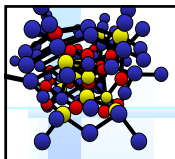

Sistemi Distribuiti
Corso di Laurea in Ingegneria

Prof. Paolo Nesi

Parte 5: Sistemi GRID e Architetture Parallele

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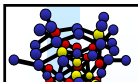


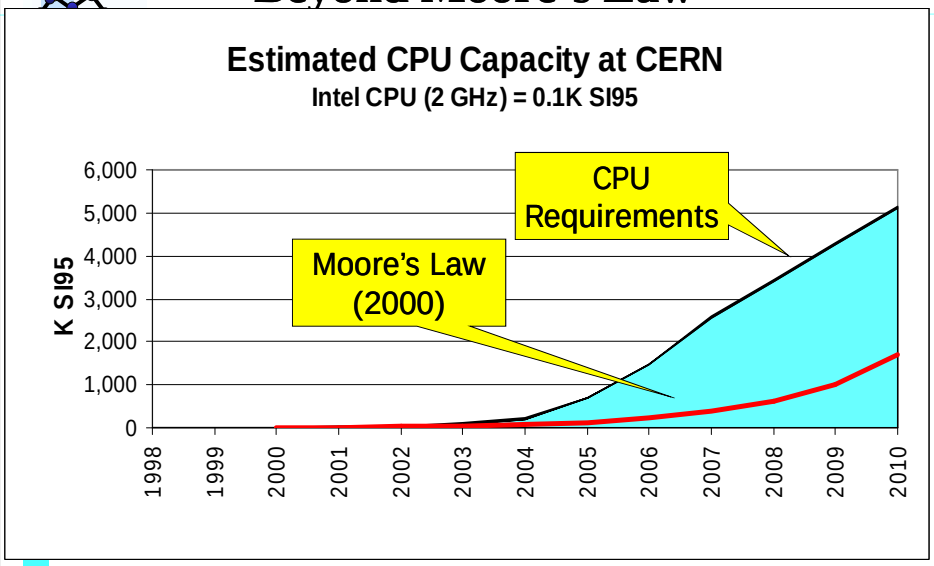
Il Contesto Tecnologico

Crescita delle risorse

- Il numero di transistor raddoppia ogni 18 mesi (Legge di Moore)
- La velocità dei computer raddoppia ogni 18 mesi
- La densità di memoria raddoppia ogni 12 mesi
- La velocità della rete raddoppia ogni 9 mesi

Differenza = un ordine di grandezza ogni 5 anni

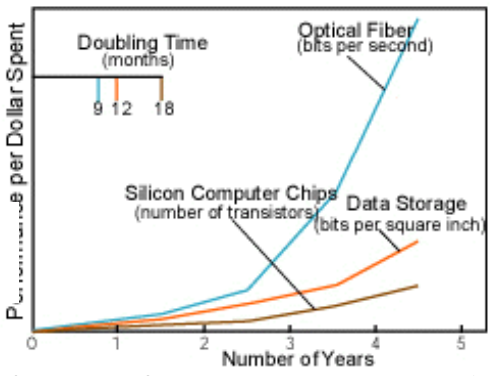
Beyond Moore's Law



Network Exponentials

- Network vs. computer performance
  - Computer speed doubles every 18 months
  - Network speed doubles every 9 months
  - Difference = one order of magnitude every 5 years
- 1986 to 2000
  - Computers: x 500
  - Networks: x 340,000
- 2001 to 2010
  - Computers: x 60

Moore's Law vs. storage improvements vs. optical improvements. *Graph from* ***Scientific American*** *(Jan-2001) by Cleo Vilett, source Vined Khoslan, Kleiner, Caufield and Perkins.*



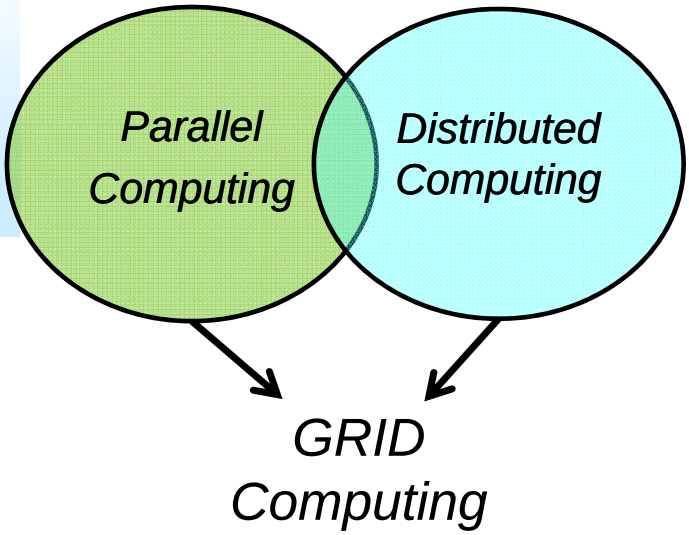
Frieda's Application …

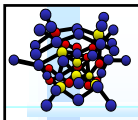
Simulate the behavior of **F**(*x,y,z*) for 20 values of *x*, 10 values of *y* and 3 values of *z* (20*10*3 = 600 combinations)

- **F** takes on the average 6 hours to compute on a "typical" workstation (total = 3600 hours)
- **F** requires a "moderate" (128MB) amount of memory
- **F** performs "moderate" I/O - (*x,y,z*) is 5 MB and **F**(*x,y,z*) is 50 MB

Non posso aspettare 3600 ore

Grid vs Distributed and Parallel





sommario

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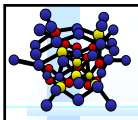
- Soluzioni GRID...Globus, Condor
- Soluzioni MicroGRID: AXCP grid
- Confronto fra GRID
- Applicazioni per microGRID

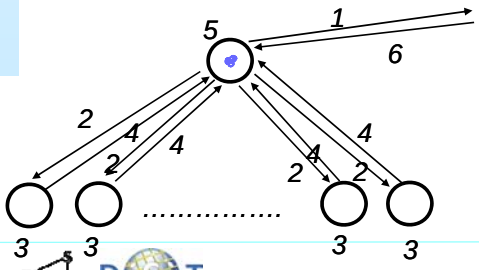
Architetture Parallele

- La definizione di un'architettura ottima in termini di processi paralleli per il calcolo scientifico dipende dal problema

- Vi sono problemi
  - intrinsecamente sequenziali
  - Lineari vettoriali
  - Multidimensionali vettoriali
  - Paralleli nei dati di ingresso
  - Paralleli nei dai di uscita
  - Paralleli nei servizi
  - Paralleli nella procedura
  - Etc..


Esempio di caso Lineare

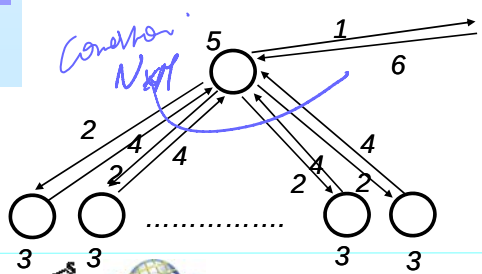
- VettC = VettA + VettB
- In modo sequenziale il Costo e' o(N), in parallelo il costo e' 1
- Soluzione parallela:
  - N nodi
  - Un concentratore per raccolta dati
  - Comunicazione fra nodi: assente
  - Comunicazione con il nodo concentratore



1. *Passa A e B*
2. *Passa Ai, Bi*
3. *Calcola Ai+Bi*
4. *Passa Ci*
5. *Metti insieme C*
6. *Passa C*

Esempio di caso 2D, (..nD)

- MatC = MatA + MatB
- In modo sequenziale il Costo e' o(NM), in parallelo il costo e' 1
- Soluzione parallela:
  - N*M nodi
  - Un concentratore per raccolta dati
  - Comunicazione fra nodi: assente
  - Comunicazione con il nodo concentratore

