



Critical

Dependable
Technologies
For Critical
Systems

xLuna

Sistema Operativo de Tempo-real baseado em RTEMS e Linux

v1

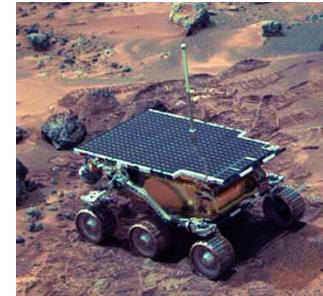
Corrida ao Espaço

"Um pequeno passo..."

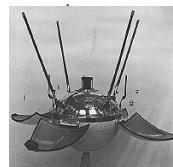
Apollo-9
(Lunar Module)
405.000 km



Mars Pathfinder
(1ª rover em Marte)

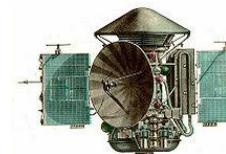
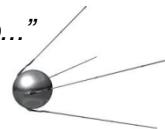


Luna-9
405.000 km
(1ª sonda lunar)



"bip... bip..."

Sputnik
1.450 km



Mars-3
55 a 405 milhões km
(1ª sonda em Marte – ~20 seg.)

"É lindo!"

Vostok-1
327 km

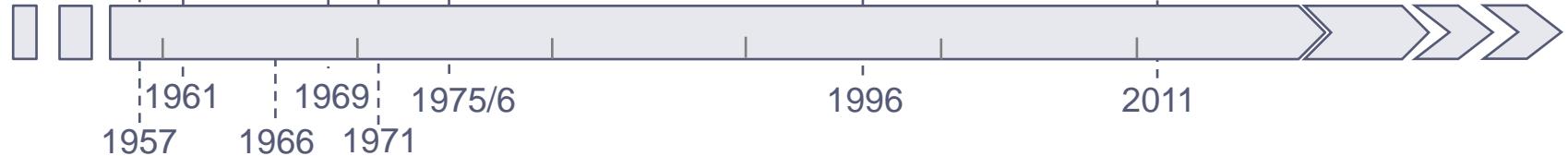


Viking-1 / Viking-2
55 a 405 milhões km
(1ª sonda bem sucedida em Marte – +6 anos)

"As of January 2011, there is one functioning piece of equipment on the surface of Mars beaming signals back to Earth: the Opportunity rover."



...Homem em Marte



Necessidades futuras

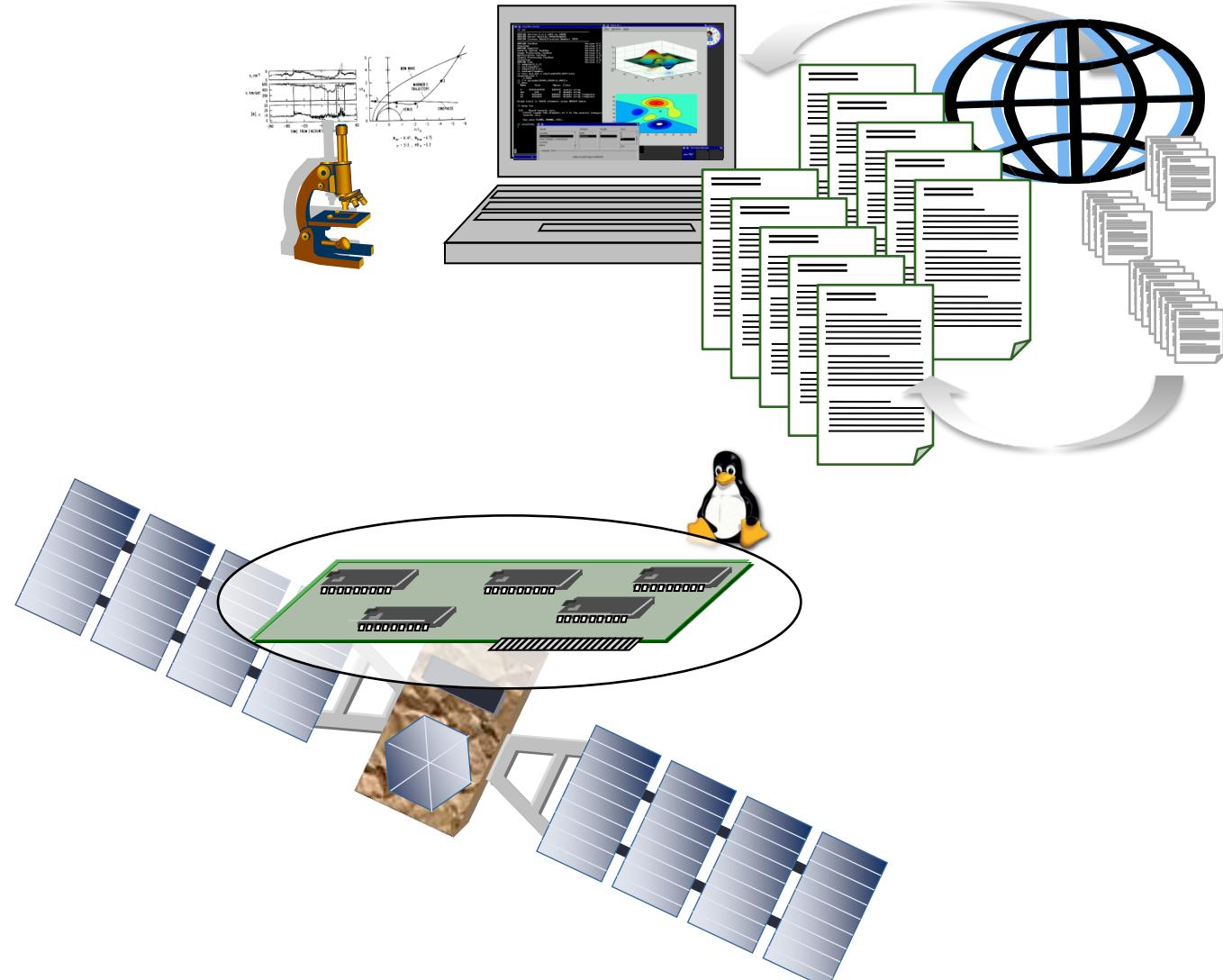
- Mais autonomia
- Mais complexidade
- Mais interfaces padrão (reutilização)
- Menor duração nos ciclos de desenvolvimento
- Processo mais simplificado
 - Exemplo:
 - os algoritmos de processamento de imagem e planeamento de rotas do veículo da ESA para Marte, foram desenvolvidos e testados completamente em Linux
 - Estão agora a ser implementados de novo, de raiz, num SOTR

