Going to Grid?

(run everywhere, is it a reality?)

Amedeo Volato Scuotto

Overview

- Introduction
- Texas Instruments
- Computing clusters at TI
- Grid status
- Run everywhere

TI Overview

Revenues in 2003

$B by segment

Semiconductors	$8.3
Materials & Controls	$1.0
Educational & Productivity Solutions	$0.5
Total	$9.8

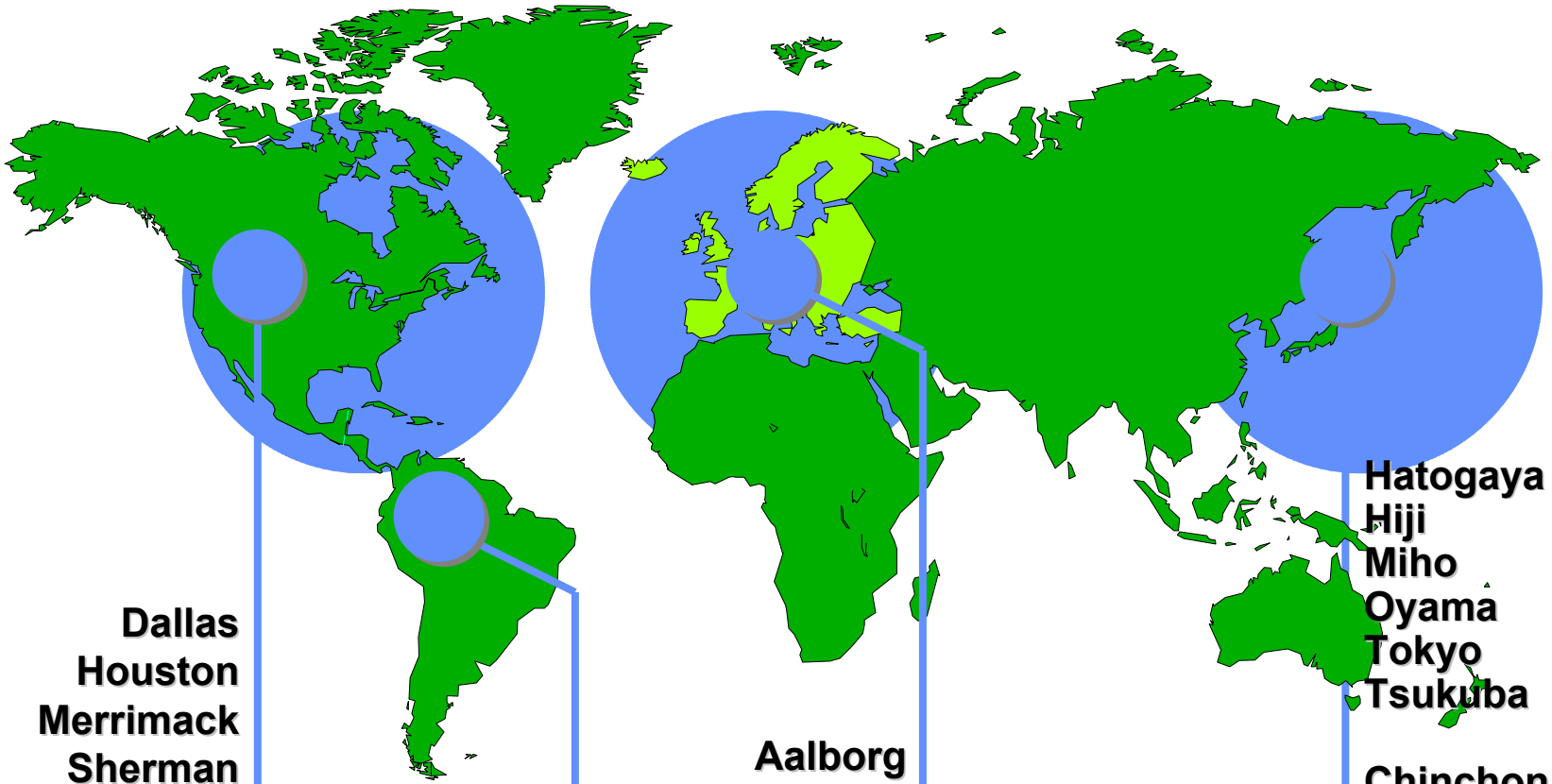
Facilities

- Facilities or sales offices in 25 countries
- 14 manufacturing plants

Employment (Apr 04)