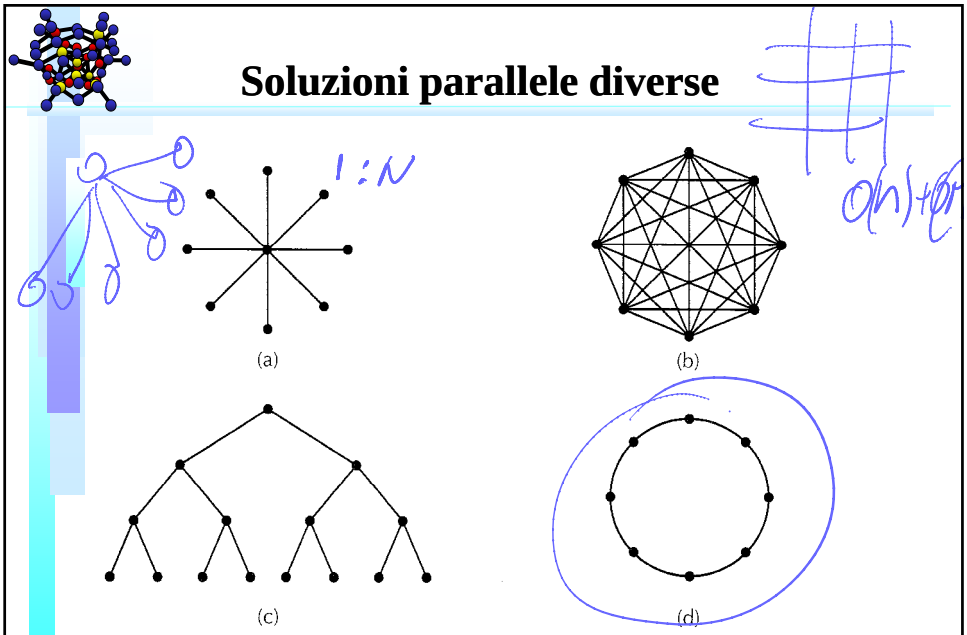


1. *Passa A e B*
2. *Passa Aij, Bij*
3. *Calcola Aij+Bij*
4. *Passa Cij*
5. *Metti insieme C*
6. *Passa C*

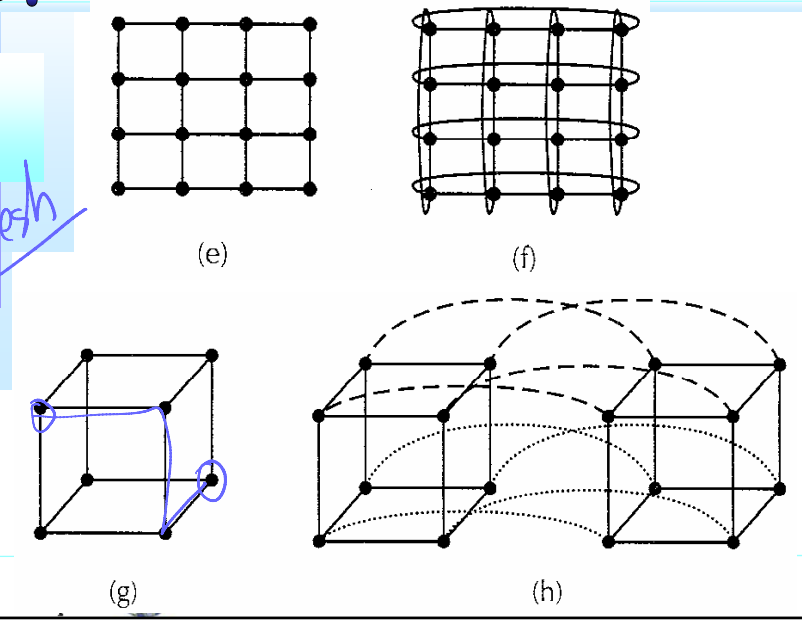
Comunicazione fra processi

- In alcuni casi vi e' la necessita' di effettuare connessioni/comunicazioni dirette fra modi dell'architettura parallela
- Se queste comunicazioni sono in parallelo si risparmia tempo rispetto a farle convergere e gestire tutte da un nodo centrale come in molti GRID
- In un GRID
  - Il GRID deve permettere di mappare in modo logico una architettura qualsiasi sul'architettura fisica del GRID
  - I nodi devono comunicare chiamandosi in modo logico e non fisico
  - Identificazione dei nodi.

Soluzioni parallele diverse



Soluzioni parallele diverse



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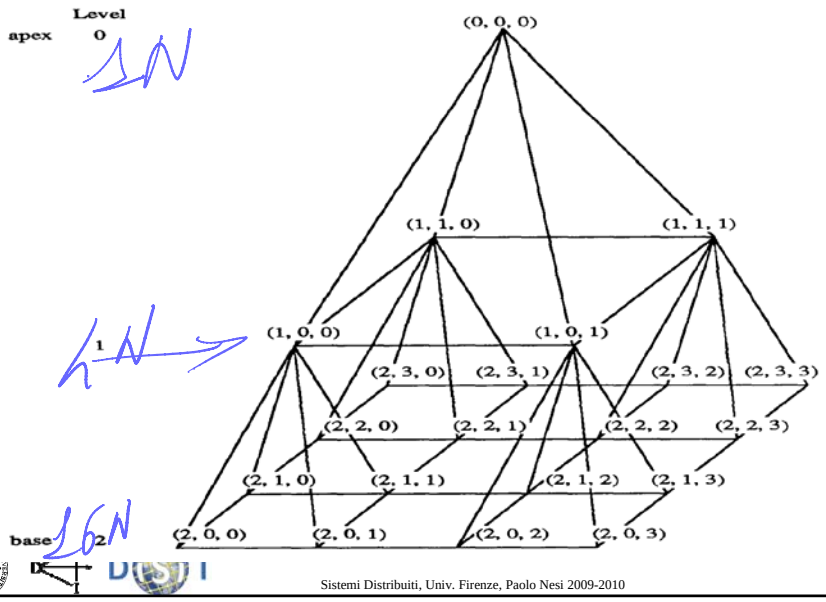
Piramide detta anche grid



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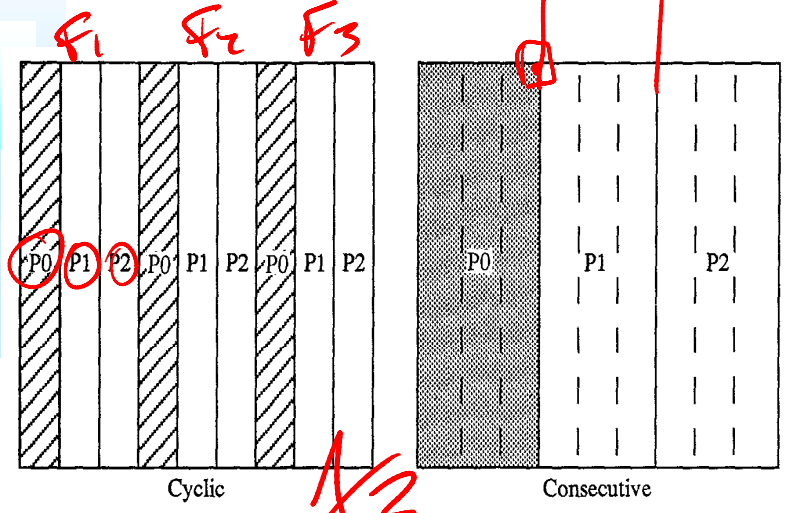
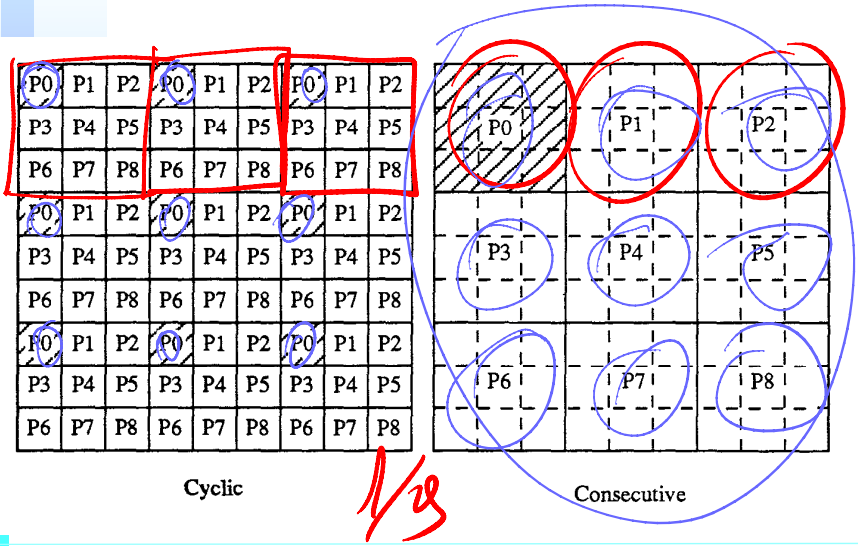
3 P in forma ciclica o consecutiva