Critical

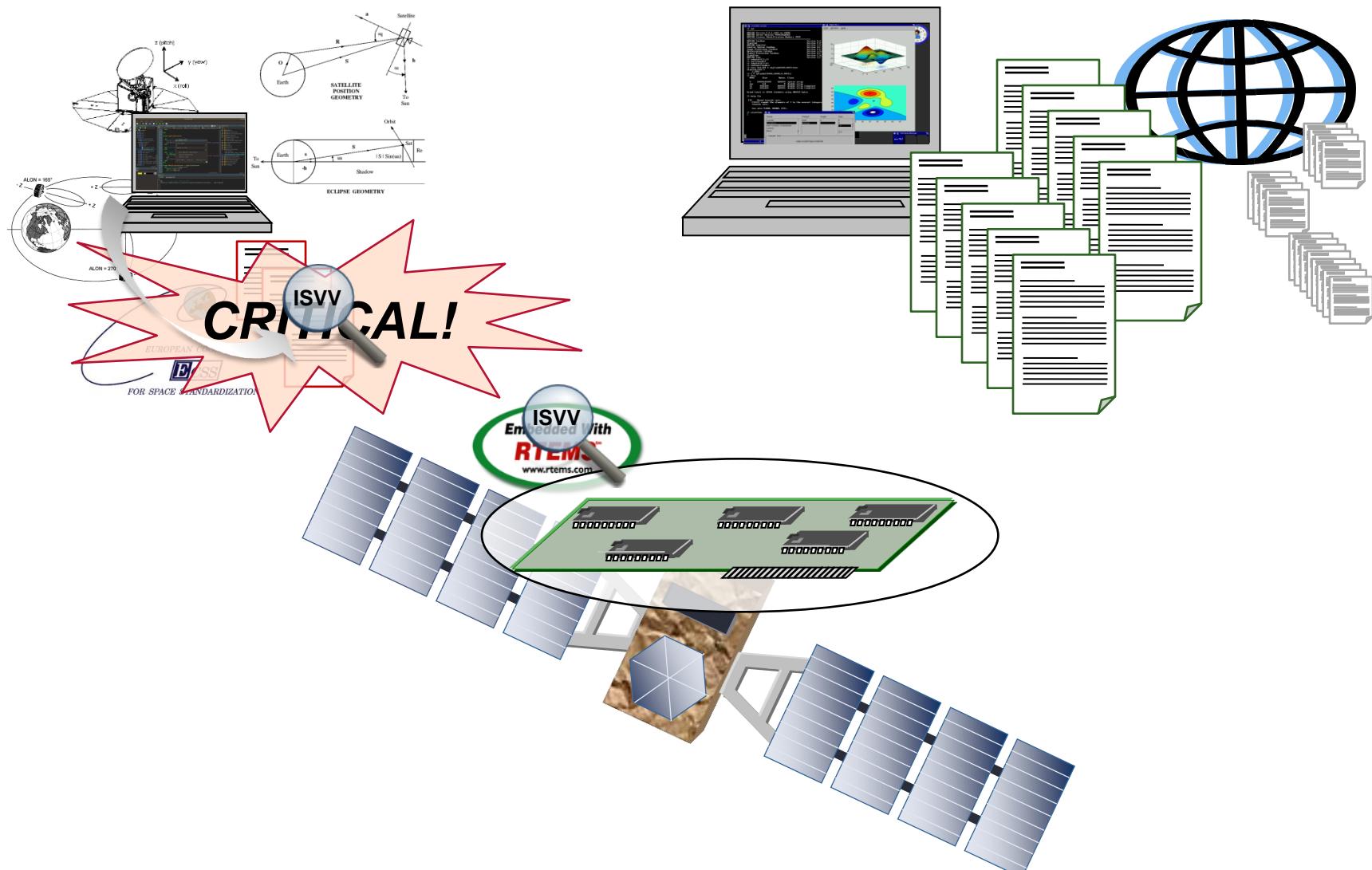
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xLuna

