metal like execution of your code
- basic OS **comfort** in kernel- and user space
- fast communication:
  - **TCP-IP** & **iRCCE**
  - blocking & non-blocking, time- & event driven
  - core $\leftrightarrow$ core, SCC $\leftrightarrow$ MCPC
- **SVM** support
- a kernel which is easily **customizable** to your needs

Finally

check out

http://metalsvm.org

contact@metalsvm.org

Questions?