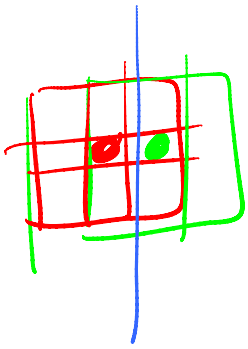


8 P in forma ciclica o consecutiva

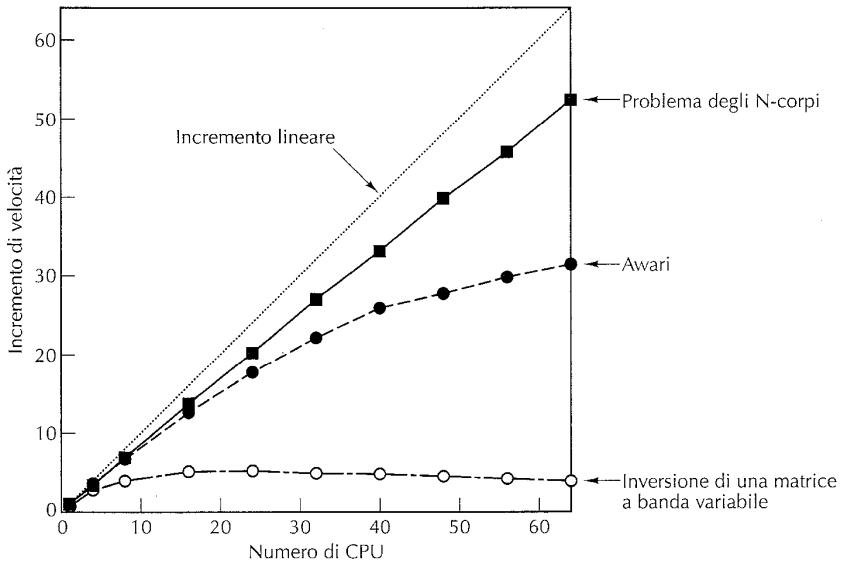


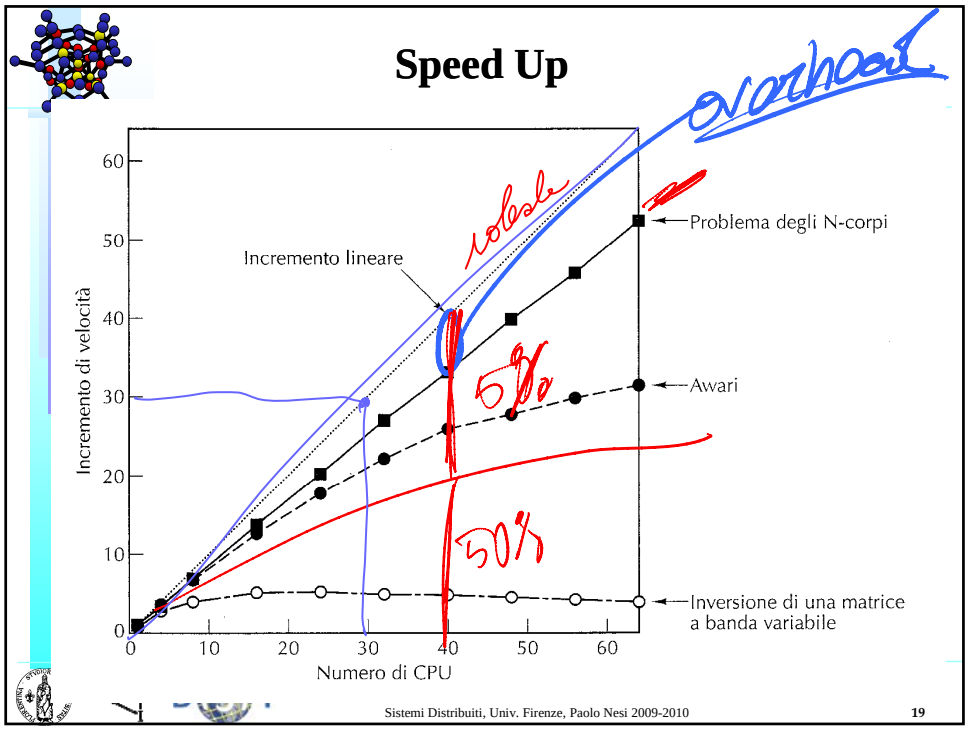
Comunicazioni fra processi

- **Comunicazione fra processi** per congiungere dati parziali
  - Spesso necessarie per processi iterativi
  - Soluzioni di equazioni alle derivate parziali
  - Soluzioni agli elementi finiti
  - Inversioni di matrici a blocchi
- **Condizioni al contorno**
  - Soluzioni di equazioni alle derivate parziali
  - Soluzioni agli elementi finiti
- **Integrazione del calcolo**
  - Equazioni differenziali alle derivate parziali
  - Calcolo di Flussi
  - Calcolo per antenne