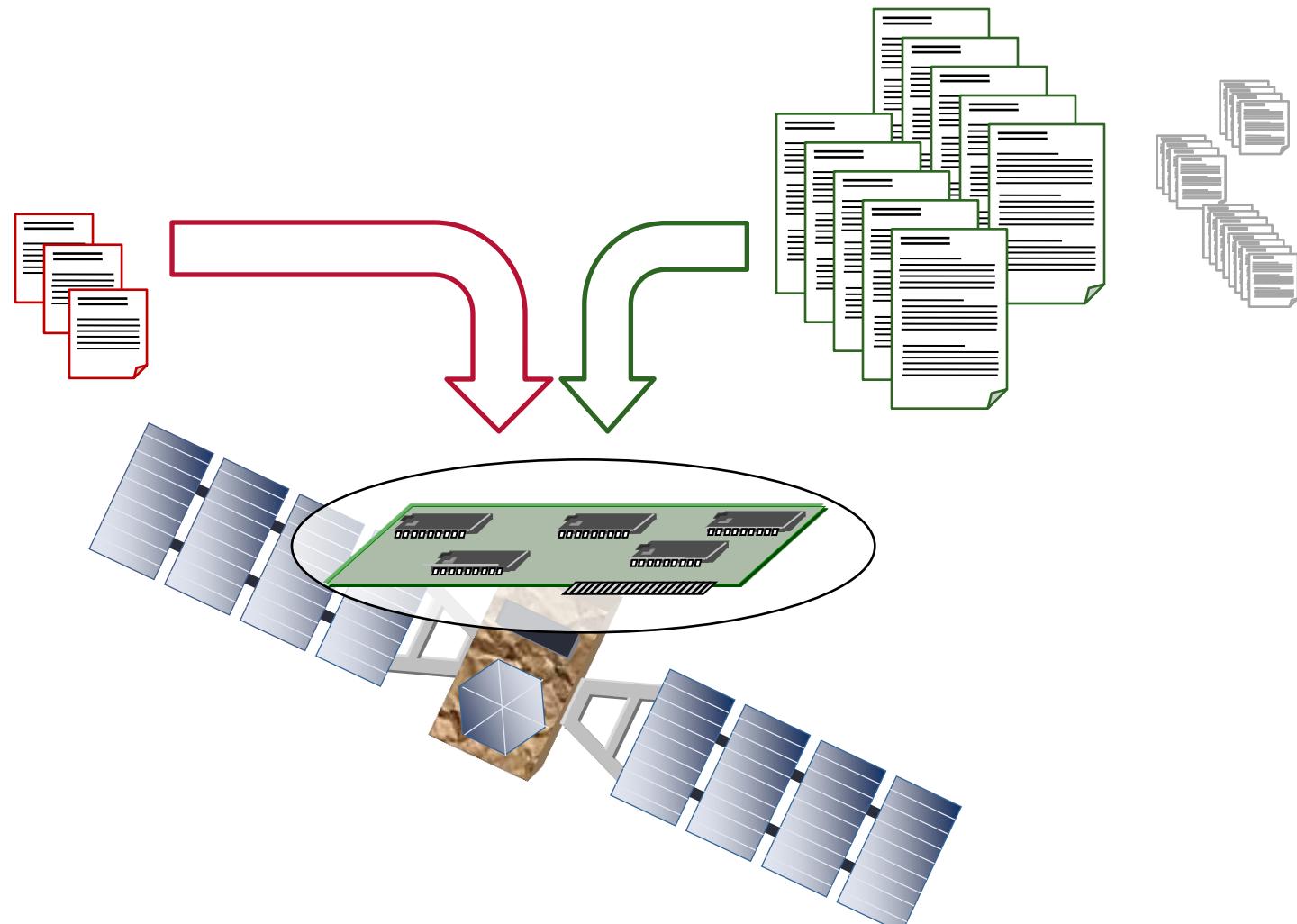
Payload



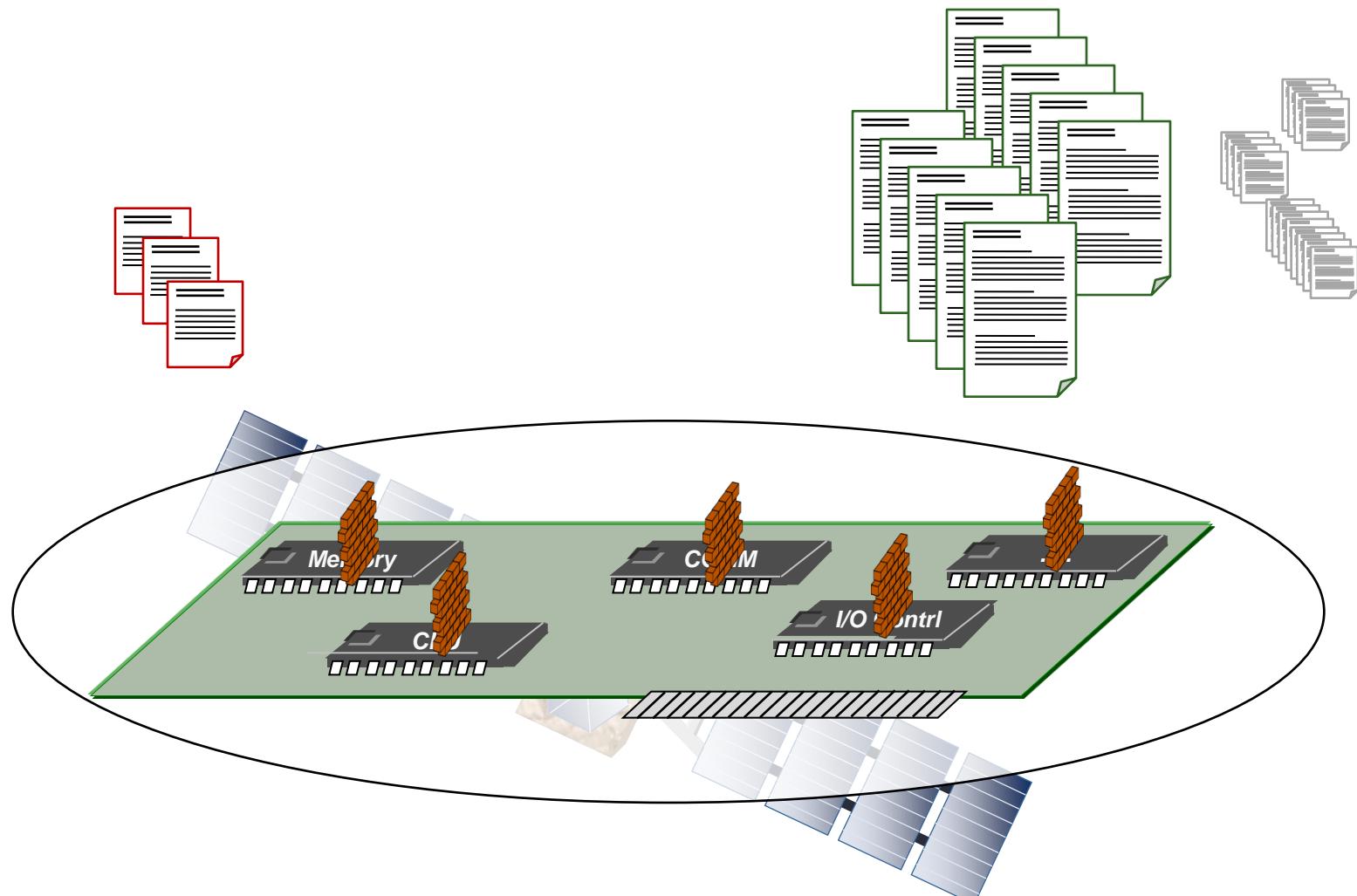
Avionics



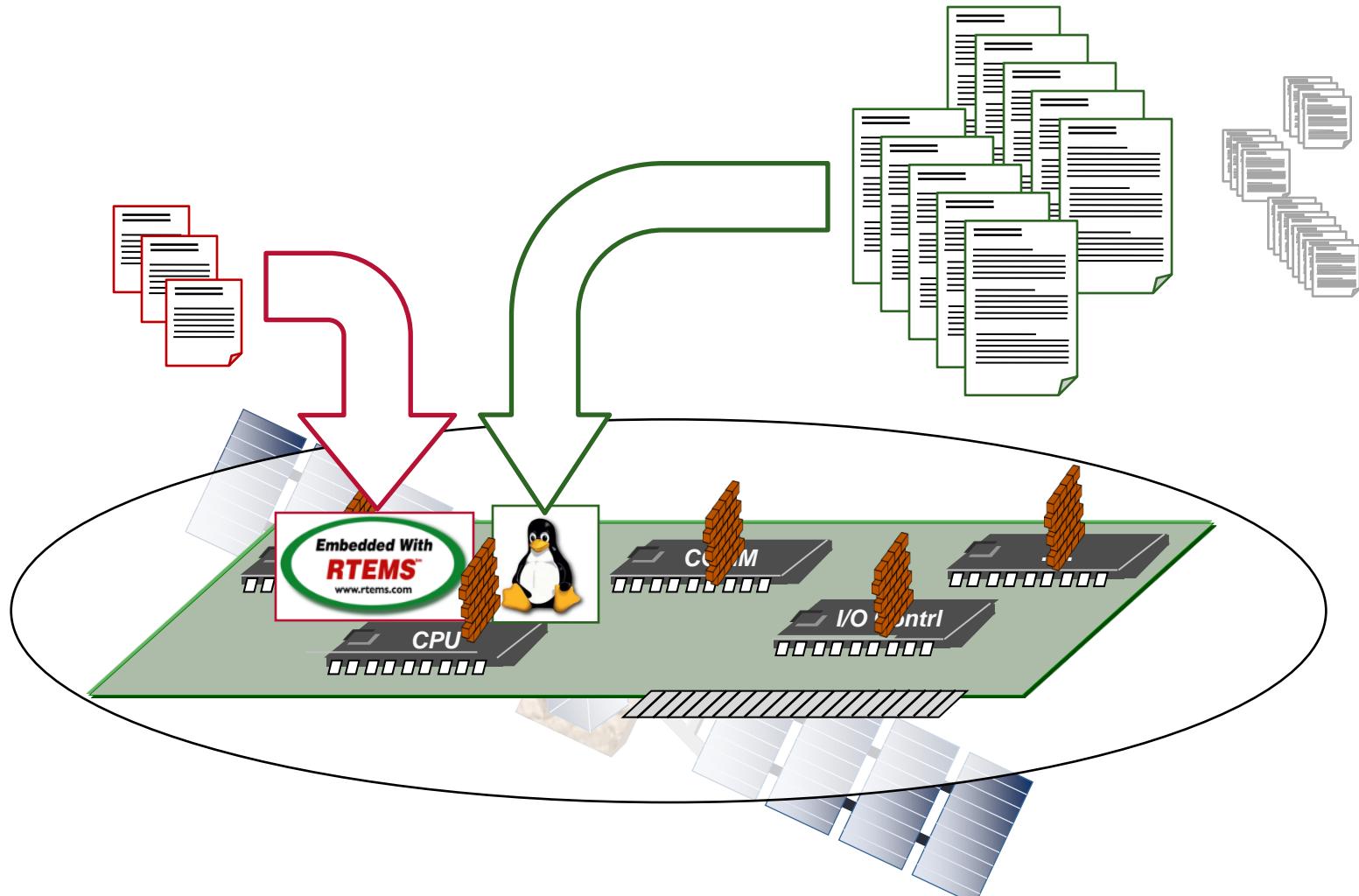
Problem



Solution: segregation on same HW

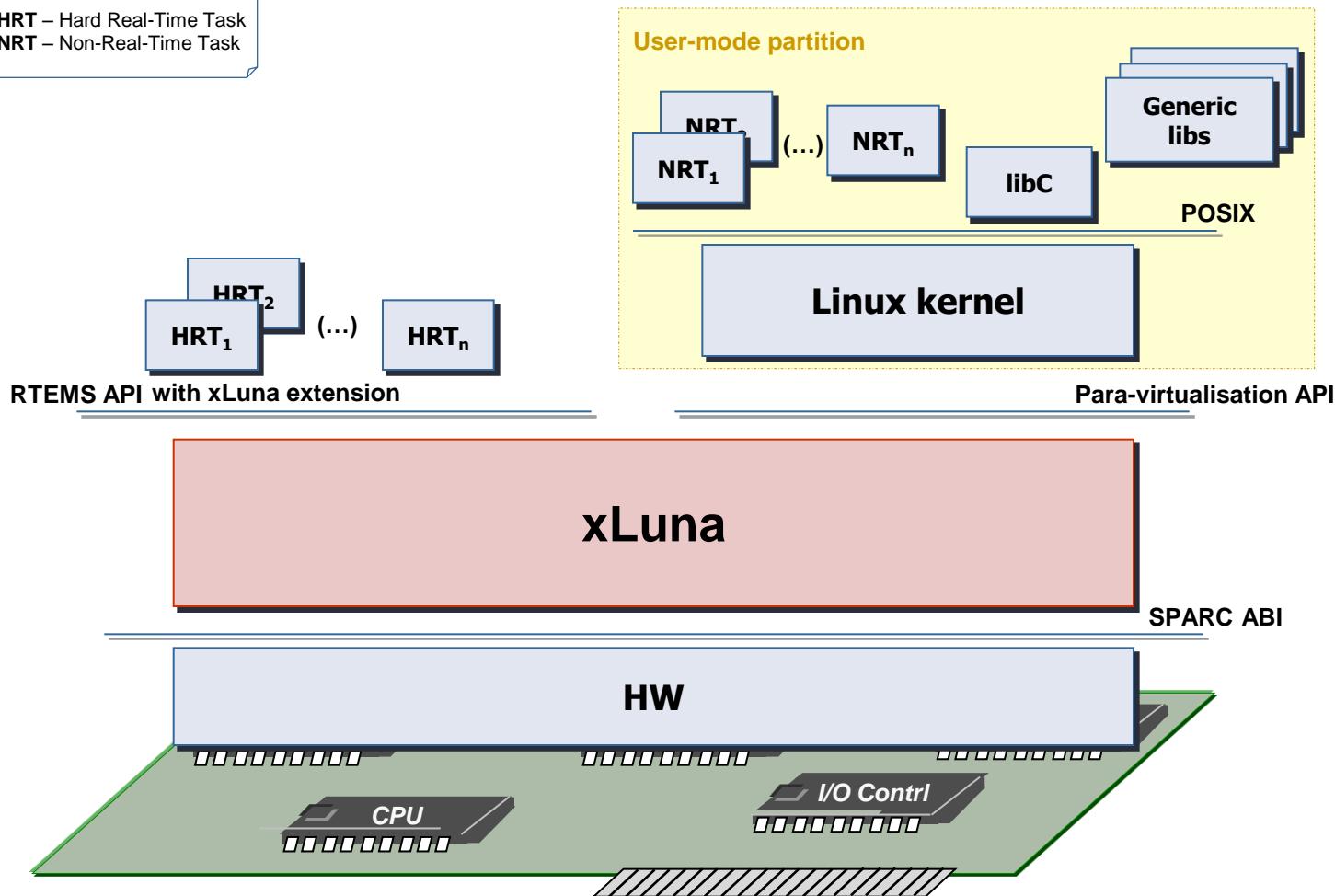


Solution: xLuna



Architecture

HRT – Hard Real-Time Task
NRT – Non-Real-Time Task



```
plbraga@xluna: ~/xluna_src/tests/just_linux_with_periodic_items_msg
tsim> reg o6 0x41000000
o6 = 1090519040 (0x41000000)
tsim> reg i6 0x41000000
