

IPv6 for Smart Objects

Adam Dunkels, PhD

Swedish Institute of Computer Science

SICS Slowpan project leader

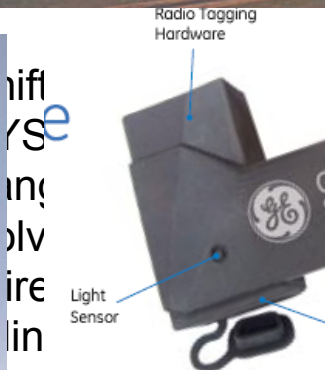
IP is in Everything

ABB
Acte
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Alter
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Auric
Axon
Cam



NAS
NBS
Nu Horizons

Phyte
PS2R
Pump
Quals
Renes
Rowle



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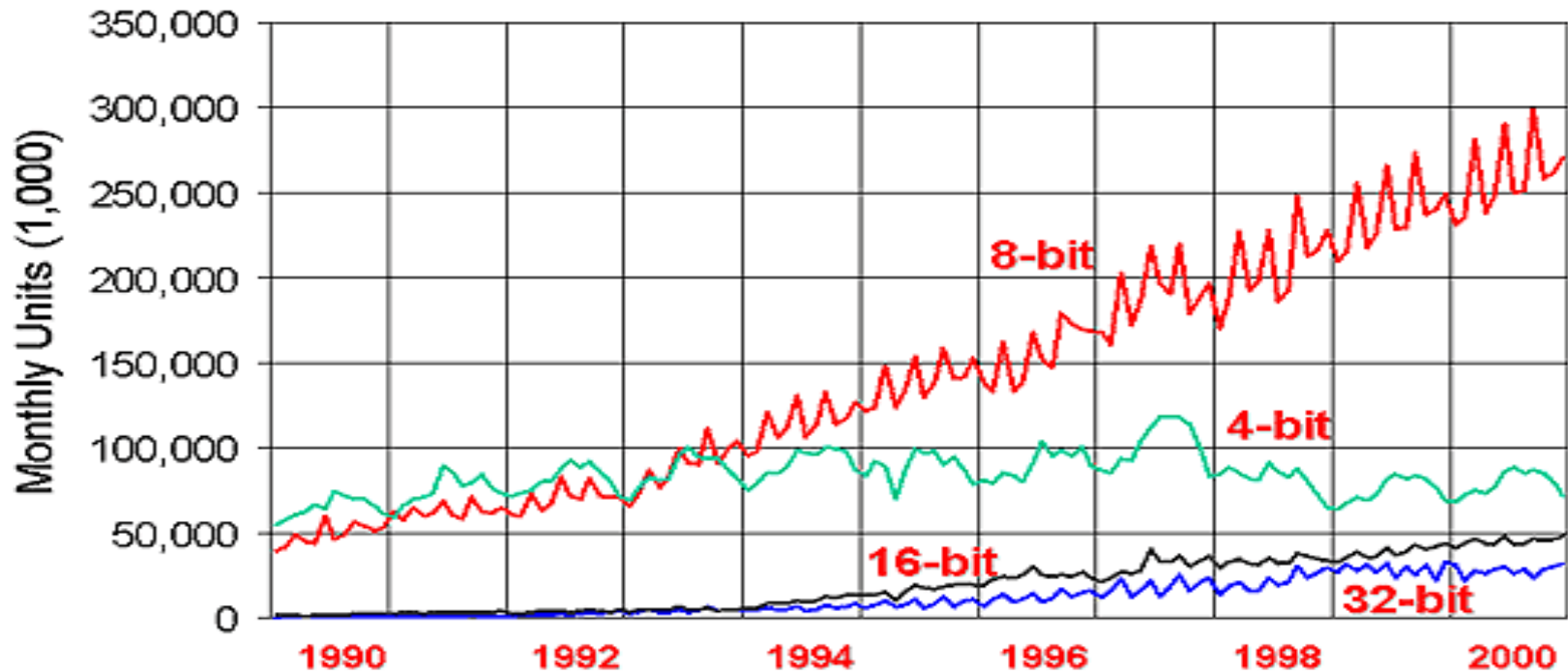
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Microprocessors