Speed Up




Speed Up
Incremento di velocità
Numero di CPU
Incremento lineare
Problema degli N-corpi
Awari
Inversione di una matrice
a banda variabile
0
10
20
30
40
50
60
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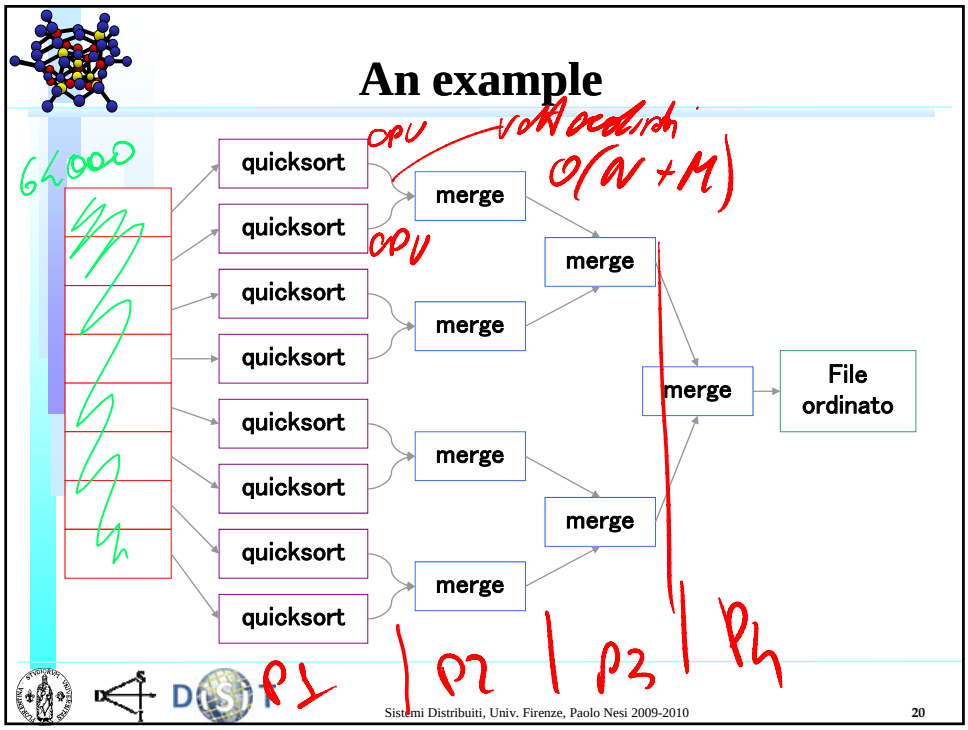
An example
quicksort
merge
File ordinato
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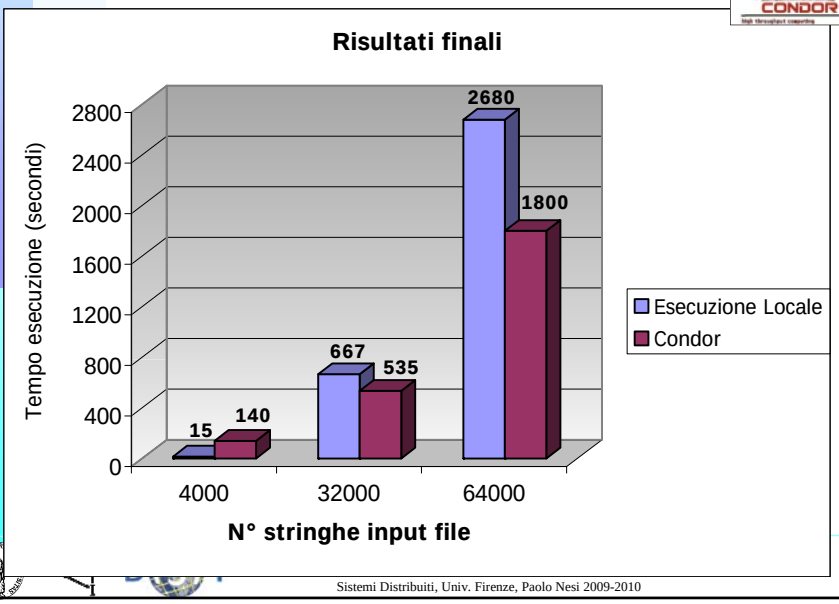
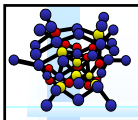
Un Esperimento CONDOR at DISIT



Scelte che hanno condizionato il risultato

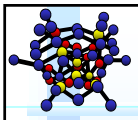
- Non si e' utilizzato un merge sort dall'inizio perche' non e' efficiente visto che inviare due valori ad un nodo per sapere quale dei due e' maggiore costa di piu' che farlo in locale
  - Andamento del costo locale e distribuito del merge, per decidere
- Si poteva utilizzare:
  - Algoritmi di ordinamento diversi
  - Una partizione diversa dei dati, non 8 processi ma per esempio 4, con due livelli e non 3
  - Questo poteva permettere di avere maggiori vantaggi in certe condizioni



Problemi

- **Parallelizzazione degli algoritmi**
  - Progettazione parallela
  - Non tutti I algoritmi si possono parallelizzare in modo facile e poco costoso..
  - Bilanciamento fra vantaggi e costi di comunicazione
  - Massimizzazione dello Speed Up:
    - Efficienza della soluzione parallela
- **Allocazione ottima dei processi sui peer:**
  - Capacità dei peer, che cambiano nel tempo
  - Costi di comunicazione che cambiano nel tempo
  - Problema di allocazione:
    - Genetic Algorithms, Taboo Search, etc.
- **Tolleranza ai fallimenti**
  - Ridondanza dei processi
  - Migrazione dei processi, salvataggio del contesto
- **Limitato controllo delle capacità dei peer**
- **Limitato controllo delle prestazioni rete… QoS….**





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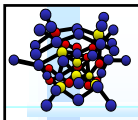
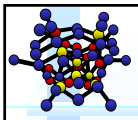


The GRID

- "the Grid" term coined in the mid 1990s to denote a distributed computing infrastructure for advanced science and engineering
- "Resource sharing & coordinated problem solving in dynamic, multi-institutional virtual organizations" (Ian Foster, Karl Kesselman)
- Un insieme di risorse computazionali, di dati e reti appartenenti a diversi domini amministrativi
- Fornisce informazioni circa lo stato delle sue componenti tramite Information Services attivi e distribuiti.
- Permette agli utenti certificati di accedere alle risorse tramite un'unica procedura di autenticazione
- Gestisce gli accessi concorrenti alle risorse (compresi i fault)
  - No single point of failure

Per essere un GRID

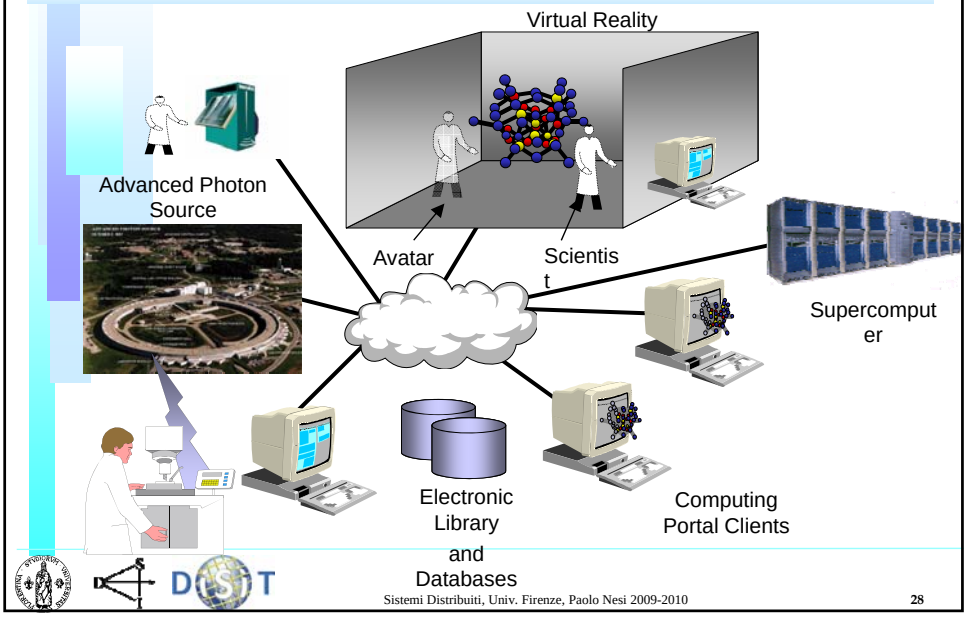
- coordina risorse e fornisce meccanismi di sicurezza, policy, membership…
- Usa protocolli ed interfacce standard, open e general-purpose.
- permette l'utilizzo delle sue risorse con diversi livelli di Qualities of Service (tempo di risposta, throughput, availability, sicurezza…).
- L'utilità del sistema (middle tier) e molto maggiore a quella della somma delle sue parti nel supporto alle necessità dell'utente.