Americas	20,400
Asia	8,700
Europe	3,100
Germany	1,300
France	932
UK	150
Other Europe	718
Japan	2,700
Total Worldwide	34,900

TI in the World



Dallas
Houston
Merrimack
Sherman
Attleboro
Santa Cruz
San Diego
Tustin
Versailles
…

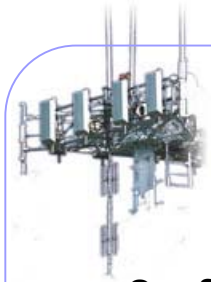
Aquascalientes
Campinas

Aalborg
Almelo
Freising
Nice
Northampton
Tel Aviv
…

Hatogaya
Hiji
Miho
Oyama
Tokyo
Tsukuba

Chinchon
Baoying
Chung Ho
Taipei
Baguio
Kuala Lumpur
Bangalore

TI Wireless Technology



Wireless Infrastructure

8 of top 10
3G transceiver customers

4 of top 6
Japanese wireless OEMs choose OMAP for 3G

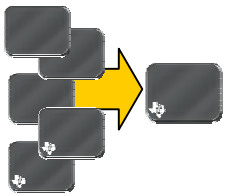
7 of top 10
Worldwide OEMs choose TI wireless technology

#1 in wireless semiconductors in 2002
Source: EMC

#2 in wireless LAN in 2002
Source: Forward Concepts

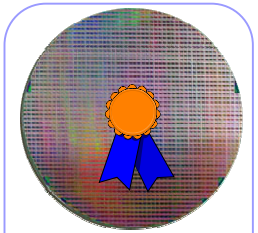
TI has shipped over
1 Billion
cellular digital baseband processors for wireless handsets

Customers Choose TI Wireless



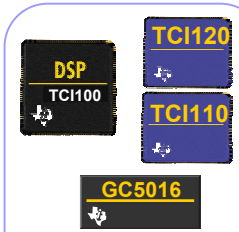
Single chip cell phone by 2004

BRF6100 single-chip Bluetooth



1st to ship 90nm cellular digital baseband

Single-chip 802.11 a/b/g MAC/PHY



Wireless Infrastructure UMTS chipset

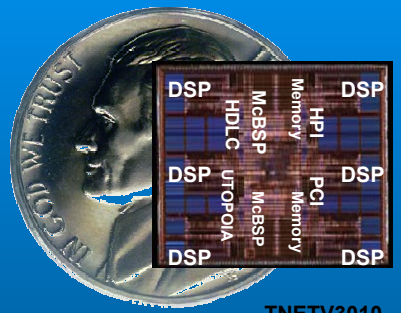
New UMTS and GPRS Terminal chipsets

Five New OMAP processors

TI Continues Technology Leadership

System Integration Expands Possibilities

High-Density VoIP Gateway



TNETV3010

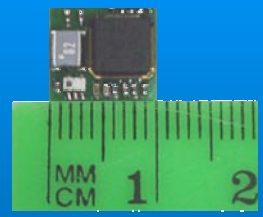
- 6 DSP Cores
- 24Mbit SRAM
- 180M Transistors

