Using CST Microwave Studio
Distributed Computing in a Workgroup Environment

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Distributed Computing - Overview

- Introduction
- First Setup *(using CST 2008)*
- Second Setup *(using CST 2009 / 2010)*
- Open Issues / Other Issues
- Conclusion
Introduction: Distributed Computing

- Distributed Computing first introduced in CST Version 2006

- Originally, seemed to be tailored for two types of computer environments:
  - „Workgroup with additional ´calculation only´ computers“
  - „one-man engineering office“ (see following slides)

In both cases, the Solver Servers will run on ´calculation only´ computers!
Introduction: Workgroup with ‘calculation only’ computers

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<tr>
<th>Computer</th>
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<th>Solver Server</th>
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- E. g. ‘Calculation only’ high-performance computers in a separate room ...
- Main Controller preferably on one of the ‘calculation only’ computers ...
### Introduction: One-Man Engineering Office

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- **Main Controller** preferably on one of the ‘calculation only’ computers...
First Setup - Motivation

Development workgroup, each engineer has his own desktop computer, but no additional ‘calculation only’ computers are available!

Does it make sense to use Distributed Computing in such an environment?

**Motivation**: Use the resources of the colleagues’ computers
- while they are doing non-computer work (RF hardware, measurements, ...)
- while they are away in a meeting / on travel / in holiday
- during nighttime or weekend

**Use Distributed Computing for**
- \( n \) parallel (port, parameter set, ...) calculations on \( n \) computers (*license!*)
- only 1 calculation on 1 other computer
  - „remote calculation“ - *no specific license option required!*
    - other computer more powerful (RAM, no. of processors, CPU speed)
    - save resources of your ‘own’ computer for other tasks
First Setup - Configuration

**Computer** | **Frontend** | **Main Contr.** | **Solver Server**
--- | --- | --- | ---
PC Roland | | | 
PC Franz | | | 
PC Jens | | | 
PC Martin | | | ...

- CST STUDIO 2008 used for this first setup
- My own desktop computer used as „Main Controller“
- Any computer may be used as „Frontend“, i. e. it may send jobs into the Distributed Computing environment
- All computers can be used as Solver Servers
First Setup – Specific Challenges

◆ Availability:
  □ Ideally, Main Controller and Solver Servers should be available **at any time**
  □ But: Personalized desktop computers will typically be **switched off**
    when their owner is absent, will be **rebooted** from time to time, etc.
  □ Computers **switched off** in the late afternoon, disregarding running jobs ...

◆ Resources:
  □ Depending on his own computational workload, the owner of a PC
    may **accept**, or **not accept**, Solver Server jobs running on his computer

◆ Inhomogeneity:
  □ Typically, computers have different RAM, no. of processors, CPU speed, ...
  □ CST STUDIO 2008 seemed to distribute Solver Server jobs just randomly
    ○ a job may start on a machine with **insufficient memory – and crash!**
    ○ a time-consuming job may run on a relatively **slow computer**
Second Setup - Motivation

◆ Main difference:
  - Moving the Main Controller from ‘PC Roland’ to a separate notebook PC!
    (5 years old, 1 GByte RAM, no other tasks than ‘Main Controller’)

◆ Reasons:
  - **Availability!!!** (permanent availability is a prerequisite for user acceptance!)
    - no reboots during daytime work
    - not switched off during nighttime
  - Environmental
    - power consumption
    - heat dissipation
    - acoustic noise
  - Main Controller is now totally independent from day-by-day computer work
## Second Setup - Configuration

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<tr>
<td>PC Roland</td>
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<td>PC Franz</td>
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<td>PC Martin</td>
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<td>PC Rainer</td>
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- CST STUDIO 2009 *(and later CST STUDIO 2010)* used for second setup
- 2 Solver Servers on the most powerful *(2 processors x 2 cores)* machines
- Only one „thread“ per Solver Server
  *(mainly Eigenmode JDM and „Resonant“ solver – these calculations use just 1 core)*
Second Setup – Improvements in CST STUDIO 2009

- Improved functionality of Main Controller ‘use’ flags
- Introducing ‘priorities’ for Solver Servers

- Improved Main Controller ‘remote connection’ functionality
- Automatic refresh of Main Controller window

- Warning messages added for certain - potentially destructive - user interactions
Second Setup – Status of ‘Specific Challenges’

◆ Availability:
  - Main Controller on **notebook PC** now **running 7 days, 24 hours**
  - As soon as a desktop PC (**frontend**) is switched on, at least one Solver Server (**on this computer**) will be available

◆ Resources:
  - Main Controller **´use´ flags** accessible to (de)activate Solver Servers
    - by every user (Main Controller **remote connection** – use some discipline!)
    - a running job will not be stopped, but no new job will be accepted

◆ Inhomogeneity:
  - Highest **Priority** („1“ is highest!) for fastest computers
  - Two Solver Servers on **dual-processor-dual-core** machines
    (can be activated / deactivated separately by the **´use´ flag**)
  - Only computers with a certain minimum RAM (2 GByte ... 4 GByte) to be used as Solver Servers
Distributed Computing – Open Issues (as of CST STUDIO 2009)

◆ **Instabilities:**
  e.g. after stopping a distributed optimization by user, sometimes a Solver Server remains blocked

◆ **Missing functionality** for Distributed Computing, e.g.:
  □ Information during optimization runs (*goal and parameter values*)
  □ Creating Touchstone files via Result Templates ...

◆ Other minor or ‘cosmetic’ bugs
New license mechanism ("Token"): 

Some improvements, e.g.: 
- Information during distributed optimization 
- Refresh behaviour of Main Controller window 

More stability (to be observed further...)
Distributed Computing – Other Issues (general)

◆ Which computers to be used as Solver Servers?
  - Use all available computers (*all computers with some minimum RAM*):
    + all jobs will start as soon as possible,
    - but some jobs will run on ‘slow’ machines
  - Use just the most powerful computers:
    - execution of some jobs will have to wait,
    + but when started, all jobs will run on fast machines!

◆ Main Controller:
  - Avoid automatic restarts (*e.g. after security updates*)
  - Prevent Main Controller from going to standby / closing down
    network connections (*energy settings ...*)

◆ Access rights: A non-administrator doing some kind of computer administration ...
Distributed Computing - Conclusion

- CST Distributed Computing makes sense in a workgroup environment, even if no additional ´calculation only´ computers are available.

- Permanent availability (especially of the Main Controller) is a prerequisite for the user acceptance of Distributed Computing.

- Ensure good communication, when sharing PCs for Distributed Computing.

- „Remote Calculation“ (moving just one calculation to another, more powerful computer) is often a more important application of ´Distributed Computing´ than doing a real distribution of $n$ parallel calculations on $n$ computers.

- Use a CST LAN (floating) license, if you want to run Distributed Computing – using a node-locked (´dongle´) license, though possible, really ain´t fun!

- Distributed Computing improvements CST 2008 $\rightarrow$ CST 2009 $\rightarrow$ CST 2010.