Scienze Data Intensive

- Fisica nucleare e delle alte energie
  - Nuovi esperimenti del CERN
- Ricerca onde gravitazionali
  - LIGO, GEO, VIRGO
- Analisi di serie temporali di dati 3D (simulazione, osservazione)
  - Earth Observation, Studio del clima
  - Geofisica, Previsione dei terremoti
  - Fluido, Aerodinamica
  - Diffusione inquinanti
- Astronomia: Digital sky surveys

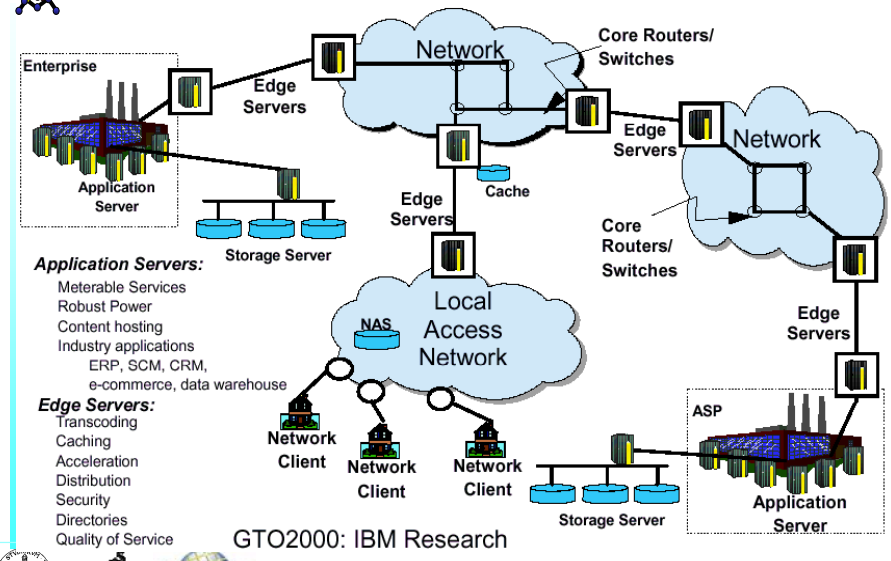
Supercomputer-Enhanced Instrumentation

Source: Globus 2002 Tutorial



Distribution of Servers in Enterprise Computing

Source: IBM, Global Grid Forum 4, 2002



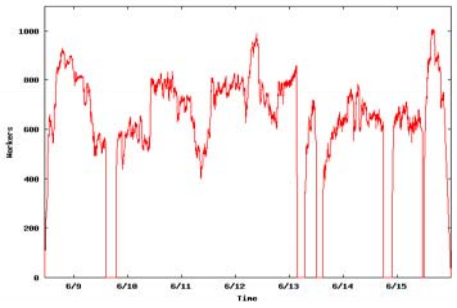
Home Computers Evaluate AIDS Drugs

- Community =
  - 1000s of home computer users
  - Philanthropic computing vendor (Entropia)
  - Research group (Scripps)
- Common goal= advance AIDS research

Mathematicians Solve NUG30

- Looking for the solution to the NUG30 quadratic assignment problem
- An informal collaboration of mathematicians and computer scientists
- Condor-G delivered 3.46E8 CPU seconds in 7 days (peak 1009 processors) in U.S. and Italy (8 sites)

  - *MetaNEOS: Argonne, Iowa, Northwestern, Wisconsin*

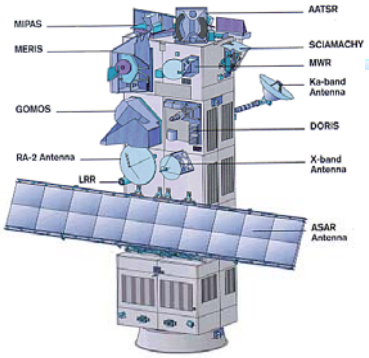


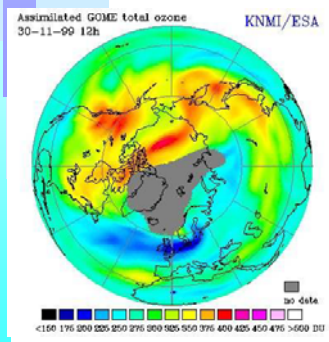
- *14,5,28,24,1,3,16,15,*
- *10,9,21,2,4,29,25,22,*
- *13,26,17,30,6,20,19,*
- *8,18,7,27,12,11,23*

Earth Observation

ESA missions:

- about 100 Gbytes of data per day (ERS 1/2)
- 500 Gbytes, for the next ENVISAT mission (2002).



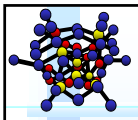


DataGrid contribute to EO:

- enhance the ability to access high level products
- allow reprocessing of large historical archives
- improve Earth science complex applications (data fusion, data mining, modelling …)

Source: L. Fusco, June 2001

Federico.Carminati , EU review presentation, 1 March 2002



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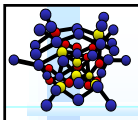
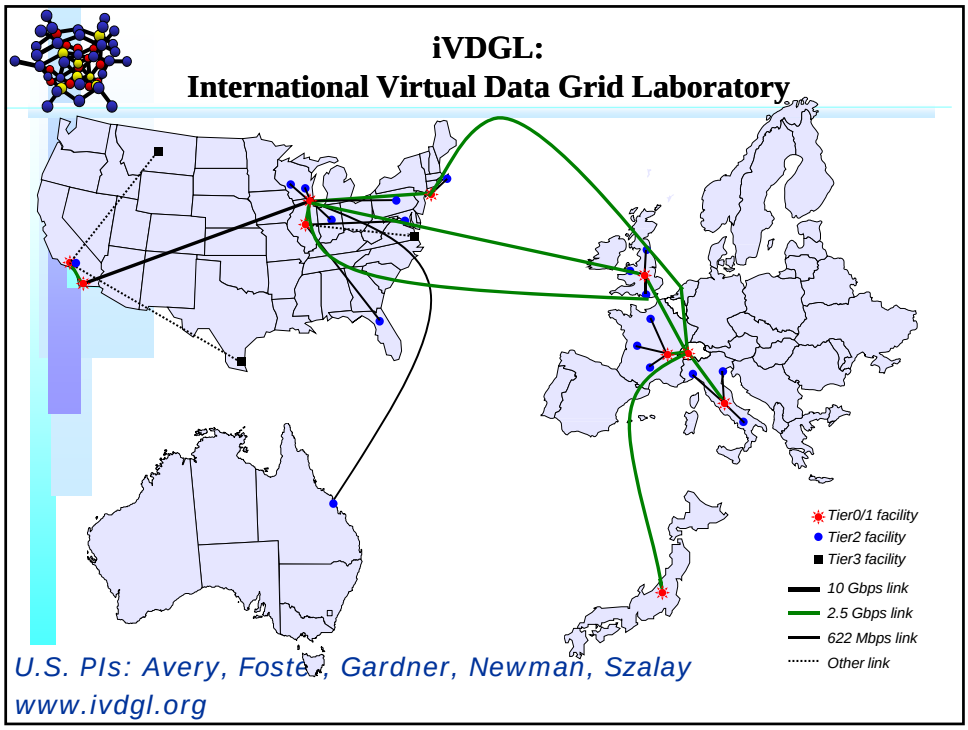
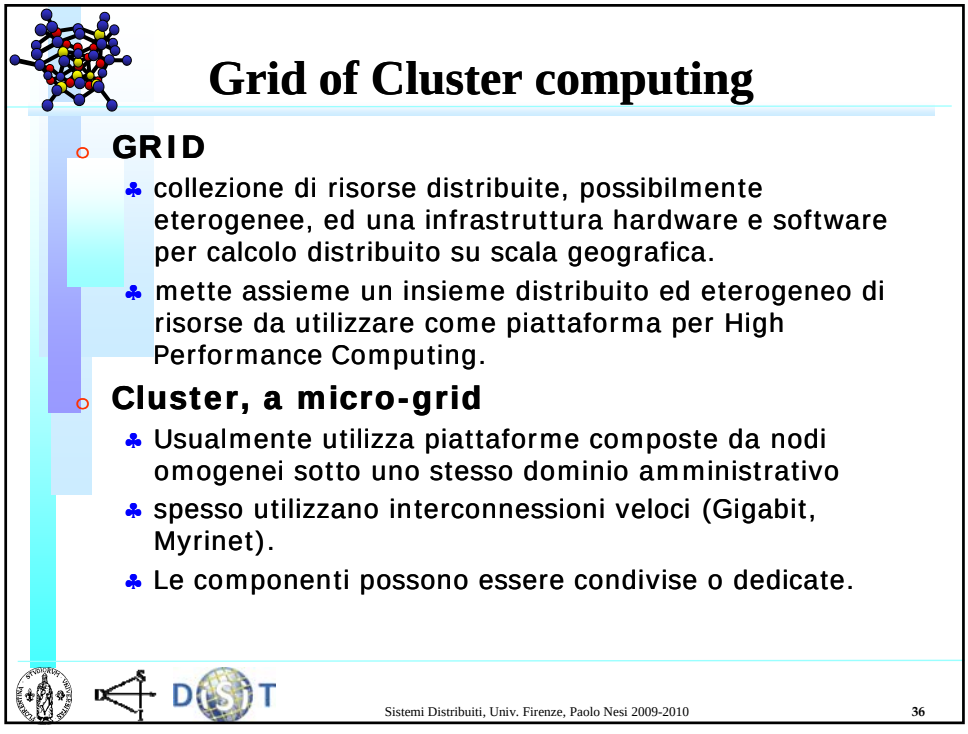