Single-Chip DSL Modem

AR7

- Comms Processor
- Digital PHY
- Analog Codec
- Line Driver
- Line Receiver

Single-Chip Bluetooth



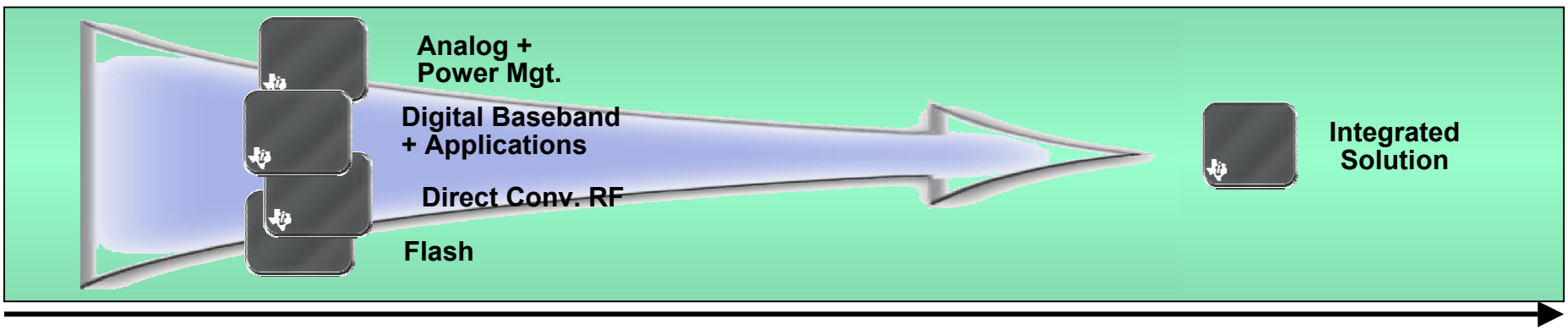
BRF6100

- Digital RF
- Digital Baseband
- Memory
- Power Mgt.

Complete Smartphone Reference Design

TCS2600

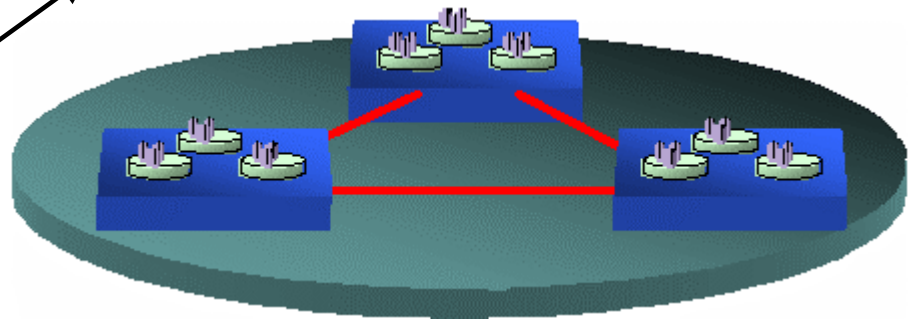
- Digital Baseband
- Analog Baseband
- Direct Conversion RF
- OMAP™ Apps Proc
- Bluetooth



Computing Challenges in Microelectronics

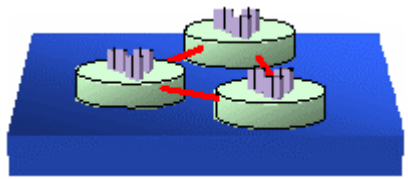
- Compute intensive applications
- Escalating resource demands
- Increasing product complexity
- Overwhelming number of different applications
- Integration into well defined workflows
- Limit usage of expensive resources
- Engineering productivity
- Design cycles shorten
- Improve time to market and reduce costs
- Maximize efficiency of HW and SW
- Poor parallelism of Electronic Design Applications (EDA)

Computing evolution



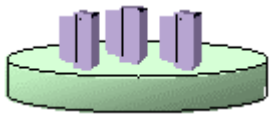
Global Grid

Middleware++



Enterprise Grids

Middleware



Clusters and
Departmental Grid

Increased complexity
- **Heterogeneous platforms**
- **Different domains**
- **Varying security policies**
- **Rights to run**

