

Stochastic Multi-CAS

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Crazy Idea Talk

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Compare and Swap

If Target = Expected Value

Then

 Target := New Value

End

Return Old Value

Compare and Swap

- Compare and Swap (CAS) is essential for implementing interesting lock-free algorithms.
- But existing CAS implementations are quite constrained...

The Problem

- Hardware gives at best a 128-bit CAS. The bits must be contiguous in memory.
- Lock-free software CAS implementations can relax this constraint - but they do so by stealing bits.

Why should you care?

- Lots of algorithms can be easily made lock-free if we had practical multi-CAS.
- Example: concurrent GC.
- But bit stealing is intrusive.

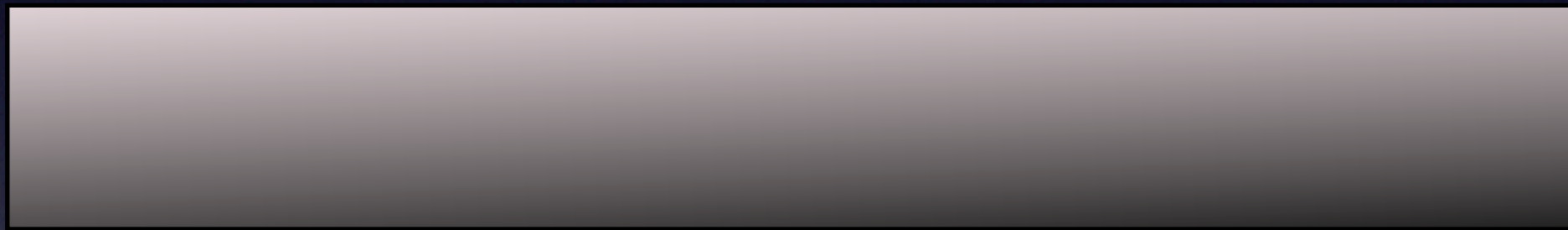
- Stealing a bit is intrusive because:
 - vanilla C/C#/Java primitive types
 - we require that the client software be designed with an a priori knowledge about bit stealing.