Concetti Estesi del GRID

- Virtual Organization (VO) è costituita da:
  - un insieme di individui o istituzioni
  - un insieme di risorse da condividere
  - un insieme di regole per la condivisione
- VO: utenti che condividono necessità e requisiti simili per l'accesso a risorse di calcolo e a dati distribuiti e perseguono obiettivi comuni.
- abilità di negoziare le modalità di condivisione delle risorse tra i componenti una VO (providers and consumers) ed il successivo utilizzo per i propri scopi. [I.Foster]


iVDGL:
International Virtual Data Grid Laboratory
Tier0/1 facility
Tier2 facility
Tier3 facility
10 Gbps link
2.5 Gbps link
622 Mbps link
Other link
U.S. PIs: Avery, Foster, Gardner, Newman, Szalay
www.ivdgl.org


Grid of Cluster computing
GRID
collezione di risorse distribuite, possibilmente eterogenee, ed una infrastruttura hardware e software per calcolo distribuito su scala geografica.
mette assieme un insieme distribuito ed eterogeneo di risorse da utilizzare come piattaforma per High Performance Computing.
Cluster, a micro-grid
Usualmente utilizza piattaforme composte da nodi omogenei sotto uno stesso dominio amministrativo
spesso utilizzano interconnessioni veloci (Gigabit, Myrinet).
Le componenti possono essere condivise o dedicate.
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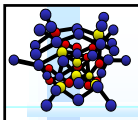
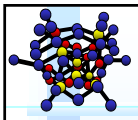


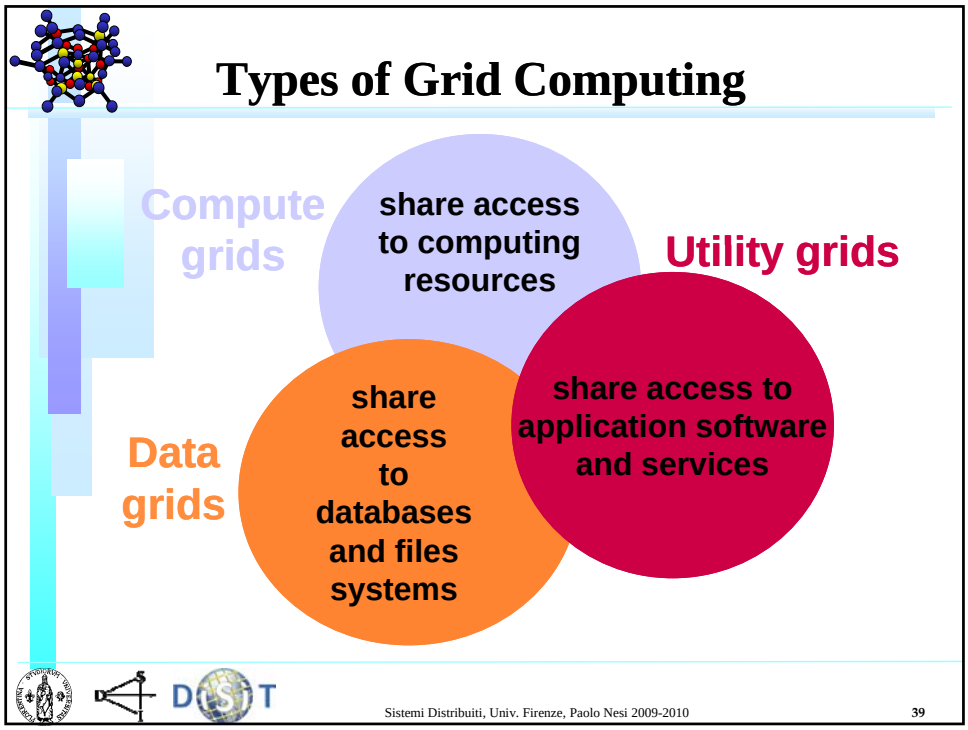
Applicazioni dei GRID

- Calcolo parallelo: sfruttamento di risorse distribuite a basso costo al posto di supercalcolatori
- Applicazioni di calcolo massivo:
  - Medicali
    - E.g.: From TAC to 3D real models
  - Profiling and personalization
  - Visione artificiale
    - E.g.: Composition/mosaicing of GIS images
  - Risoluzione delle license per DRM
  - Adattamento di risorse digitali, coversione di formato
  - Stima di fingerprint di risorse digitali
  - Generazione di descrittori di risorse digitali
  - Simulazione strutturali, fluidodinamica, deformazioni, finanziarie, servizi, etc.
  - Predizioni del tempo
  - Predizioni finaziarie

Alcuni dettagli

- Profiling and personalization
  - Profilo del cellulare, capabilities, preferenze utenti
  - Richiesta di contenuti, formati, img, doc, etc.
  - Milioni di utenti al secondo
- Visione artificiale
  - E.g.: Composition/mosaicing of GIS images
- Risoluzione delle license per DRM
  - Richieste di risoluzione delle license
- Adattamento di risorse digitali, coversione di formato
- Stima di fingerprint di risorse digitali
  - Riconoscimento delle tracce audio
- Generazione di descrittori di risorse digitali
  - Produzione di descrittori per inserirle in metadata, quando viene riprodotto un catalogo