Desktops and servers
cycles aggregation

1999 2002 2004

Milestones for Grid Technology at TI

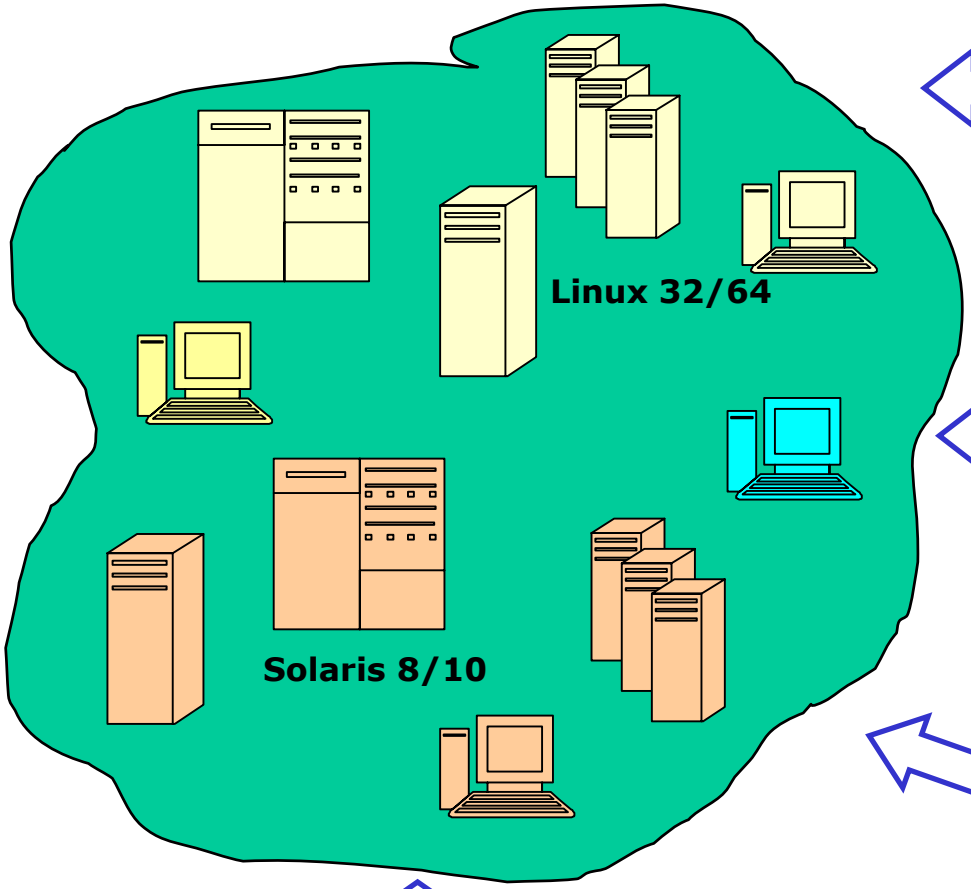
- 1998 EDA support team started introducing Load Sharing Facility (LSF) in Dallas
- 1999 IT uses LSF in major sites at department level
- 2000 IT DS define the WW computing roadmap
  - All servers and powerful desktops aggregate in clusters
  - Clusters interconnection
  - Merge all clusters at site level
  - Reporting system

Grid level 1

- 2001 The thin clients required a model revision
  - No more desktops in the clusters
  - Environment standardization
- Dramatic increase in resource usage during the last years
- 2003 Reporting and capacity planning
- 2004 Enterprise Grid

Grid level 2

Grid scenario is complex



Jobs resources requirements
- OS and architecture
- Ram and storage
- Tools and their location
- Licenses

Authentication and security
- proxies
- firewalls
- license servers

Clusters configurations
- resources
- monitoring
- …

Usage profile
- 7x24 for batch
- 5x24 for interactive
- interactive queue time = designers waste time

