Xenon Assurance Modifications to Xen Code

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Prologue: Security

* Strength of mechanism - any conceptual flaws?
* Assurance - any construction flaws?

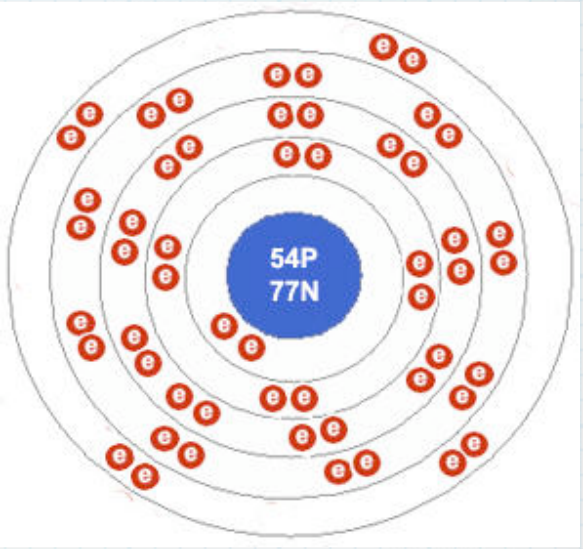
Prologue: Security

- Security is always defined with respect to a threat model.
- A threat model has
  - threat
  - threat actor
    - capability
    - initial access
    - initial knowledge

The Xenon Project

* Project Goals:
  * What happens when you try to develop high assurance open source?
  * Can you build a "separation kernel" that supports unmodified uninterpreted off-the-shelf software, on commodity hardware (e.g. x86_64 with APIC)?

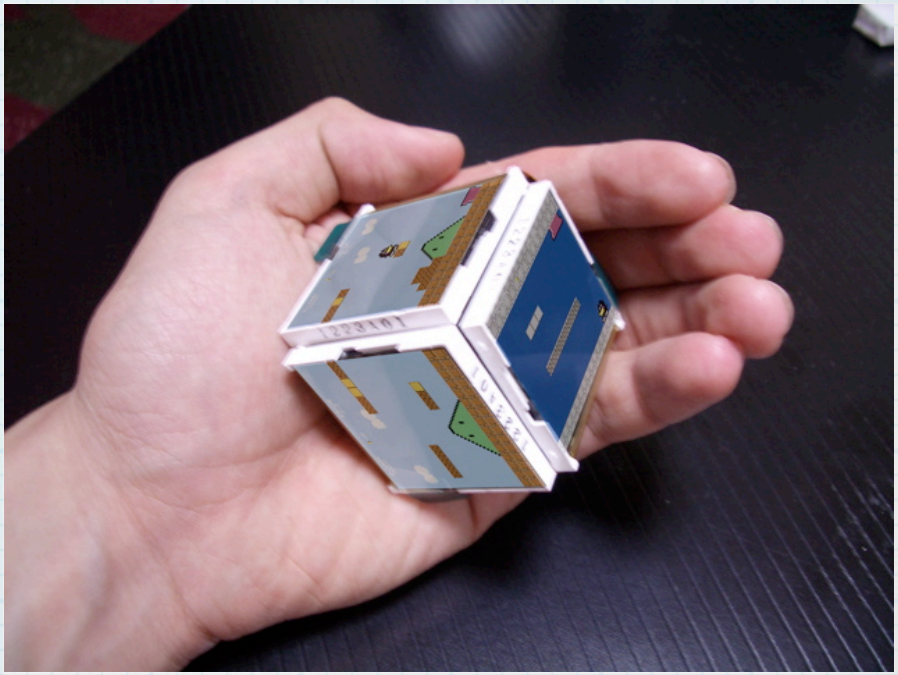
Xenon



* A "separation hypervisor"
* Not a separation kernel
* Not a "secure" replacement for Xen
* A new security-oriented product for specialized use
* See the Apr. '07 slides at www.xen.org/xensummit

