

Using CST Microwave Studio Distributed Computing in a Workgroup Environment

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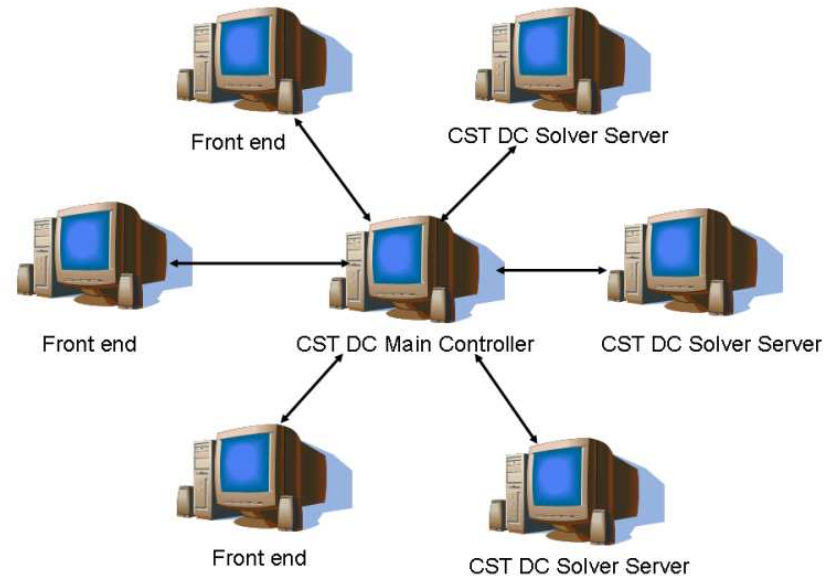
Distributed Computing - Overview

- ◆ 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)

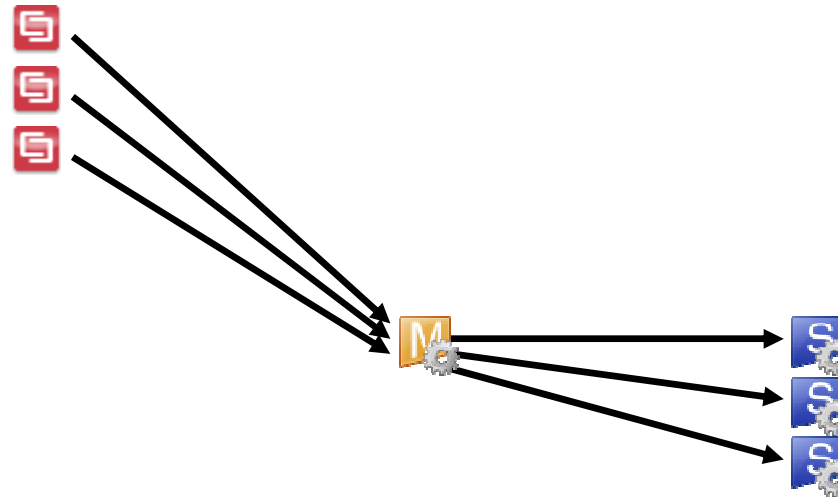
In both cases, the Solver Servers will run on ‘calculation only’ computers!

Introduction: Workgroup with 'calculation only' computers

Computer **Frontend** **Main Contr.** **Solver Server**

Desktop #1
Desktop #2
Desktop #3
...

'Calc only' #1
'Calc only' #2
'Calc only' #3
...



- ◆ 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

Computer

Frontend

Main Contr.

Solver Server

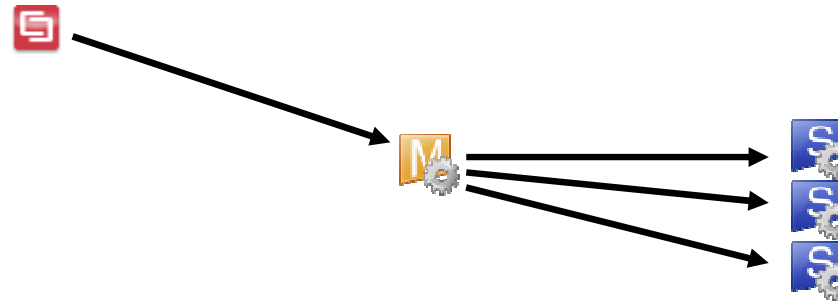
Desktop

'Calc only' #1

'Calc only' #2

'Calc only' #3

...



- ◆ **Main Controller** preferably on one of the 'calculation only' computers ...