- In 2002, 98% were embedded
 - 2% in PCs

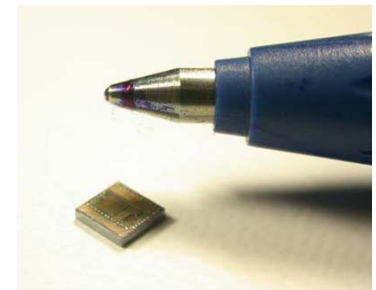
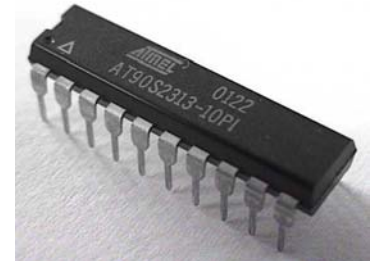
Tiny microprocessors are huge



Source: WSTS

Bell's law: Major computing shift every decade

- 1980s: the PC revolution
- 1990s: the Internet revolution
- 2000s: the embedded revolution
- 2010s: the Internet of Things – Smart Objects





Predictive maintenance



Energy Saving (I2E)



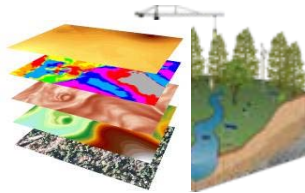
Intelligent Building



Defense



Improve Productivity



Enable New Knowledge



Food & H2O Quality



High-Confidence Transport and assets tracking



Healthcare

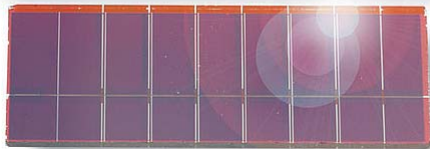
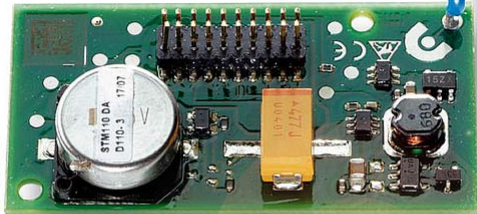
Enhance Safety & Security



Smart Home

Building automation

- Health monitoring of buildings, bridges, ...
 - Mix devices right into the concrete



