The imagination driving Australia's ICT future.

NATIONAL ICT AUSTRALIA LIMITED

Trustworthy Embedded Systems
How Australian Research Can Have an Impact

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Australian Government
Department of Communications, Information Technology and the Arts
Australian Research Council

NICTA Members

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Queensland University of Technology

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NICTA Partners

What Are Embedded Systems?

Embedded Operating Systems

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WRONG!

Modern Embedded Software is Big and Complex

Examples:

- Mobile phone handsets run software that consists of *millions* of lines of code
- A top-of-the-line car has in excess of a Gigabyte of software

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Other Scary Examples

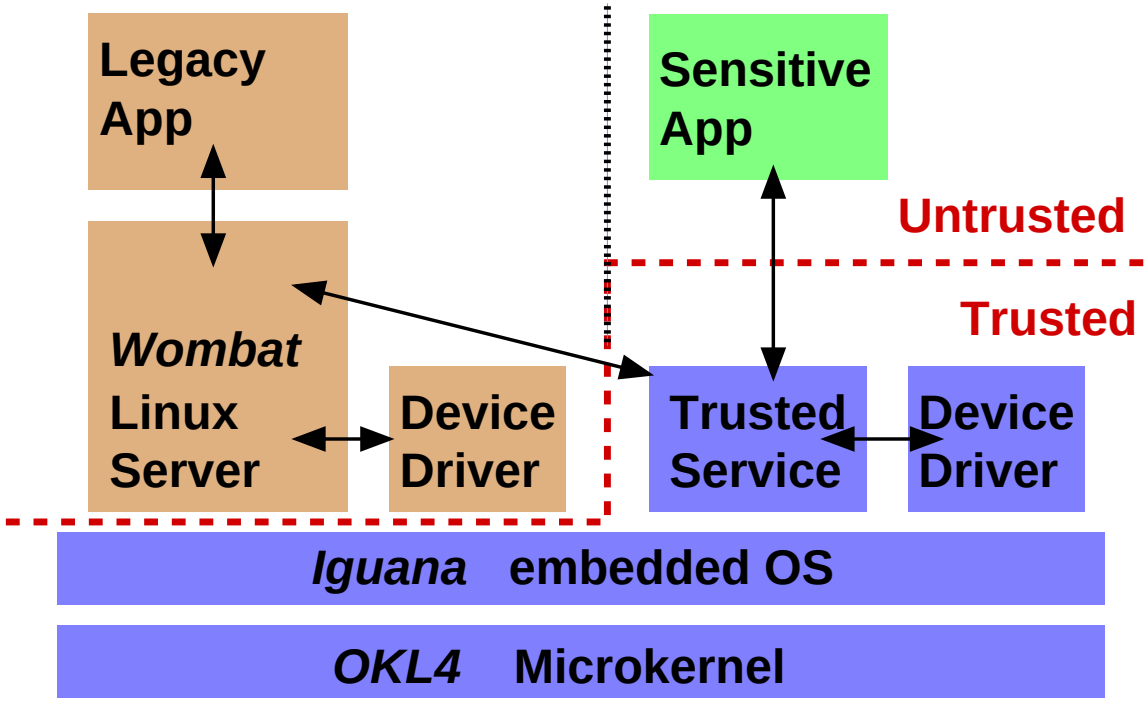
- Internet banking
  - ➜ how safe are your access keys?
  - ➜ how safe is your money?
- Health cards
  - ➜ how private is your health data?
  - ➜ is someone changing your medication?
- Property protection
  - ➜ is someone disabling your house/car alarm?
- Personal safety
  - ➜ is some hoon hacking their steering/breaks?
  - ➜ is someone hacking *your* steering/breaks?
- Mobile communication infrastructure
  - ➜ will your phone become a jammer?
  - ➜ will 100,000 phones become jammers?

Operating Systems Can Help!

