Strategies for Memory Accounting of Cooperating Pi-Calculus Processes

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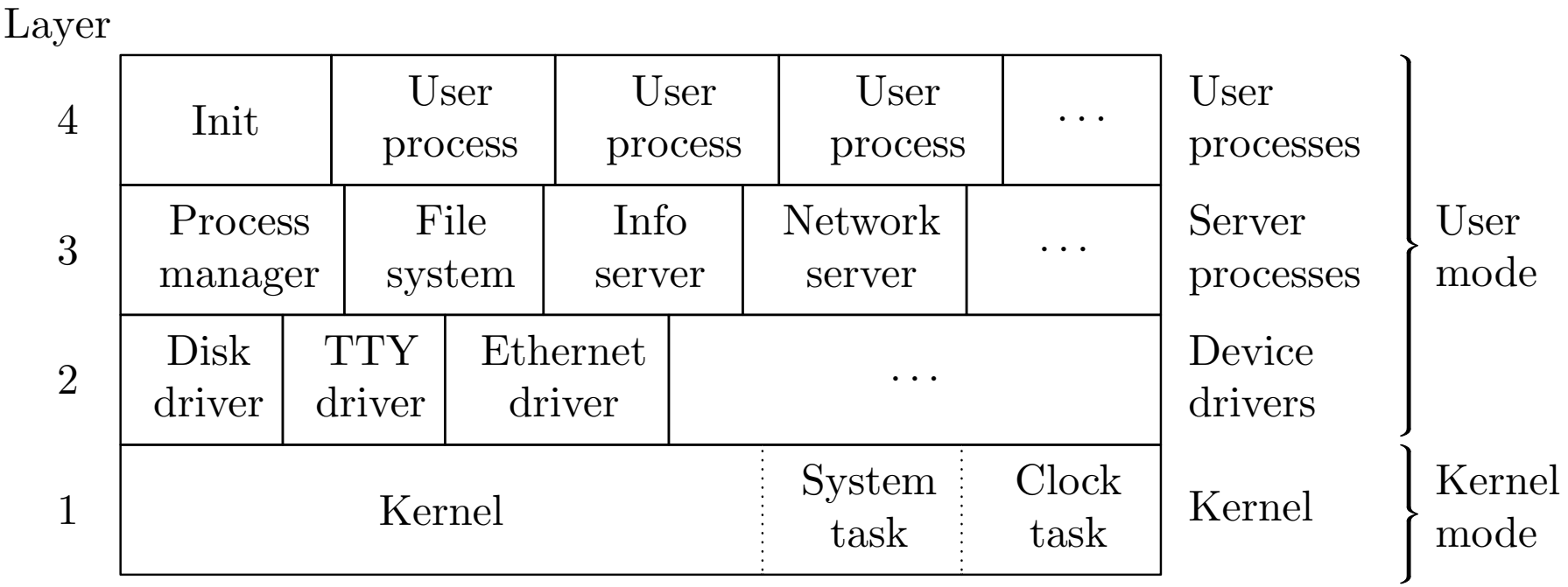
Contents

Topics of interest

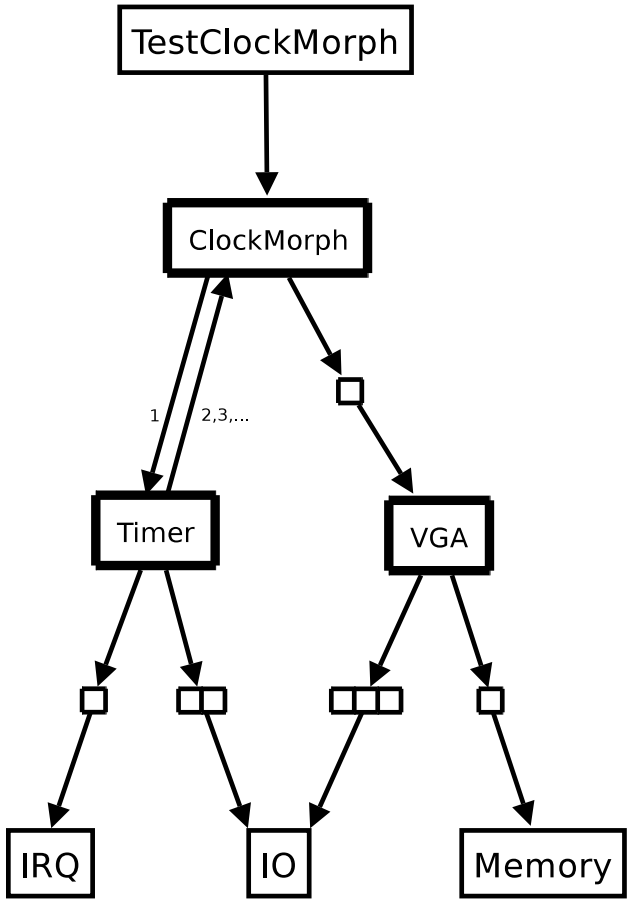
Randy Pausch's Last Lecture:
"Fundamentals, fundamentals, fundamentals. You've got to get fundamentals down because otherwise the fancy stuff isn't going to work."