First Setup - Motivation

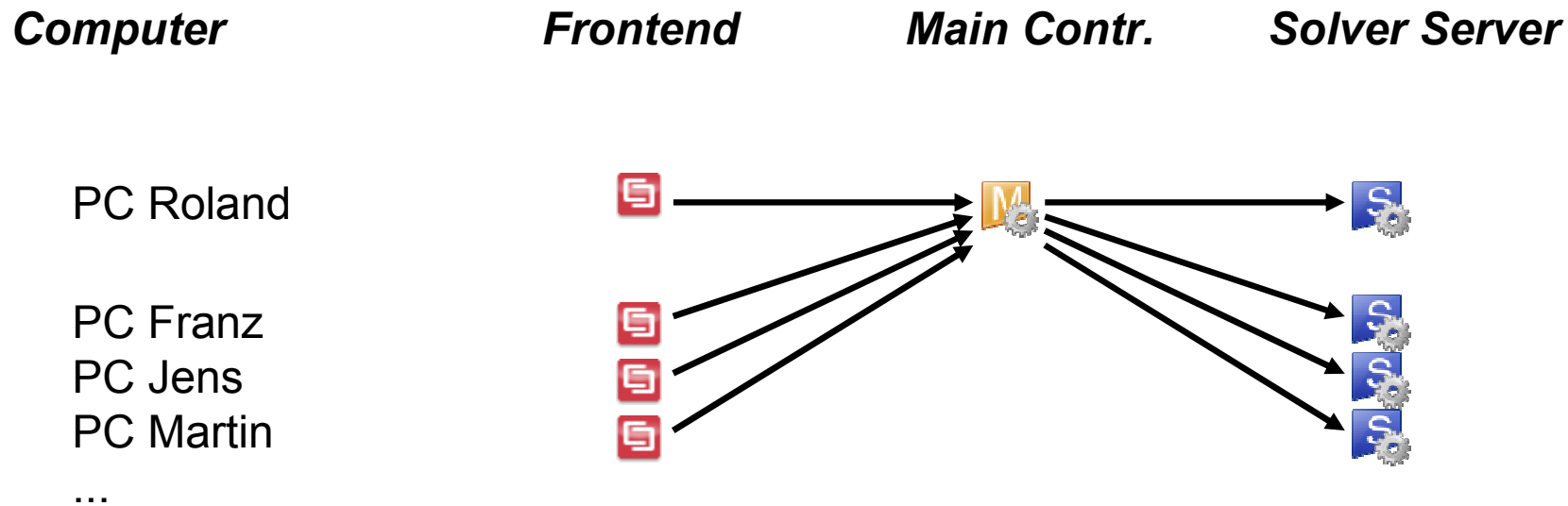
Development workgroup, each engineer has his own desktop computer, but no additional 'calculation only' computers are available!

→ 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



- ◆ 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:

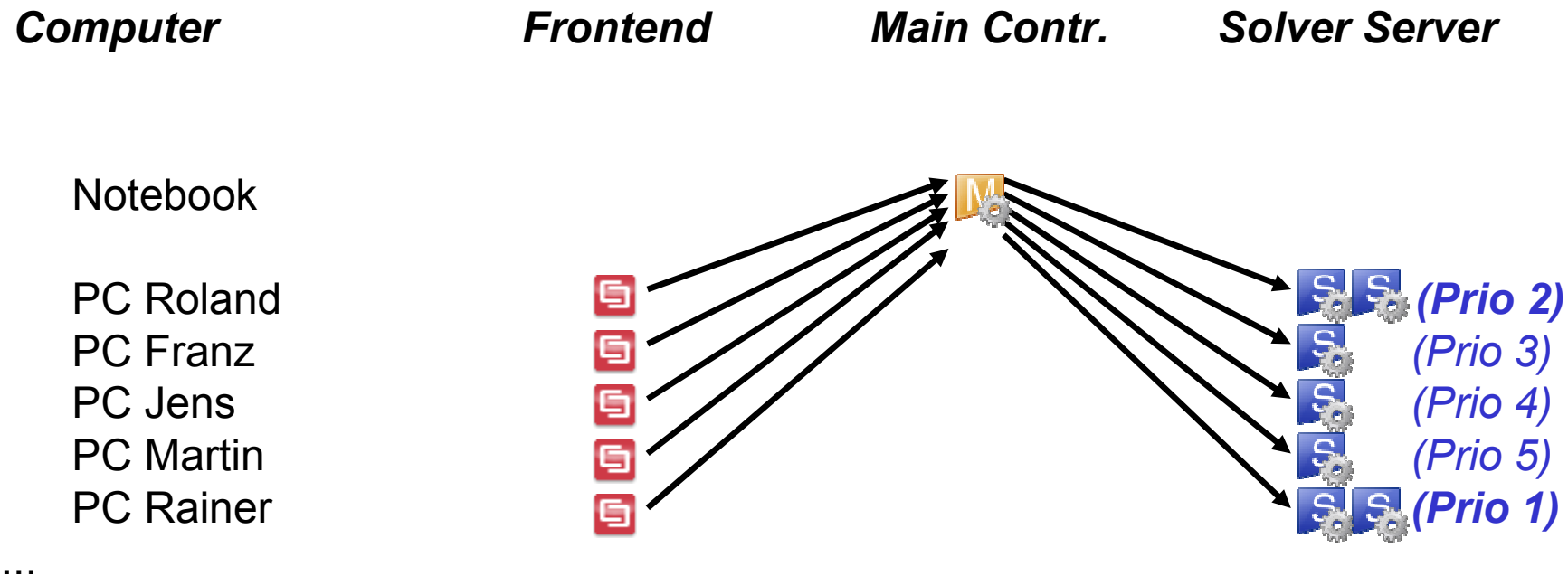
- Moving the Main Controller from 'PC Roland' to a separate notebook PC!
(5 years old, 1 GByte RAM, no other tasks than 'Main Controller')