OKL4/Iguana: An Operating System for Trustworthy Embedded Systems

OKL4/Iguana:

- supports structuring embedded software into isolated components
- allows running an other operating system on top (eg Linux, Windows)



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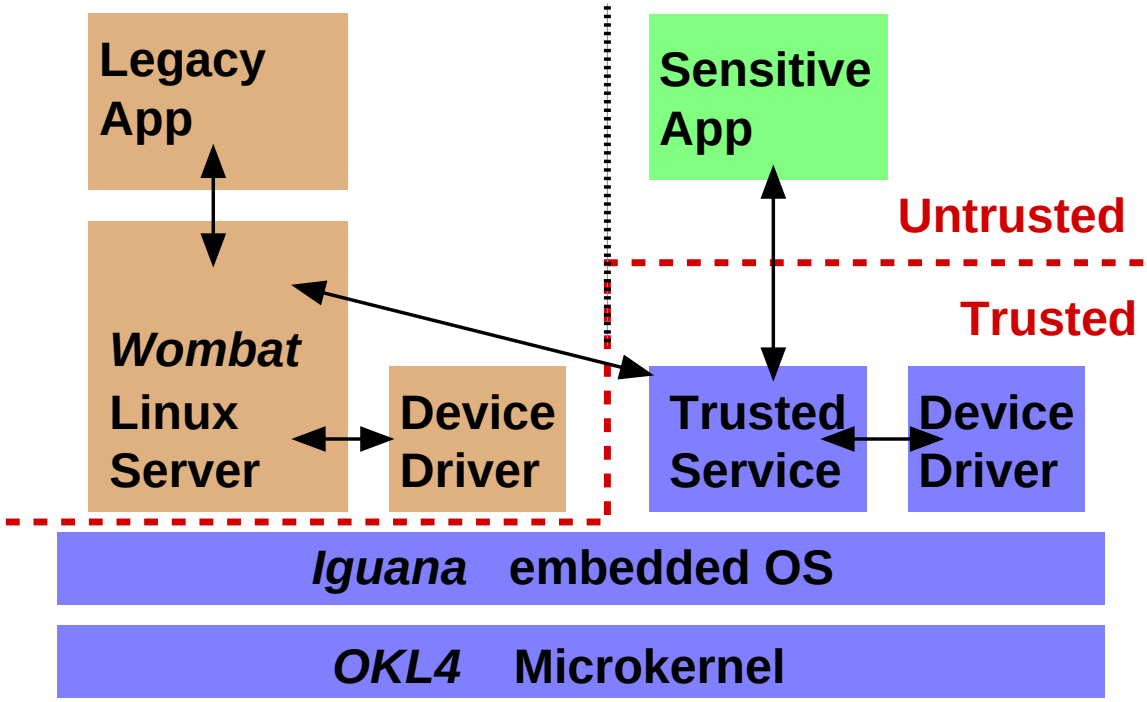