Harris approach



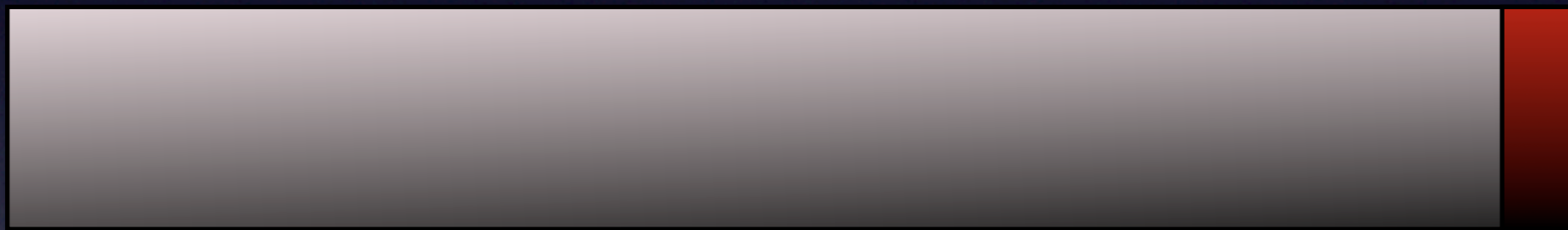
Harris approach

Hardware CAS-able word



Harris approach

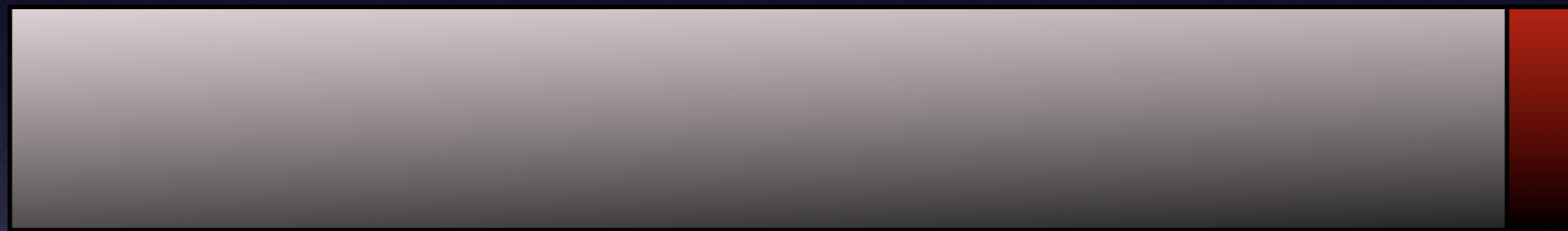
Hardware CAS-able word



Steal one bit

Harris approach

Hardware CAS-able word



Either payload

-or-

CASN control data

Steal one bit

Can we get 1 bit
without stealing
it?

Is there some
way to cheat?

Yes!

Use a random
number!

Stochastic approach



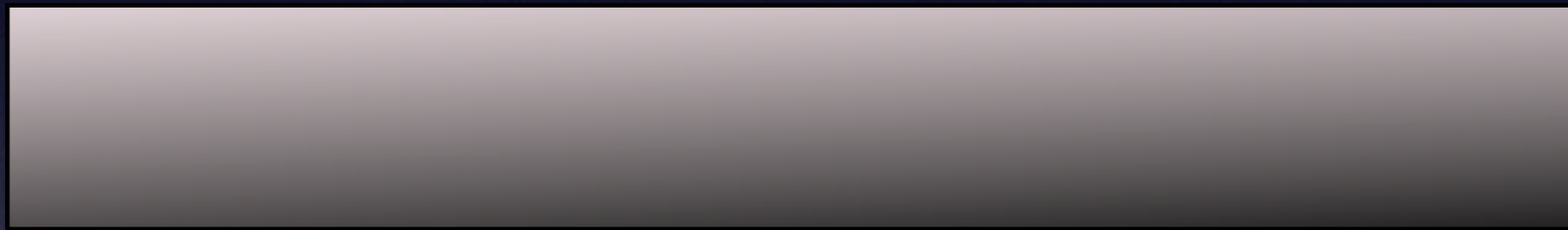
Stochastic approach

Hardware CAS-able word



Stochastic approach

Hardware CAS-able word



All bits available

for payload!

Stochastic approach

Hardware CAS-able word

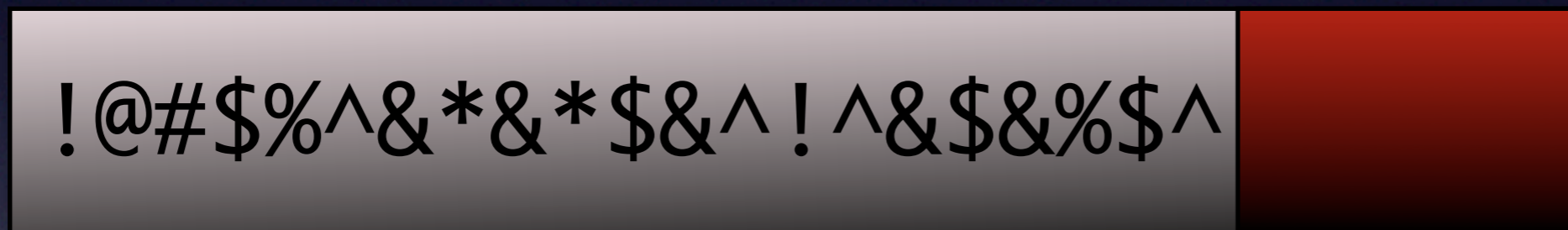
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When it comes to run
multi-CAS, store random
marker.



Stochastic approach

Hardware CAS-able word



When marker present, use remaining bits for multi-CAS control data.

Why is it good?

- Can multi-CAS any field (including primitive fields)
- The types don't need to change
- Lock-free, performance need not be atrocious.

What is the challenge?

- Convincing people to use a stochastic algorithm.

Conclusion

- An implementation already exists:

<http://homepage.mac.com/pizlo/smcas>

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Read barrier throughput: ~2ns/64bit!