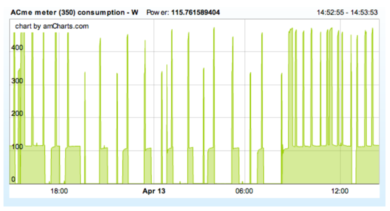
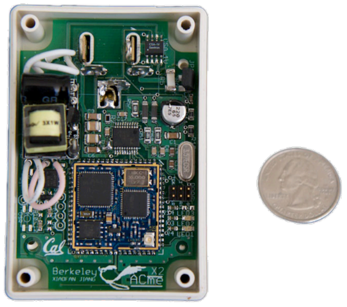
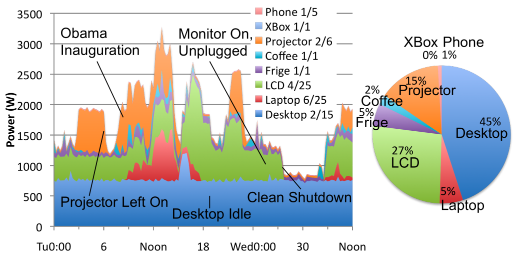
ACme Quick Start Guide

For Developers







http://acme.cs.berkeley.edu/

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LICENSE

Step 1: Installing TinyOS

- Follow instructions at http://docs.tinyos.net/index.php/Getting_started to install the TinyOS development environment.
    - Xubuntos VMware virtual machine image is often the easiest way to obtain a working TinyOS development environment.
    - This guide will assume you have successfully installed TinyOS 2.1 or later.

Step 2: Setting up ACme source tree

- Install tinyos-contrib source tree (example code installs it in the same level as $TOS_ROOT):

```
cd $TOSROOT/../

cvs -d:pserver:anonymous@tinyos.cvs.sourceforge.net:/cvsroot/tinyos login

cvs -z3 -d:pserver:anonymous@tinyos.cvs.sourceforge.net:/cvsroot/tinyos
co -P tinyos-2.x-contrib
```

- Compiling an example application

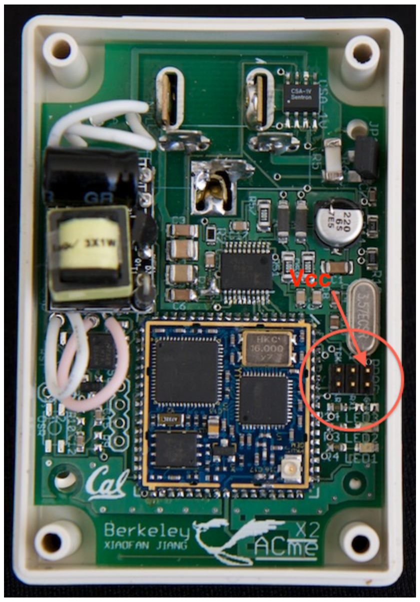
```
cd $TOSROOT/../tinyos-2.x-contrib/berkeley/acme/apps/ACMeterApp

make epic
```

- This application should compile without error (warning is ok).

Step 3: Programming an ACme

- Insert Epic Programmer into the programming header as shown below. The side marked with Vcc should align with the pin pointed by the arrow.



- Make sure that Makefile has the right version of ACme uncommented and the same radio channel as the BaseStation you are using.

```
COMPONENT = ACMeterAppC
include $(MAKERULES)
# Specify radio channel here
PFLAGS += -DCC2420_DEF_CHANNEL=18
# Uncomment this line for ACme Rev.A
# CFLAGS += -I../../tos/sensorboards/ACme/
# Uncomment this line for ACmeX2 (Rev.B)
CFLAGS += -I../../tos/sensorboards/ACmeX2/
```

- Connect the other end to a USB port and program ACme (assuming you only have one ACme connected via USB):

```
cd $TOSROOT/../tinyos-2.x-contrib/berkeley/acme/apps/ACMeterApp

make epic install miniprog
```

- At this point, the ACme should be broadcasting power readings at 1Hz.
- **IMPORTANT: NEVER PLUG IN ACME INTO AC SOCKET WHILE ATTACHED TO THE PROGRAMMER!**
- Unplug programmer from both the laptop and the ACme and securely screw in the cover. Do not leave any internal parts exposed. Plug into an AC socket and plug in the appliance under monitoring.