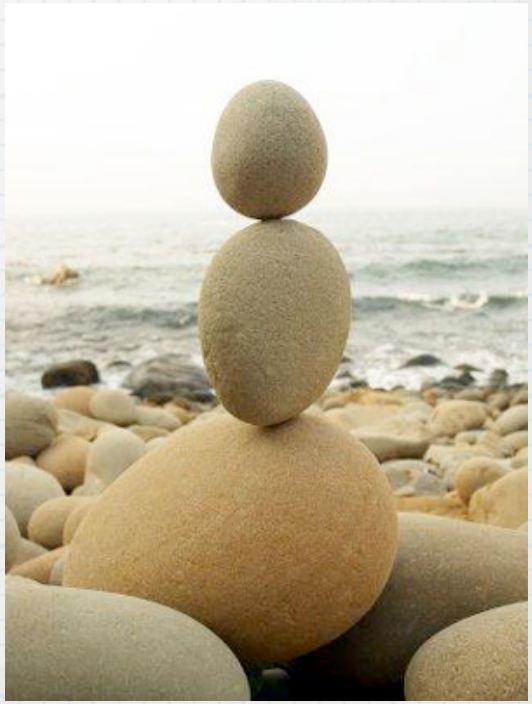
The Xenon Prototype

* Based on 3.1
* Some features removed
* Only supports x86_64
* Refactored code
* Evidence package



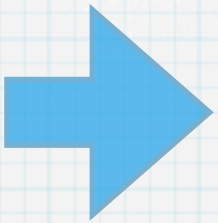
Simplicity

* McCabe cyclomatic complexity
* Halstead effort (sanity check)
* Size (sanity check)
* Xen 3.1 has approx. 3810 C functions
* Approx. 200 will have to be re-factored
* x86_emulate.c ?