Grid Level 2 limits

- A project uses tens of tools and hundreds GB of data
- The global efficiency (HW, licenses, wan, storage) is not optimized. Example of run:
  - Input 300 GB (data and applications)
  - 700 jobs x 3GB output files over night
- The WAN introduce latency and increase costs ($)
- The data and power proximity seems a must to have

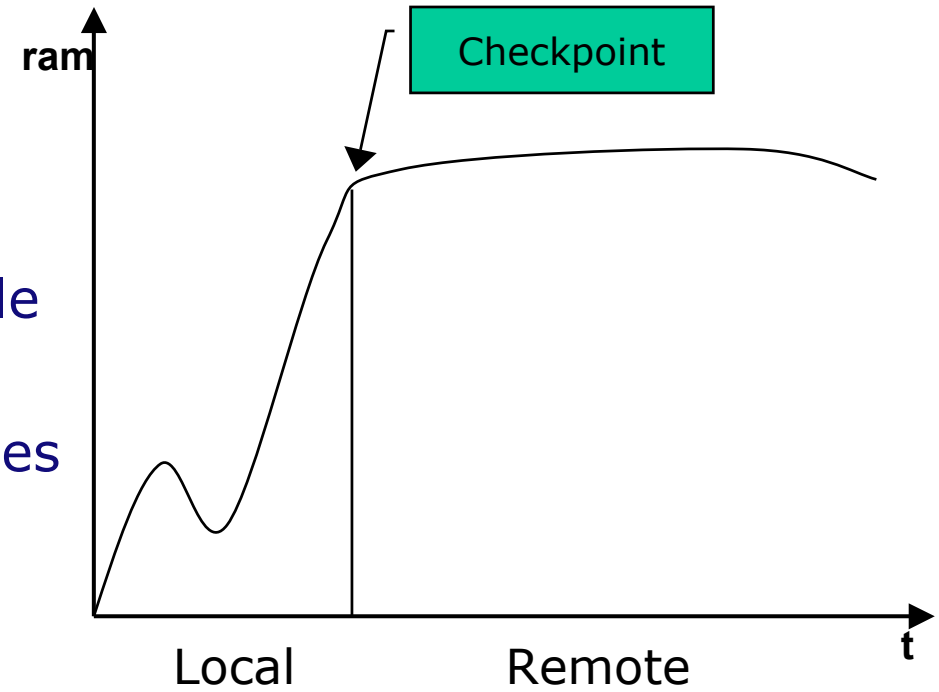
- Regional model
  - Clusters concentration
  - CDOE (Common Design Operating Environment)
  - Environments duplication and synchronization
  - move screens over WAN

$$T_f = \frac{\sum_{j=1}^{J} t_{run_j} \frac{C_{run_j}}{C_{best}}}{\sum_{j=1}^{J} t_{run_j}}$$

T_f = token effectiveness factor
t_{run} = run time per job
C_{best} = fastest resource factor
C_{run} = actual used resource factor
j = individual compute job
J = number of job

Grid Level 3

- Run everywhere within and outside TI
  - Use all TI clusters
  - Computing on demand
  - Computing power exchange with research centers
- Like electrical power
- The run bullet
  - Secure
  - Self contained
  - Result time predictable
  - Efficient
  - A certificate for licenses



Q&A

Some Grid Computing definitions

- Grid Computing: A form of networking. Unlike conventional networks that focus on communication among devices, grid computing harnesses unused processing cycles of all computers in a network for solving problems too intensive for any stand-alone machine. A well-known grid computing project is the SETI (Search for Extraterrestrial Intelligence) @Home project
- **Grid computing** offers a model for solving massive computational problems using large numbers of computers arranged as clusters embedded in a distributed telecommunications infrastructure. Grid computing's focus on the ability to support computation across administrative domains sets it apart from traditional distributed computing. Grid computing has the design goal of solving problems too big for any single supercomputer, whilst retaining the flexibility to work on multiple smaller problems. Thus grid computing provides a multi-user environment.