WiFröst – IoT Debugging IDE

Instruments device code, network calls, and a local router to capture network communications and program activity.

Provides a time-linked data visualization and automatic checks to highlight potential programming errors and failure states.
Low Power Networking in Tock

- Userland API
- UDP
- 6LoWPAN
- Low Power MAC
- 802.15.4 Radio

Making socket-like interface available to untrusted C processes.

Swappadle MAC interface and a Rust X-MAC implementation.

Jean-Luc Watson, Paul Crews, Conor McAivity, Hudson Ayers

```c
#include <udp.h>

int main(void) {
    sock_handle_t handle;
    sock_addr_t addr = { ifaces[0], 15123 };  
    udp_socket(&handle, &addr);
    sock_addr_t destination = { ifaces[1], 16123 };  
    ssize_t bytes_sent = udp_send_to(&handle, packet, len, &dest
    printf("sent!\n");
```
ObliDB: Oblivious Query Processing using Hardware Enclaves

Saba Eskandarian and Matei Zaharia

Point Queries

- 3-10ms point queries on 1M rows
- 7-22x faster than prior work that doesn’t use enclaves

Analytics

- 20-330x improvement over Naive approach
- 1-19x improvement over Opaque
Dynamic Multi-Clock Management for Embedded Systems

Clocks
- PLL
- DPLL
- RCFAST
- OSC0
- RC1M
- RC80M

- ADC
- Flash
- USART
- SPI
- GPIO
- Other Peripherals
Design Considerations for Low Power Internet Protocols

Hudson Ayers
**NPN Silicon Switching Transistors**

- High DC current gain: 0.1 mA to 100 mA
- Low collector-emitter saturation voltage

**Maximum Ratings**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector-emitter voltage</td>
<td>$V_{CEO}$</td>
<td>40</td>
<td>V</td>
</tr>
<tr>
<td>Collector-base voltage</td>
<td>$V_{CBO}$</td>
<td>60</td>
<td>V</td>
</tr>
<tr>
<td>Emitter-base voltage</td>
<td>$V_{EBO}$</td>
<td>6</td>
<td>V</td>
</tr>
<tr>
<td>Collector current</td>
<td>$I_C$</td>
<td>200</td>
<td>mA</td>
</tr>
<tr>
<td>Total power dissipation</td>
<td>$P_{tot}$</td>
<td>≤ 330</td>
<td>mW</td>
</tr>
<tr>
<td>$T_J \leq 60^\circ C$</td>
<td>$P_{J1}$</td>
<td>330</td>
<td>mW</td>
</tr>
<tr>
<td>$T_J \leq 115^\circ C$</td>
<td>$P_{J2}$</td>
<td>250</td>
<td>mW</td>
</tr>
<tr>
<td>Junction temperature</td>
<td>$T_J$</td>
<td>150</td>
<td>°C</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>$T_{stg}$</td>
<td>-65 ... 150</td>
<td>°C</td>
</tr>
</tbody>
</table>

**Transistor Datasheet**

- **SMBT3904**: 200mA
- **MMBT3904**: 200mA

**Challenges of Richly Formatted Data**

- Prevalent document-level relations
- Multimodal information
- Data variety

**Fonduer Users:**

- **fonduer** is available as a Python package today!

---

**Input:** Richly formatted documents (PDF/HTML/XML/etc.)

**Output:** Structured, queryable knowledge base

**Paper:** arxiv.org/abs/1703.05028

**Code:** github.com/HazyResearch/fonduer

Sen Wu, Luke Hsiao, Xiao Cheng, Braden Hancock, Theodoros Rekatsinas, Philip Levis, Christopher Ré — Stanford University
Pantheon: a community evaluation platform for congestion control
Francis Yan, advised by Keith Winstein and Philip Levis
https://pantheon.stanford.edu

Pantheon contains:
- a common reference set of 15+ benchmark algorithms
- a diverse testbed of network nodes in 10+ countries
- a collection of pathological and calibrated emulators
- a continuous-testing system and a public archive of results

Pantheon use cases
- Vivace (NSDI 2018)
- Copa (NSDI 2018)
- Indigo: a machine-learned congestion control

**Figure**: AWS Brazil to Colombia (wired, 1 flow, 10 trials, P1439: pantheon.stanford.edu/result/1439)
User-Centric PCB Tools

- **SITP ’17: EDG talk**
  (Embedded Design Generation)
  - Solver synthesizes circuit from spec
  - Is it sufficient for all designs?

- **We interviewed PCB designers**
  - Hobbyists, researchers, industry
  - Examine holistic design flows

- **New design interface proposal**
  - System architecture level of input
Compressing Neural Networks for Mobile

Challenge: Large Models

- Typical model >100MBs
- Large models hard to deploy
- Limited memory bandwidth on mobile

Solution: Network Compression

Our Work: Compressed model for Machine Translation

1/80 the size + State of the art accuracy

<table>
<thead>
<tr>
<th></th>
<th>BLEU Score</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Original</td>
<td>Retrained</td>
</tr>
<tr>
<td>Baseline</td>
<td>28.53</td>
<td>28.29</td>
</tr>
<tr>
<td>Compress</td>
<td>27.44</td>
<td>28.27</td>
</tr>
</tbody>
</table>

Compressing method:
- Prune
  - Threshold Weights
  - Fine Tune
- Quantize
  - Build Codebook
- Reduce 10x
- Reduce 80x
- Fine Tune
- Fine Tune
T/Key: Offline Second-Factor Authentication without Server Secrets

Time-Based One-Time Passwords (TOTP) rely on symmetric keys and are therefore susceptible to server-side hacks.

T/Key Agent is an offline second-factor authentication scheme based on hash chains:
✓ requires no secrets to be stored on the server
✓ OTPs are much shorter than in signature-based schemes
Permamote: A Long-Lifetime Sensor Platform for a Reliable Internet of Things

Neal Jackson, Joshua Adkins, and Prabal Dutta

- Based on newest, lowest power components
- Hierarchical power supply combines energy harvesting and backup battery storage
- High reliability
- Estimated >10 year lifetime
- Supports occasional long running computation
  - Firmware updates, cryptography
Experiences with Using Bluetooth-Based Tools for Internet Connectivity in the Web of Things

Thomas Zachariah & Prabal Dutta

IoT Gateway on a Diet

Creating a simple, cheap gateway using ESP32, a new SoC with integrated Bluetooth & Wi-Fi

Bluetooth as a Web Standard

Interacting with nearby devices through websites using Web Bluetooth, a new (risky) W3 standard & JS API

Things | Gateway | Cloud

$4 | $125 | $3

$53

Vulnerabilities

Web Bluetooth Model

https://huewebbulb.io

Pair with:

HomeThermostat
LivingRoomBulb1
LivingRoomBulb2

NAME: LivingRoomBulb1
Light Bulb by HUE

NAME: LivingRoomBulb2
Light Bulb by UTE-EX