Types of Grid Computing
Compute grids
share access to computing resources
Utility grids
share access to application software and services
Data grids
share access to databases and files systems
Sistemi Distribuiti, Univ. Firenze, Paolo Nesi 2009-2010
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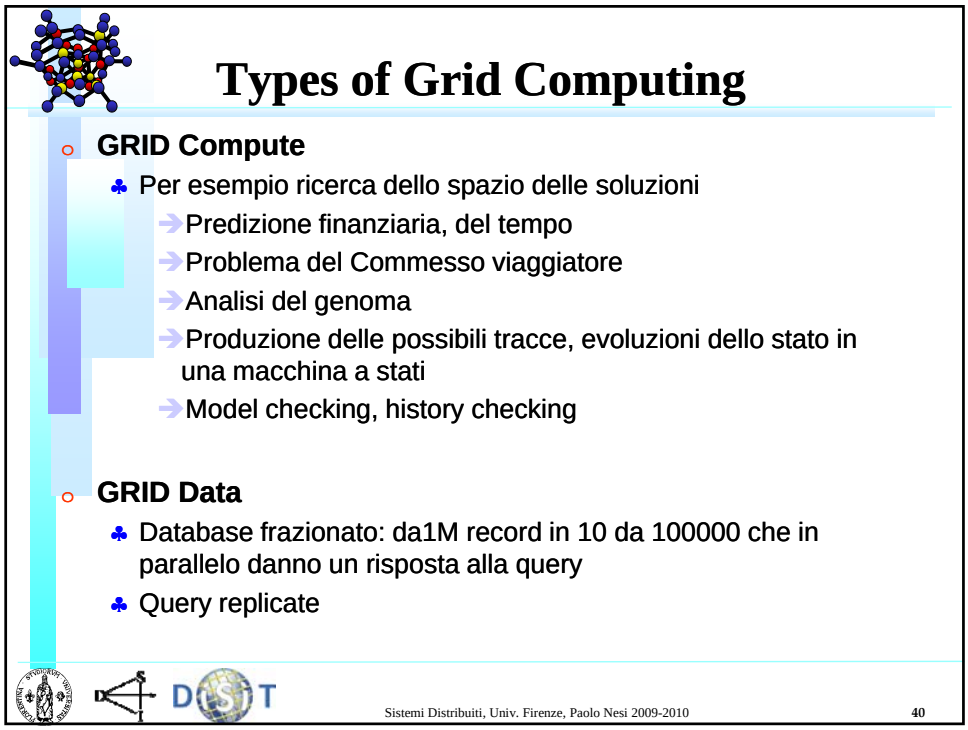
Types of Grid Computing
GRID Compute
Per esempio ricerca dello spazio delle soluzioni
Predizione finanziaria, del tempo
Problema del Commesso viaggiatore
Analisi del genoma
Produzione delle possibili tracce, evoluzioni dello stato in una macchina a stati
Model checking, history checking
GRID Data
Database frazionato: da1M record in 10 da 100000 che in parallelo danno un risposta alla query
Query replicate
Sistemi Distribuiti, Univ. Firenze, Paolo Nesi 2009-2010
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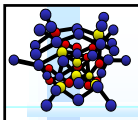
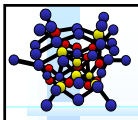


Types of Grid Computing

- **GRID Service**
  - Database replicato per dare un servizio a molte persone, il parallelismo e' sulle persone, sugli accessi al servizio.
    - Query diverse sullo stesso database
- I probemi reali in effetti integrano I vari aspetti producendo la necessita' di gestire GRID che hanno vari aspetti

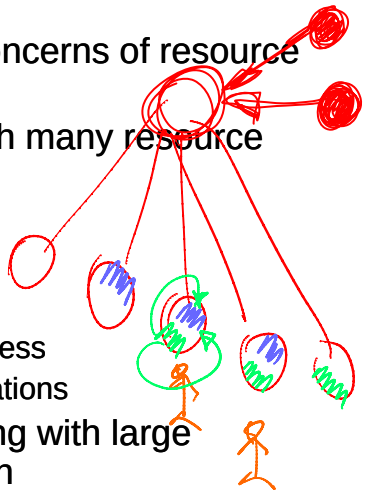



One View of Requirements

- Identity & authentication
- Authorization & policy
- Resource discovery
- Resource characterization
- Resource allocation, management
- (Co-)reservation, workflow
- Distributed algorithms
- Remote data access
- High-speed data transfer
- Performance guarantees
- Monitoring, se non misuri non controlli
- Security: intrusion detection
- Accounting: Grid cost
- Fault management
- Fault tolerance
  - Recovery from failure
- Grid System evolution
- Etc.
- …

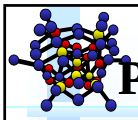

The Systems Problem: Resource Sharing Mechanisms That …

- Address security and policy concerns of resource owners and users
- Are flexible enough to deal with many resource types and sharing modalities
- Scale to
  - large number of resources,
  - many participant/users
  - many program components/process
  - On different nodes and configurations
- Operate efficiently when dealing with large amounts of data & computation



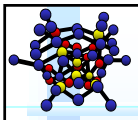
Aspects of the Systems Problem

1) interoperability when different groups want to share resources
   - Diverse components, policies, mechanisms
   - E.g., standard notions of identity, means of communication, resource descriptions
2) shared infrastructure services to avoid repeated development, installation
   - E.g., one port/service/protocol for remote access to computing, not one per tool/application
   - E.g., Certificate Authorities: expensive to run
- A common need for protocols & services



Programming & Systems Problems

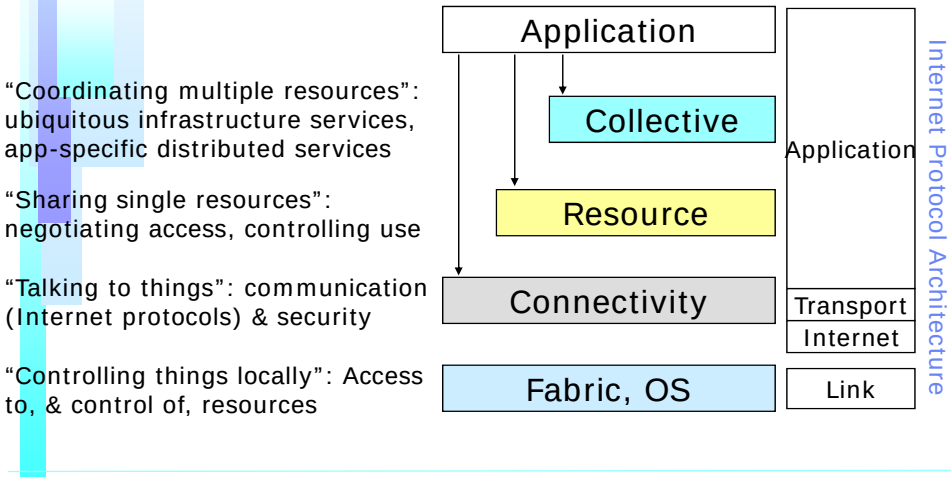
- The programming problem
  - ♣ Facilitate development of sophisticated applications
  - ♣ Facilitate code sharing among nodes
  - ♣ Requires programming environments
    - ➔ APIs, SDKs, tools, distributed debug
- The systems problem
  - ♣ Facilitate coordinated use of diverse resources
    - ➔ Smart allocation, profiling, capabilities
  - ♣ Facilitate infrastructure sharing
    - ➔ e.g., certificate authorities, information services
  - ♣ Requires systems
    - ➔ protocols, services

Problemi dei GRID

- condivisione delle risorse flessibile e sicura su scala geografica
- L'ottimizzazione dello sfruttamento delle risorse, il cui stato non è direttamente sotto controllo e le informazioni relative sottostanno ad un certo grado di incertezza
- Formazione dinamica di organizzazioni virtuali, VO
- Negoziazione online per l'accesso ai servizi: chi, cosa, perché, quando, come, QOS
  - ♣ sistemi in grado di fornire diversi livelli di "Quality of Service"
- Gestione automatica della infrastruttura
- Problemi a licello di risorse e connettivita' che sono il collo di bottiglia di molte applicazioni GRID


Layered Grid Architecture (By Analogy to Internet Architecture)

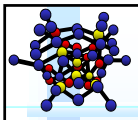


Collective Layer

Definisce protocolli, SDK ed API per l'interazione con le risorse.