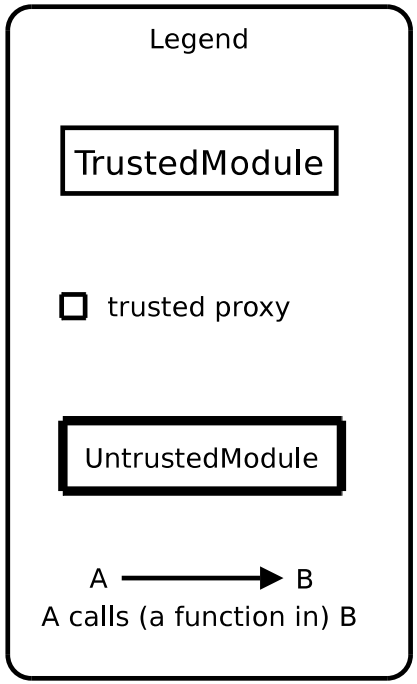
- Properties:
  - robustness
  - how not to trade security for functionality (and vice versa)
- Techniques:
  - microkernel architecture [4]
  - object-capability programming languages [2, 3]
- Applications:
  - kernel-space (mainly)
  - user-space (also)

Minix—operating system designed as a microkernel



Backwater—kernel written in an object-capability language





Two approaches compared

	μ-kernel approach	object-capability approach
communication primitives	some	excellent
TCB size	**X** LOC	**X**/**10** LOC
memory management	solid	missing
CPU management	solid	missing

Object-capability security paradigm

the only way how a subject can get a capability on some object is by:

- initial conditions
- introduction
- parenthood
- endowment

access control design patterns:

- Caretaker (David D. Redell)
- Powerbox !!! (Mark Miller, Marc Stiegler, . . .)
- Membrane (Mark Miller)
- Horton (Mark Miller)

Security policies here are expressed as programs (algorithms or processes), not as as a tuple of values we can set via some configuration options.

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Contents

Cancer

```
def cancer [] =
    ( cancer![] | cancer![] )

cancer![]
```

Cancer

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( cancer![] | cancer![] | cancer![] | cancer![]
| cancer![] | cancer![] | cancer![] | cancer![]
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( cancer![] | cancer![] | cancer![] | cancer![]
| cancer![] | cancer![] | cancer![] | cancer![]
| cancer![] | cancer![] | cancer![] | cancer![]
| cancer![] | cancer![] | cancer![] | cancer![]
)
```

Cancer

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def cancer [] =
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( cancer![] | cancer![] | cancer![] | cancer![]
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| cancer![] | cancer![] | cancer![] | cancer![]
| cancer![] | cancer![] | cancer![] | cancer![]
| cancer![] | cancer![] | cancer![] | cancer![]
)
```

Cancer

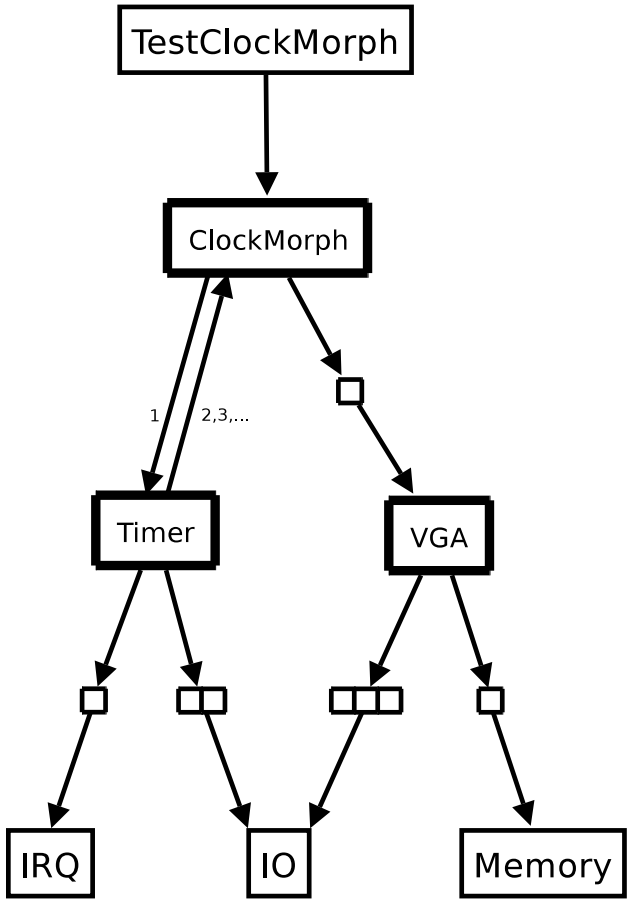
. . . . . .