◆ 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



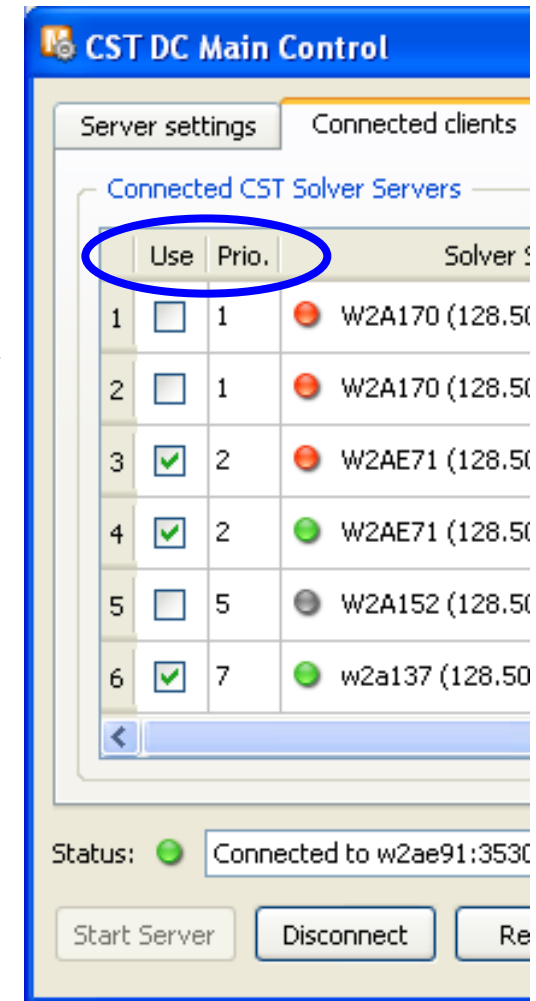
Second Setup - Configuration



- ◆ 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

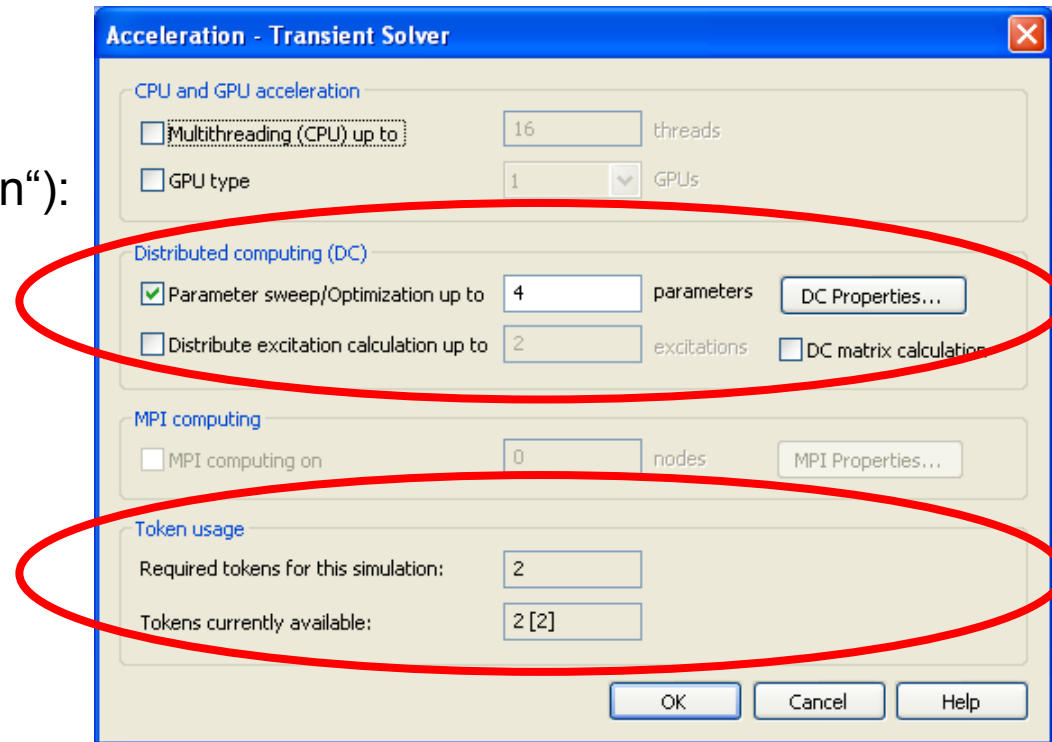
- ◆ **Missing functionality** for Distributed Computing, e.g.:

- Information during optimization runs (*goal and parameter values*)
 - Creating Touchstone files via Result Templates ...

- ◆ Other minor or 'cosmetic' bugs

Distributed Computing – Changes / Improvements in CST 2010

◆ 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 → CST 2009 → CST 2010