Step 4: Monitoring Energy Wirelessly

- Plug in a CC2420 compatible mote (telosb in this example) and program with BaseStation (make sure Makefile specify the same channel used to program ACme).

```
cd $TOSROOT/apps/BaseStation

make telosb install
```

- The mote's green LED should be blinking at 1Hz indicating reception of packets from ACme. Try pressing the "reset" button on the mote if not working right away.
- Start decoding packets:

```
cd $TOSROOT/../tinyos-2.x-contrib/berkeley/acme/tools/

java net.tinyos.tools.Listen -comm serial@/dev/ttyUSB0:telos |
./powerParse.pl
```

- Note: **ttyUSB0** may be different depending on the OS and which USB port the mote is assigned too. Use "motelist" command to find the right port.
- At this point, energy readings should be streaming to stdout and can be piped / redirected as desired.

IPv6/6LoWPAN Connectivity

ACme can be easily programmed with the Berkeley *blip* IPv6/6LoWPAN stack to enable Internet connectivity via UDP/IP. In this part of the guide, we will install the /app/ACme application which sends energy statistics to a user-specified IP address and allows remote administration.

Step 1: Installing and configuring *blip* Edge Router

Please refer to the *blip* document for installation and basic usage of the *blip* stack: http://docs.tinyos.net/index.php/BLIP_Tutorial

This guide will assume you have installed the Edge Router on a mote successfully and have activated *ip-driver*.

Make sure to specify the same channel in the *serial_tun.conf* file as the ACme nodes.

It's a good idea to familiarize with the built-in commands of the ip-driver, such as *help*, *conf*, *links*, *routes*.

Step 2: Configuring and installing ACme/IP application

- The ACme/IP application opens two UDP ports, one for reporting energy/power readings to a user-specified IP address, and the other for interacting with the onboard shell.
- If you have established global IP connectivity in the previous step, you can specify any IPv6 address. The computer at that IP address can monitor a UDP port and process the packets.

```
COMPONENT=ACMeterAppC

BOOTLOADER=tosboot

# Report locally

CFLAGS += -DREPORT_ADDR=\"fec0::64\"

# Report to other IPv6 address

# CFLAGS += -DREPORT_ADDR=\"2001:283:6f04:5c8::64\"

# Use same channel as serial_tun.conf

CFLAGS += -DCC2420_DEF_CHANNEL=21

......
```

- Configuring the reporting frequency and UDP port number in the ACMeterAppP file:

```
......
// PERIOD specifies the reporting frequency
#define PERIOD 60
// this line specifies the reporting UDP port
report_dest.sin6_port = hton16(7001);
......
```

- Install ACme/IP application. Make sure Makefile specify the same channel as in serial_tun.conf

```
cd $TOSROOT/../tinyos-2.x-contrib/berkeley/acme/apps/ACme
make epic blip install.xx miniprog ### replace xx with node ID
```

- Replace *xx* with the node ID you wish to use (such as 1).
- Screw in cover and plug into AC outlet.
- At this point, if you type *links* in the ip-driver terminal, you should see the ACme node showing up. Issue *newroutes* command to update link distance.

Step 3: Interacting with ACme/IP application

- You can interact with ACme directly using standard networking tools such as netcat and ping. The address for the ACme node is fec0::xx (or optionally the global IP prefix). In the following example, the node ID is 1.

```
xubuntos@xubuntos-tinyos:~$ ping6 fec0::1
PING fec0::1(fec0::1) 56 data bytes
64 bytes from fec0::1: icmp_seq=1 ttl=65 time=78.2 ms
64 bytes from fec0::1: icmp_seq=2 ttl=65 time=72.6 ms

xubuntos@xubuntos-tinyos:~$ nc6 -u fec0::1 2000
nc6: using datagram socket
help
sdsh-0.9        builtins: [help, echo, ping6, uptime, ident]
                [set, read, period, reset]
read power
Instantious power: 775 watts
read energy
Energy: 1381 jouls
set off
uptime
up 99 seconds
```

Congratulations! You have reached the end of the quick start guide. Please email me at fxjiang@eecs.berkeley.edu if you have any questions or suggestions.