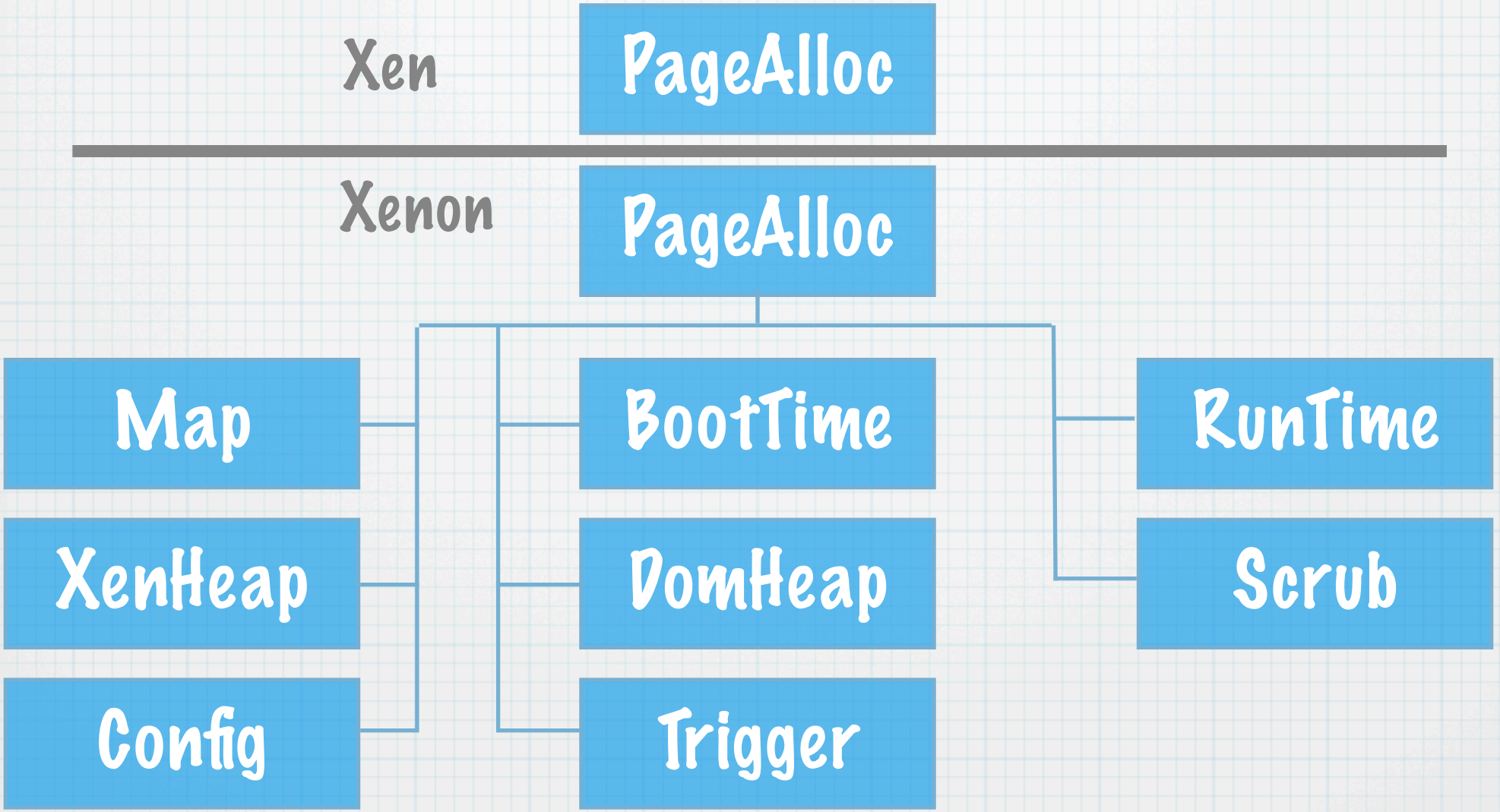
Simplicity: _evtchn_close

* _evtchn_close - 34

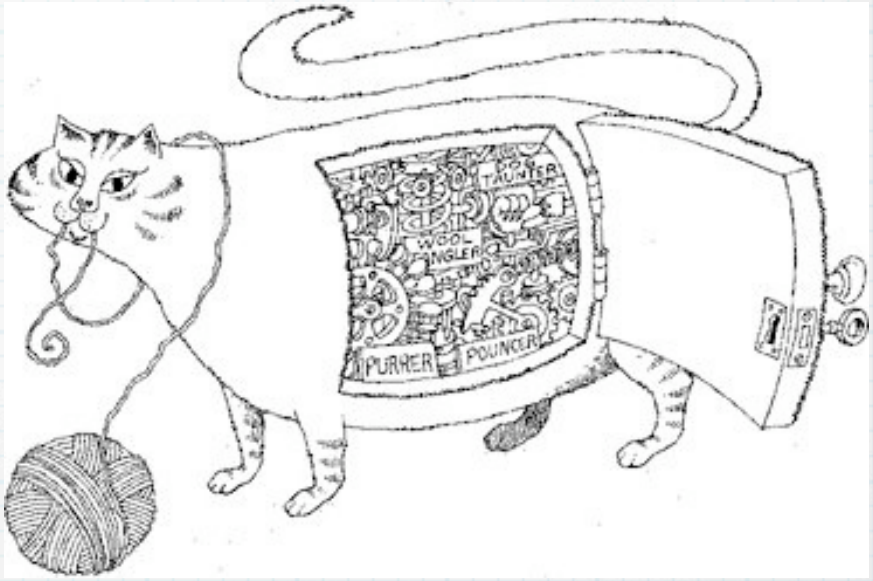


* _evtchn_close - 3
* _finish - 5
* _chk_state - 3
* _state_INTERDOMAIN - 17
* _state_VIRQ - 3
* _state_PIRQ - 2
* _get_port - 6
* _try_again - 3
* _init_state - 1

Modularity (cohesion)



Encapsulating Global Data



* No global data allowed, e.g.
  * v->vcpu_id
* Information hiding instead, e.g.
  * loose: #define vcpu_id(v)
  * strict: static inline int vcpu_id

Strict encapsulation of vcpu: schedule.c

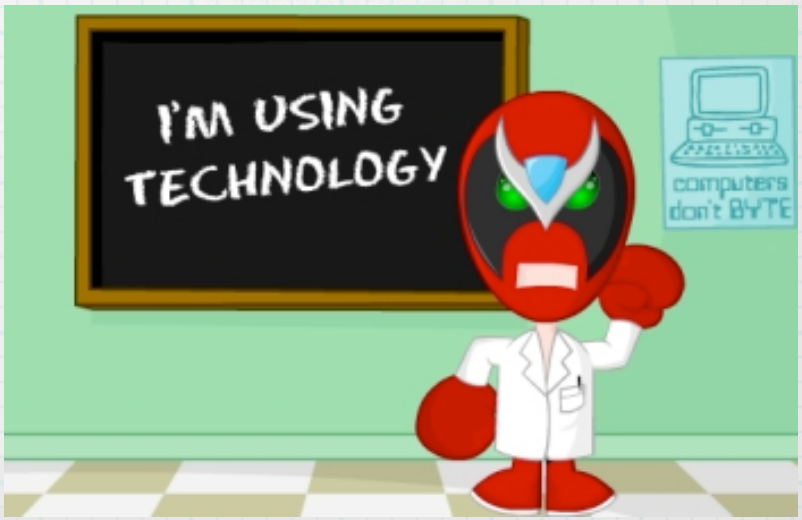
* get/set_vcpu_id
* larger but just as fast
* object size: 158744b vs. 157240b
* sort test: 0.121s vs. 0.122s
* search test: 0.836s vs. 0.854s