i6 = 1090519040 (0x41000000)
tsim> cont
===== Starting Linux (xLuna Guest Version 0.3.2 for 2.6.11) =====
[RTEMS tarefa A] tarefa de controlo simulada 0
[RTEMS tarefa A] tarefa de controlo simulada 1
Mounting the proc file system ...

BusyBox v1.1.0 (2011.04.07-14:27+0000) Built-in shell (ash)
Enter 'help' for a list of built-in commands.

/ # ls
[RTEMS tarefa A] tarefa de controlo simulada 2
bin      etc      lib      proc      sbin
dev      init      linuxrc  root

/ # ps
  PID  Uid      VmSize Stat Command
    1  0          612 S  init
    2  0          RWN [ksoftirqd/0]
    3  0          SW< [events/0]
    4  0          SW< [khelper]
    5  0          SW< [kthread]
    6  0          SW< [kblockd/0]
    7  0          SW  [pdflush]
    8  0          SW  [pdflush]
   10  0          SW< [aio/0]
    9  0          SW  [kswapd0]
   17  0         692 S  /bin/sh
   19  0         628 R  ps

/ # ls /proc
  1          6      devices      interrupts      misc      uptime
 10         7      diskstats  io_map      mounts      version
 17         8      dma      iomem      net      vmstat
  2         9      driver      ioports      partitions
 20        10      buddyinfo  dvma_map      kmsg      self
  3         11      bus      execdomains  loadavg      slabinfo
  4         12      cmdline      filesystems  locks      stat
  5         13      cpufreq      fs      meminfo      tty
[RTEMS tarefa A] tarefa de controlo simulada 3
/ # cat /proc/cpuinfo