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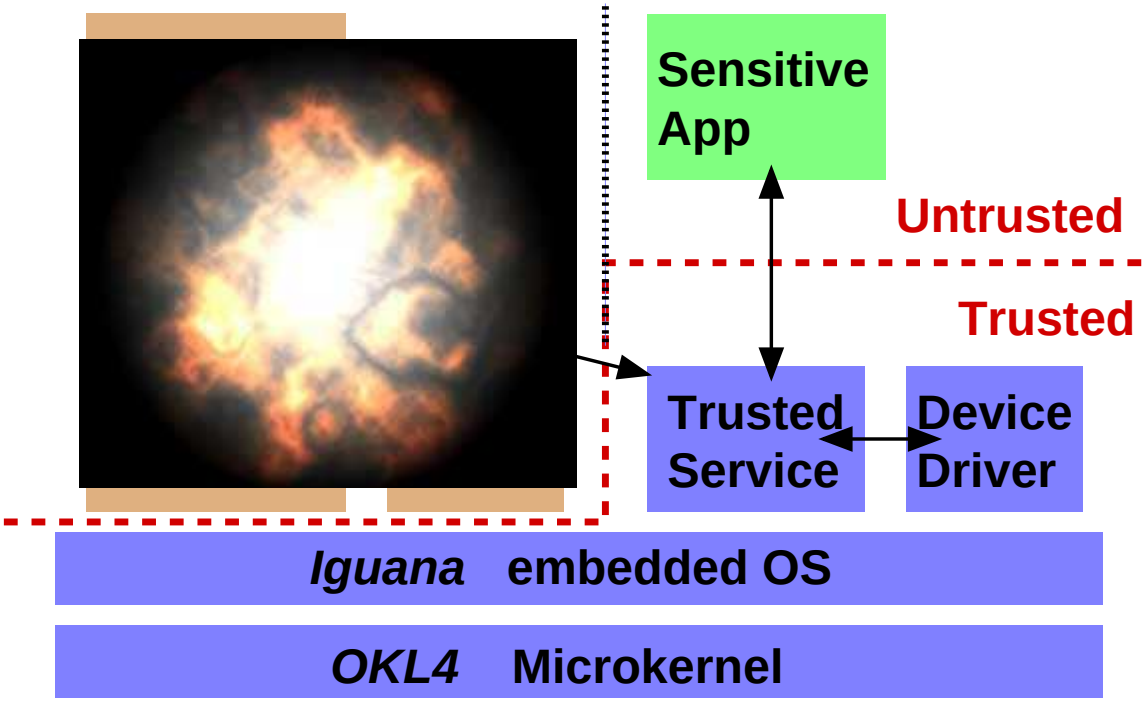