enoclean.com



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Wireless parking management



.com

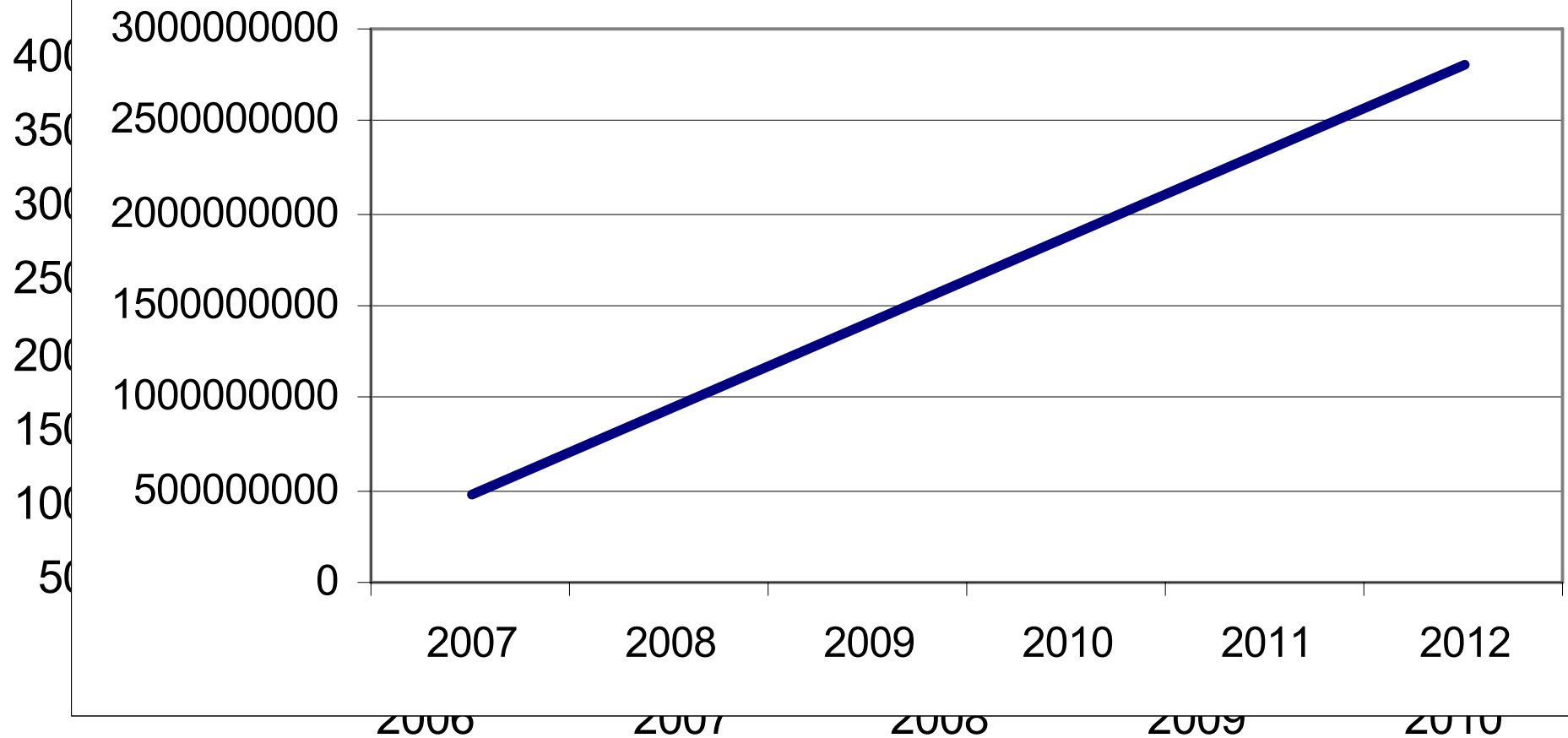
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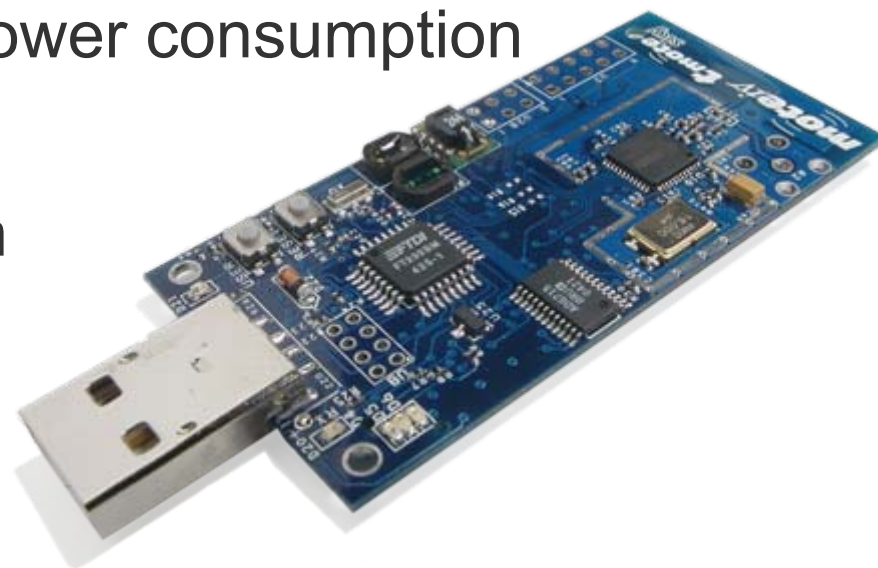
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Electronics.ca, Smart home market



Resources are limited

- Cost, physical size, ...
- Limitation 1: Memory
 - ~10 k RAM, ~100 k ROM
- Limitation 2: Energy, power consumption
 - Batteries, ~1 mW
- Limitation 3: Bandwidth
 - ~100 kbits/second



2001: The uIP TCP/IP stack

- Fully RFC compliant IPv4 in 6 kilobytes ROM, 1 kilobyte RAM
- Later additions
 - Header compression
- Open source
- Widely used