[RTEMS tarefa A] tarefa de controlo simulada 4
cpu      : Leon2
fpu      : Meiko FPU
promlib : Version 0 Revision 0
prom     : 0.0
type    : leon2
ncpus probed : 1
ncpus active : 1
CPU0Bogo : 0.81
CPU0ClkTck : 0
MMU type : Leon2
contexts : 256
nocache total : 2097152
nocache used : 86272
/ # [RTEMS tarefa A] tarefa de controlo simulada 5
```

Preparar o simulador

Execução

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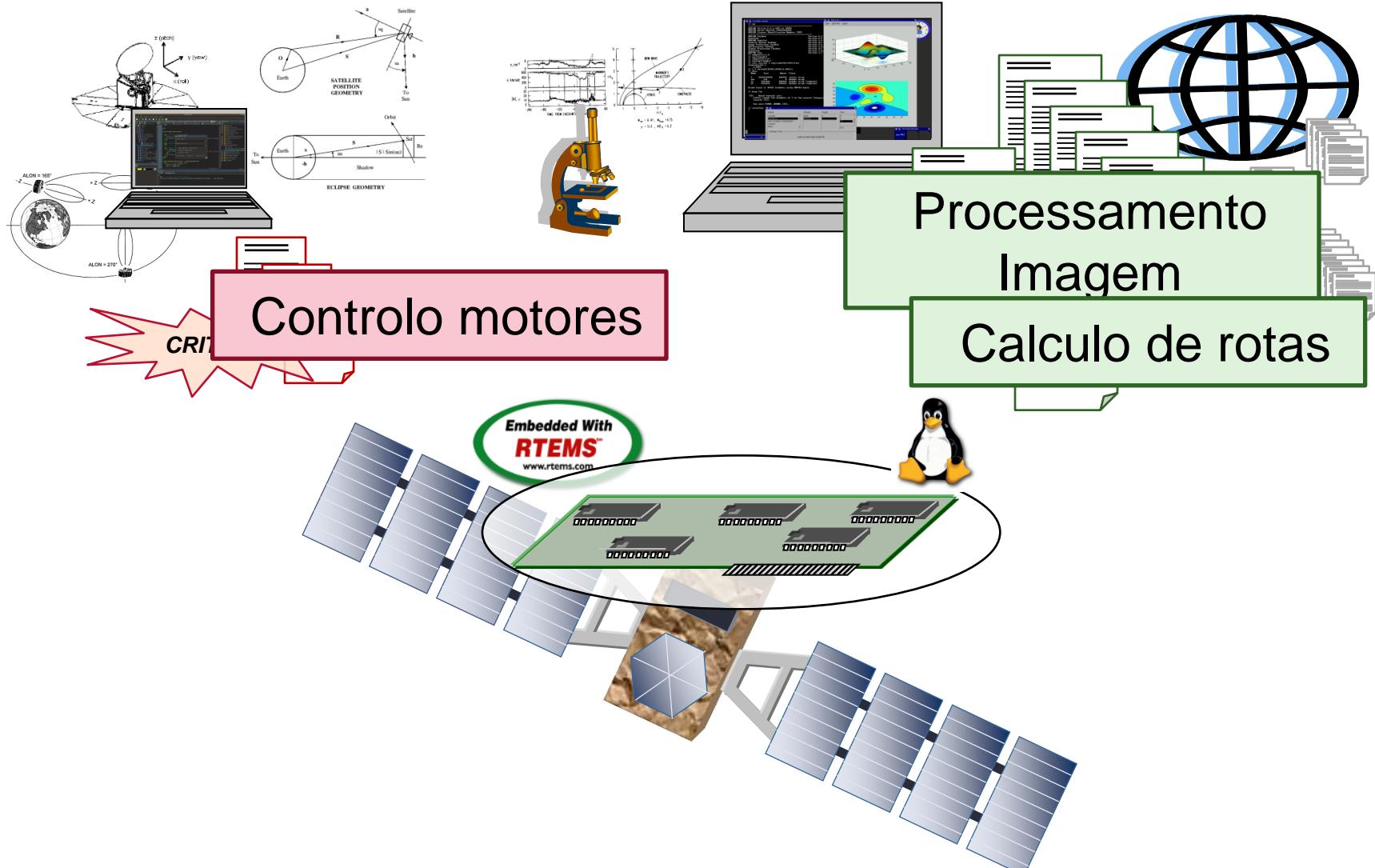
XLUNADMO