Xenon Construction Guidelines

* comments
* PDL files
* readme files
* tool-based formatting
* complexity, modularity, abstraction limits
* logical completeness
* coding practices

Guidelines: Comments

* minimal
* don't comment anything that could be understood in a first reading of the source
* assume the reader has a modern, program-slicing based source code browser, e.g. CodeSurfer



Guidelines: PDL

* each source or header file has a companion Pseudocode Design Language file, e.g. dom_event_channel_c.pdl
* explains the intent of each line of code
* does not explain coding, algorithms or data structures
* see McConnel's Code Complete, 2nd ed.

Guidelines: readme file

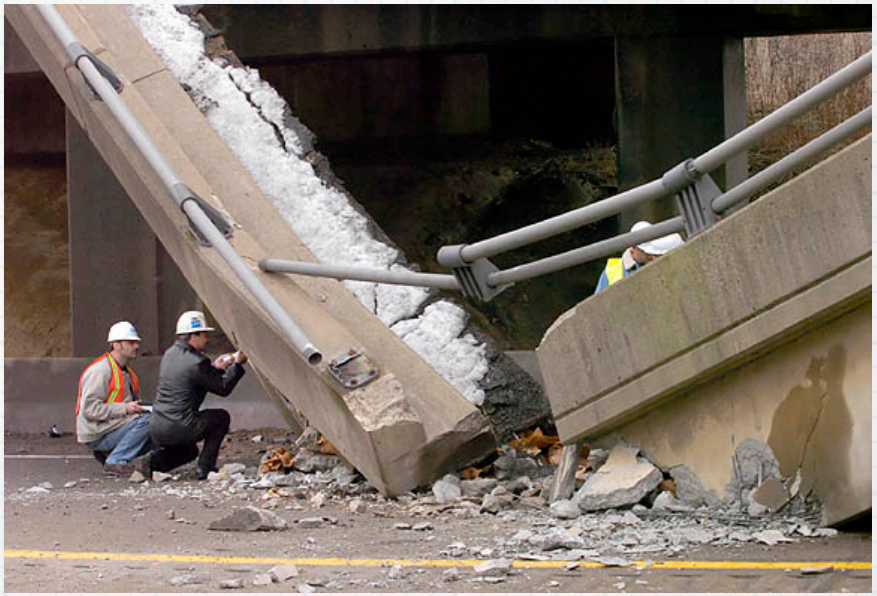
* each source, header, and assembler file has a companion "readme" file.
* everything not covered by the .pdl file
  * todo's,
  * data structures (e.g. event channel buckets) and algorithms,
  * coding techniques (e.g. container_of)
  * workarounds, etc...

Guidelines: formatting

- all files formatted by a tool
- public Xenon format is defined as GNU indent
  - `indent -kr -nut -i8 -l128 file.c`
- everyone can re-format to their preferred style for local work

Guidelines: structural limits

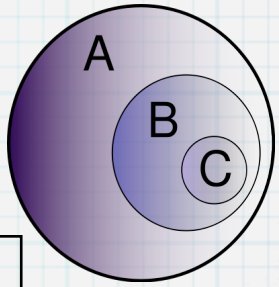
* complexity, modularity, and abstraction limits
* examples shown in earlier slides
* departures from these limits explained in the .readme file, i.e. the code is more complex, less modular on purpose



Guidelines: logical completeness

* suppose code has conditions (x < y) and (v->task)
* what about (x >= y) and (v->task == NULL)?
* should be dealt with in the code, covered by an assertion, or explained in the .readme file

Guidelines: coding practices



* how to avoid high-risk or low-assurance C coding techniques?
* could have used a safe subset of C, e.g. MISRA C,
* subsets can be "noisy" and irritating
* instead, adopt 18 high-assurance coding rules, mostly from Les Hatton

More Information

* email: john.mcdermott@nrl.navy.mil (Xenon)
* http://www.grammatech.com (CodeSurfer)
* Steve McConnel, Code Complete, 2d ed. ISBN 0-7356-1967-0 (PDL)
* http://www.leshatton.org/ISOC_subset1103.html (Coding Practices)