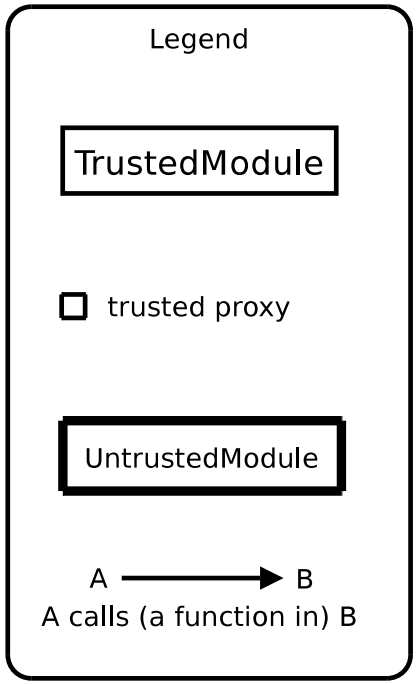
Cancer

STOP

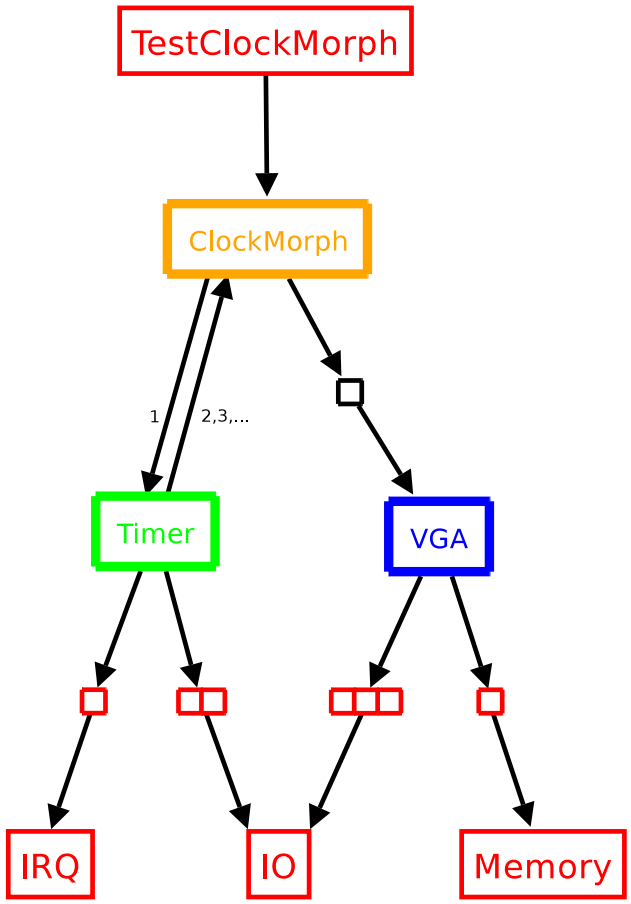
Contents

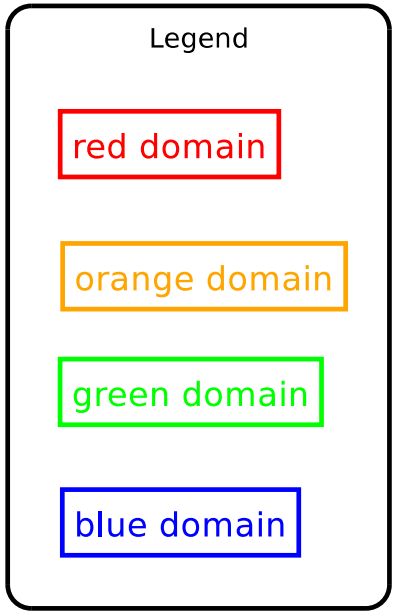
Instead of:


TestClockMorph
ClockMorph
1
2,3,...
Timer
VGA
IRQ
IO
Memory


Legend
TrustedModule
trusted proxy
UntrustedModule
A
B
A calls (a function in) B

we would like to have something like:





The plan

- enhance original Pict programming language
- then I decided to define sufficiently interesting subset of the Pict programming language and enhance this subset
- the chosen subset (I call it Sahara [1]) is based on the π-calculus with i/o-types
- and then add proper new constructs to it

How can that be achieved [1]

- new syntactic constructs
  (for domains)
- update the type system; add new type operators
  (for specifying ownership policy)
- update the operational semantics of the language
  (it should capture changing colors of existing objects and determining color of new objects)

References

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Thank you.