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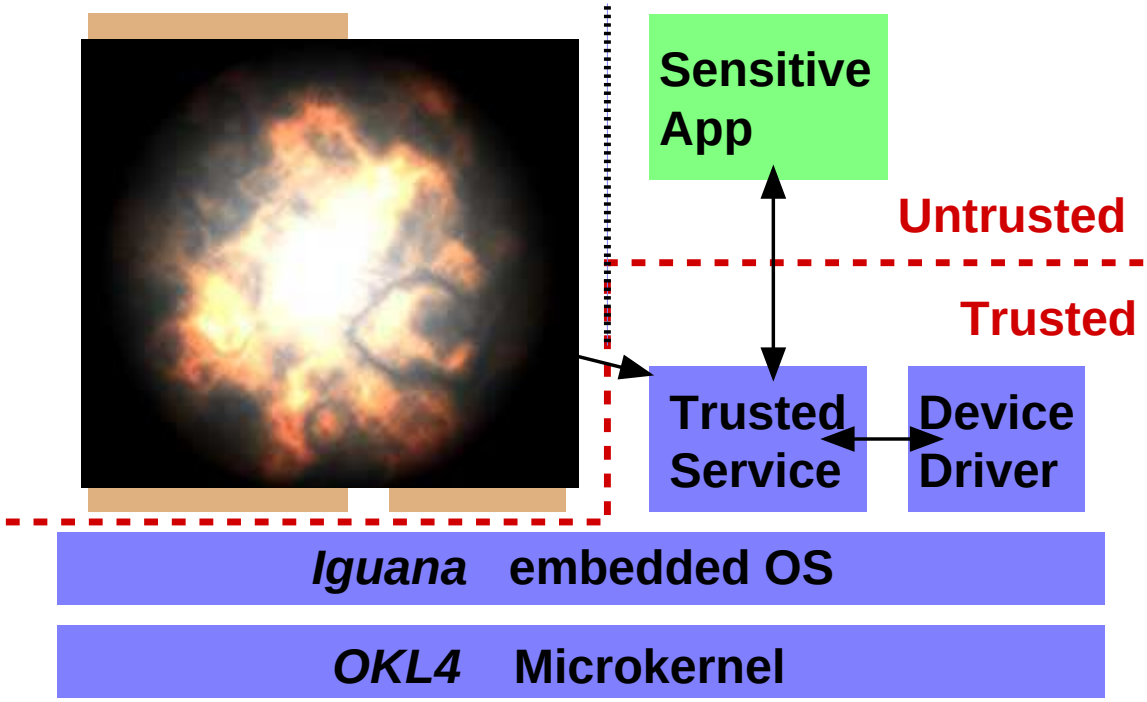
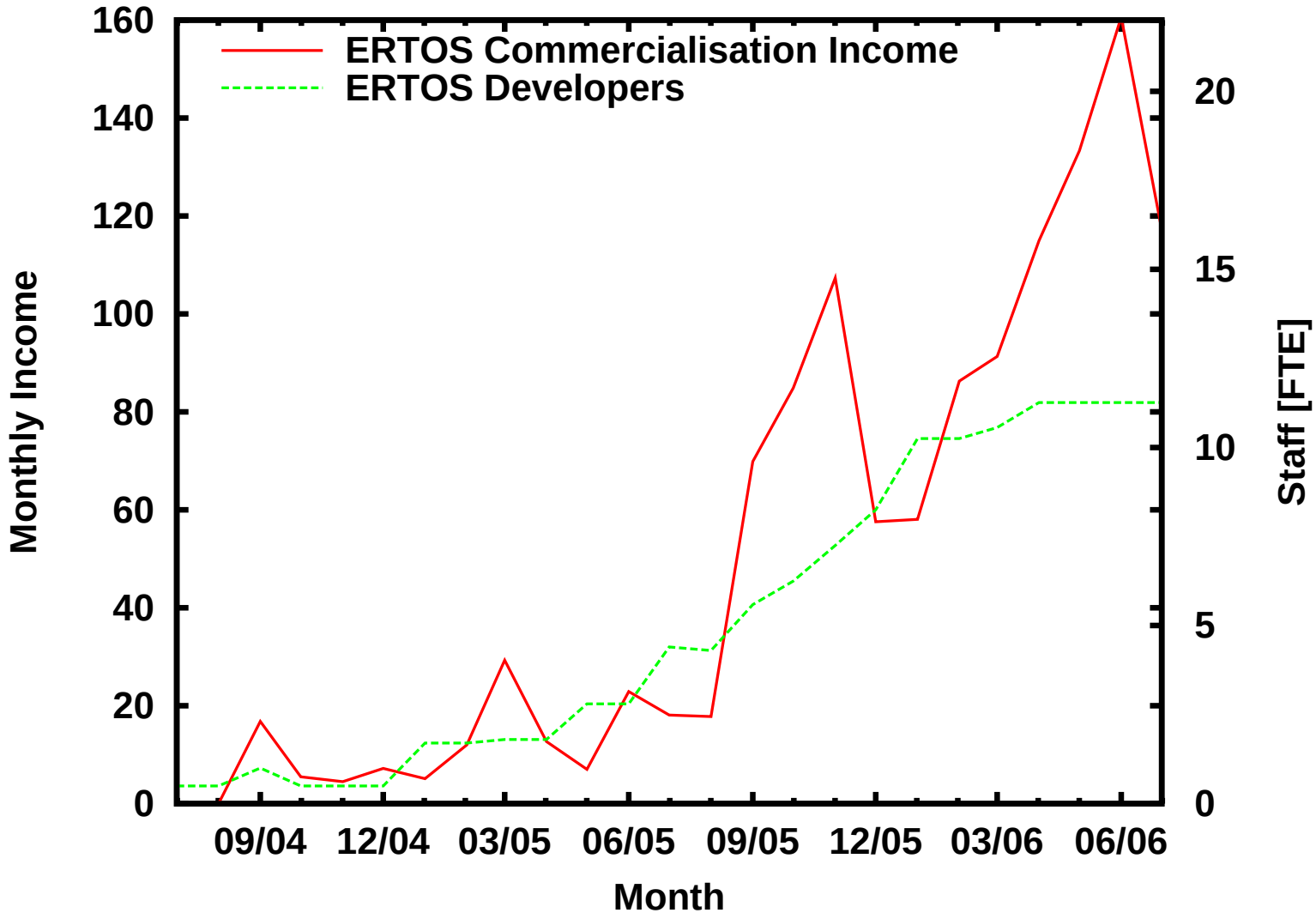
- ➜ *all open source!*