Demonstração do xLuna no protótipo do EXOMADER -
“EXOMArS DEMonstration Rover”

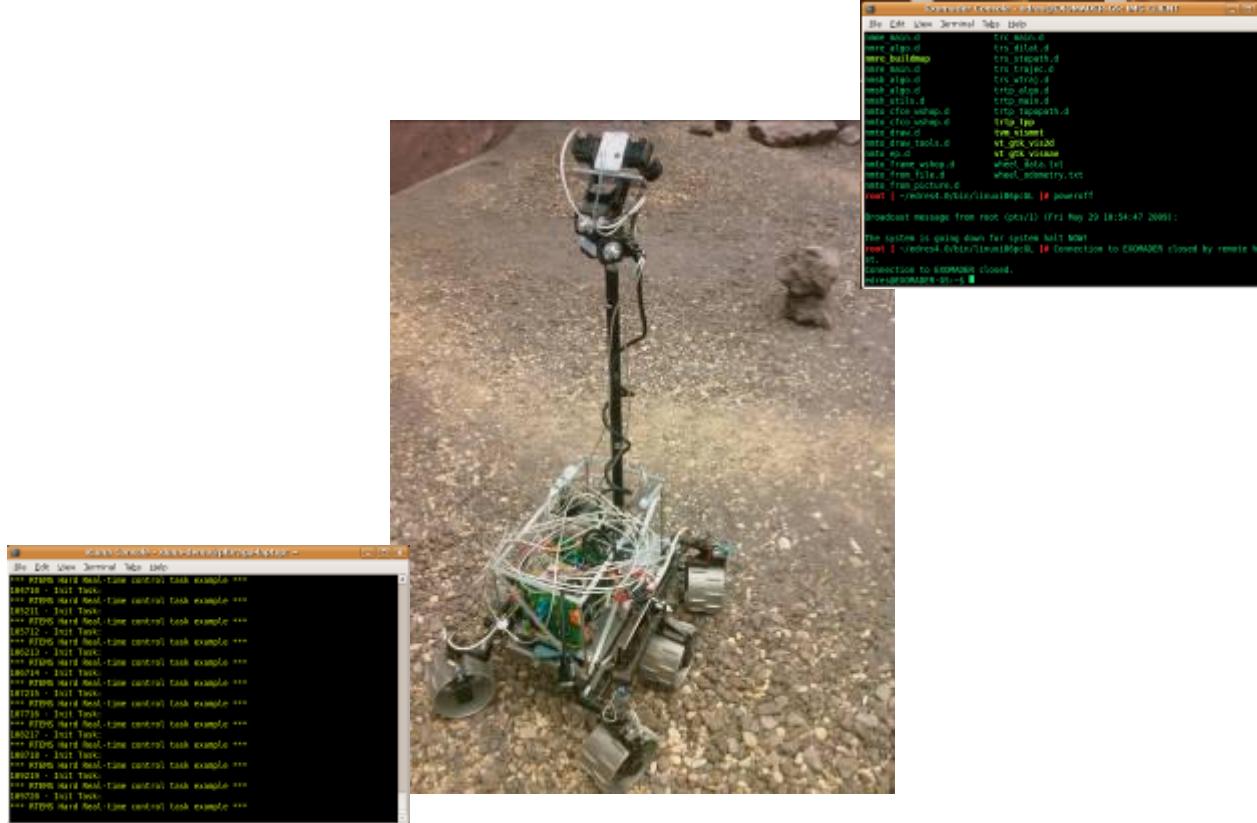
Motivações

- No fim do projecto, tínhamos um protótipo
 - Prova de conceito em HW simulado (TSIM)
 - Com casos de teste específicos
 - RTEMS
 - Linux
- O objectivo seguinte passava por validar o xLuna
 - Em HW real
 - Com aplicações representativas de missões
- A CSW propôs demonstrar o xLuna no veiculo de exploração a Marte que estava a ser usado para testar o SW de processamento de imagem e planeamento de rotas

Target application



Scenario Setup



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