But: ability to communicate more important than throughput

- Low memory usage, low throughput
- Small systems: not that much data
- Example – CubeSat:
 - μ IP with 100 bytes buffer
 - 9600 bps RF link



2005: the 6lowpan IETF wg

- Formalized IPv6 header compression for 802.15.4
- RFC4944

September 2008: IPSO Alliance

- Internet Protocol for Smart Objects Alliance
- Promote IP, support IETF, interoperability
- Technical advisory board: Cisco, Sun, SICS, UC Berkeley, Eka Systems



... and 20 more

<http://www.ipso-alliance.org/>

October 2008: *uIPv6, the world's smallest IPv6 stack*

- Cisco, Atmel, SICS
- 11 kilobytes code, 2 kilobytes RAM
- Based on uIP, world's smallest IPv4 stack
 - Integrated in Contiki

The screenshot shows a news article from the website 'Elektronik i Norden'. The article is titled 'World's Smallest IPv6 Stack By Cisco, Atmel, SICS' and is posted by 'timothy' on Wednesday, October 15, 2008, at 03:25 PM. The article mentions that Cisco, Atmel, and the Swedish Institute of Computer Science (SICS) have announced a new IPv6 stack. The article is part of a section titled 'World's Smallest IPv6 Stack By Cisco, Atmel, SICS' and includes a link to 'Read online!'. The article is written by B. Rog and mentions that the stack is based on uIP, the world's smallest IPv4 stack, and is integrated into the Contiki embedded operating system. The article also mentions that the stack is designed to be used in small devices, such as thermometers or light bulbs.

ELEKTRONIK TIDNINGEN NYHETER FÖR ELEKTRONIKPROFFS

SÖNDAG 19 OKT

Elektronik i Norden TIDNING FÖR NORDENS ELEKTRONIKER

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World's Smallest IPv6 Stack By Cisco, Atmel, SICS

Posted by [timothy](#) on Wednesday October 15, @03:25PM from the [is-beautiful](#) dept.

B. Rog writes

"Cisco, Atmel, and the Swedish Institute of Computer Science have announced a new IPv6 stack, as open source [uIPv6, the world's smallest IPv6 compliant IPv6 stack](#), as open source [Contiki embedded operating system](#). The intent is to bring IP address mapping by giving devices such as thermometers or light bulbs an IP address."

Måndag 20 okt 09:27

Read online!

Samarbete för IPv6 i sensornät

Skrivet av Göte Fagerfjäll
2008-10-16

Cisco, Atmel och SICS lanserar tillsammans

IPv6 for Smart Objects

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Conclusions

- IPv6 is connecting the Internet with the physical reality
- Millions of new IPv6 nodes
 - Business opportunities
- IPSO Alliance
- uIPv6 – world's smallest IPv6 stack
- SICSslowpan – making IPv6 power-efficient



<http://www.sics.se/contiki/>

Contiki

A Memory-Efficient Operating System for Embedded Smart Objects

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Administrative Tasks

uIPv6: Contiki is IPv6 Ready



Current Events

Written by Adam Dunkels, Tuesday, 14 October 2008

Cisco, Atmel, and SICS today announced uIPv6, the world's smallest open source compliant IPv6 stack, for Contiki. uIPv6 passes all the tests required for an IPv6 stack to be called **IPv6 Ready** and we therefore can use the IPv6 Ready logo on the Contiki web site. uIPv6 has been tested on the **Atmel AVR Raven platform** and on the x86. We have committed the code to the Contiki CVS and will release the code as part of the upcoming 2.3 release, as well as a snapshot release of the current code planned for tomorrow.



Together with uIPv6, we include an 802.15.4 MAC layer for the Raven platform as well as SICSslowpan, an implementation of the 6lowpan header compression mechanism for IPv6 over 802.15.4.

Further reading:

- Press releases: [Cisco](#), [Atmel](#), [SICS](#)
- [FAQ](#)
- [Technical paper \(PDF\)](#) . [[bibTeX entry](#)]

New Industry Alliance Promotes the use of IP in Networks of Smart Objects

Slashdot: "IP Meets Physical Reality", article about Contiki



Current Events

uIPv6: Contiki is IPv6 Ready

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