COMMERCIALISING OPERATING SYSTEMS



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Customers and Partners

February 2004	ST Microelectronics
August 2004	Qualcomm
September 2005	Multinational 3
July 2006	Multinational 4
August 2006	Ericsson
October 2006	Multinational 5
Q1 2007	first mobile phone in stores
Q3 2007	first non-phone consumer item

Vision: Phase I

Maximise market penetration

- Based on our present technology (and incremental improvements)
  - ➜ service-based business
  - ➜ proceeds fund on-going development
- Become industry standard in a number of verticals
  - ➜ enabled by openness, superior technology and lower cost
  - ➜ on track for mobile phone handsets
  - ➜ entries made into other sectors
- Ecosystem of SME partnerships
  - ➜ local companies with complementary products

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Continue research in NICTA

- Leverage small size of system to achieve unprecedented reliability
  - ➜ complete and guaranteed timing model of kernel
  - ➜ formally-verified implementation — proven bug-free

Vision: Phase II

Disruptive technology changes the game

- Formal verification opens new markets
  - ➜ reduce certification cost (mil/aero/auto)
  - ➜ certification bodies likely to increase requirements (including for CE)
- Massive technology advantage strengthens competitiveness
  - ➜ achieve robustness beyond competitor's reach
- Transform into product business
  - ➜ licensing, subscriptions

What is Behind?

1. Superior Technology:

- 10+ years of research (originally at UNSW)
  - ➜ resulted in fastest and smallest system of its kind
- Unrivalled research agenda
  - ➜ 50 people in NICTA across 4 programs in 3 labs
  - ➜ strong collaboration, unique collection of skills
  - ➜ ability to out-innovate any competitors
- Goal: Unprecedented level of trustworthiness
  - ➜ mathematical proof of system correctness
  - ➜ migration path from present system

What is Behind?

2. Vision and Stubbornness:

- We want to change the world!
  - ➜ long-term goal
  - ➜ drives research agenda
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- Challenge: How to escape the bean counters?
  - ➜ successes are rare for a long time
  - ➜ hard to survive in publish-or-perish system
  - ➜ has all but killed off university research in operating systems

What is Behind?

3. The Best Team:

- 90% of spinout team are former UNSW students
  - ➜ universities are full of very bright kids
  - ➜ believing in their abilities is rewarding
  - ➜ challenge is to get their attention
  - ➜ challenging teaching is the key

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- Researchers come from all over the world
  - ➜ attracted by NICTA and what it offers

What is Behind?

4. The NICTA Model:

- Critical mass
  - ➜ ability to tackle projects requiring significant resources

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- Critical mass
  - ➜ ability to tackle projects requiring significant resources
- Use-inspired basic research
  - ➜ encourages a vision of long-term impact
  - ➜ ... while ensuring that it is *really* research
- Strong encouragement and support for cross-area collaboration
  - ➜ develop strong synergies

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- Strong encouragement and support for cross-area collaboration
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- Encouragement and infrastructure for commercialisation
  - ➜ provides credible path to real-world impact
  - ➜ entrepreneur-in-residence program rocks!

What is Behind?

5. Open Source:

- It's a *disruptive mechanism* for spreading *disruptive technology*
  - ➜ destroys competitors' revenue models
  - ➜ eases and speed market penetration
  - ➜ replaces expensive sales and marketing teams
  - ➜ removes incentive for launching new competitors

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- It's the *way of the future* for infrastructure technologies
  - ➜ openness is *essential* for trustworthiness
  - ➜ sharing cost of infrastructure makes economic sense

What is Behind?

1. Superior technology through long-term research
2. Vision and stubbornness
3. The best team, fed by UNSW student pipeline
4. The NICTA model of research and commercialisation
5. Open Source, the big disrupter