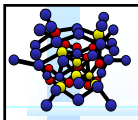
Fornisce ai membri di una VO meccanismi per:

- Directory services: scoprire l'esistenza di risorse.
- Co-allocation, scheduling, brokering services:allocare una o più risorse e schedulare task
- Monitoring services: scoprire e gestire failure, intrusioni, overload…
- Data Replication services: scoprire la copia dei dati che permette di massimizzare le performance, in termini di tempi di accesso, reliability, costo…
- Software Discovery services: scoprire la miglior piattaforma di esecuzione (anche per il SW) in base ai parametri del problema (NetSolve)



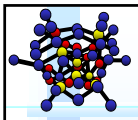
Resource and Connectivity

- **Connectivity**:
  - Definisce i protocolli base per la comunicazione e l'autenticazione.
  - I protocolli di Comunicazione permettono lo scambio di dati tra le risorse del livello inferiore.
  - I protocolli di Autenticazione forniscono meccanismi sicuri (crittografia) per verificare l'identità di utenti e risorse.
- **Resource**:
  - Definisce, sulla base dei protocolli sottostanti, protocolli, SDK ed API per l'inizializzazione, il monitoraggio ed il controllo di operazioni su di una risorsa.
    - Information Protocol: informazioni sullo stato della struttura (configurazione, carico…)
    - Management Protocol: negoziazione per l'accesso alla risorsa, tramite la specifica di requirement e operazioni da effettuare

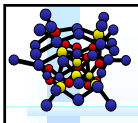
GRID Standards

- Non esiste uno standard
- Vi sono degli standard per le comunicazioni, per la negoziazione dei servizi, e altre cose di questo genere.

sommario

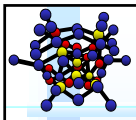
- Contesto tecnologico
- Architetture Parallele
- The GRID, definizione e motivazioni
- Concetti estesi dei GRID, microgrid
- Applicazioni e problemi dei GRID
- Soluzioni GRID...Globus, Condor
- Soluzioni MicroGRID: AXCP grid
- Confronto fra GRID
- Applicazioni per microGRID



GRID projects

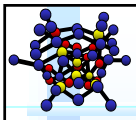
- **LEGION**
  - Middleware per la connessione di reti
  - Distribuzione di processi ed allocation
  - Trasparente per l'utente che chiede il servizio

- **UNICORE**-UNiform Interface to COmputing REsources
  - Ministero tedesco
  - Combina le risorse di centri di computer e le rende disponibili in modo sicuro e senza cuciture attraverso intranet o internet.
  - Peer certificati per garantire l'uso e la sicurezza dei dati
- **GLOBUS**
  - Open source (era)
  - Ora sta diventando commerciale



Some GRID Solutions !!

- **Condor**
  - Unix and windows
  - Small scale GRID, non parallelism
- **Globus**
  - Parallel
  - Unix like
  - C and java
- **Legion**
  - Parallel, C++
  - Unix like
  - Too much space needed, 300Mbyte
- **Unicore**
  - Java
  - Unix like
  - Open source
- **AXMEDIS, AXCP**
  - C++ and JavaScript
  - Windows
  - Accessible Code, Free Software

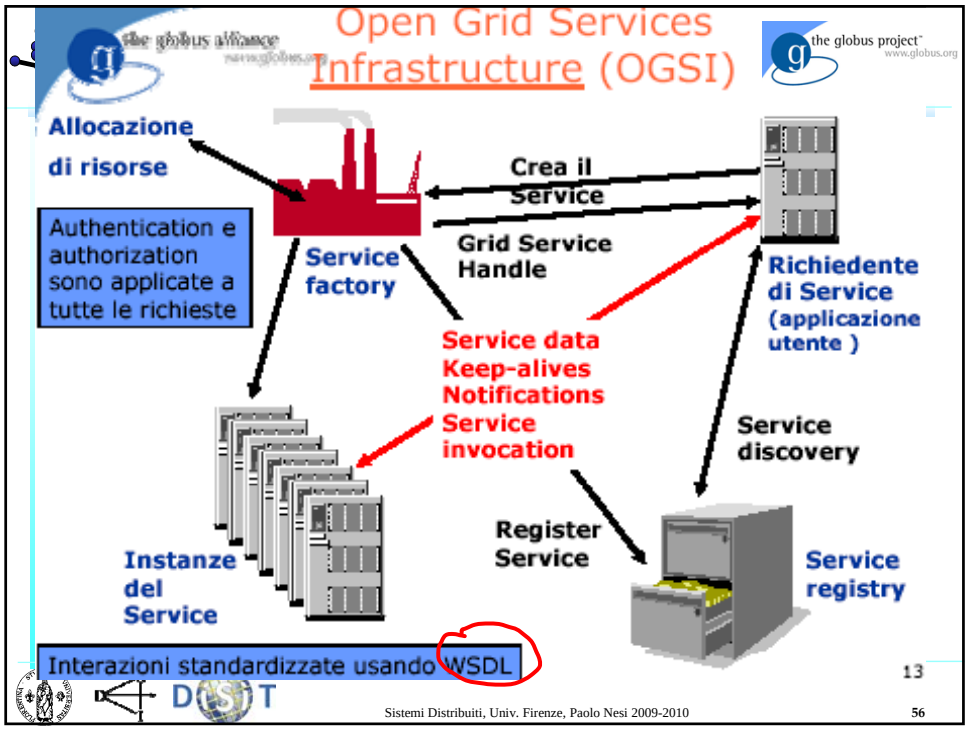


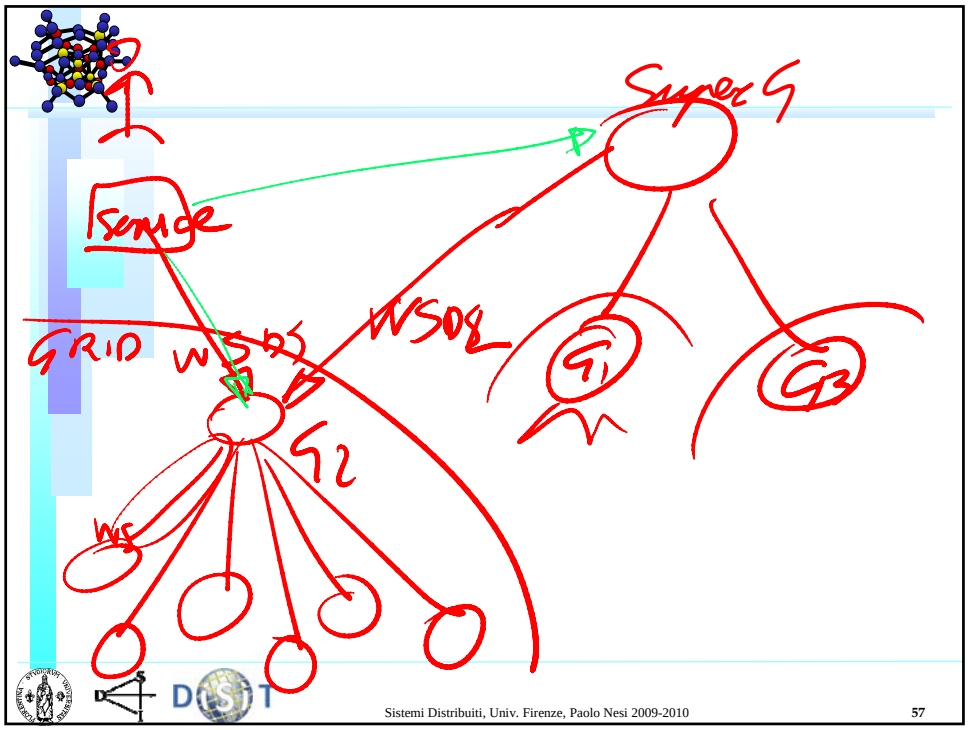
GLOBUS and its toolkit

- Open Source, Middleware
- http://www-unix.globus.org/toolkit/license.html
- Library for:
  - monitoraggio, scoperta e gestione delle risorse e delle informazioni
  - sicurezza dei nodi (certificati, autenticazione)
  - sicurezza delle comunicazioni
  - tolleranza dei guasti
  - portabilità
- Globus Toolkit è cresciuto attraverso una strategia open-source simile a quella di Linux: questo ha incoraggiato una vasta comunità di programmatori e sviluppatori a introdurre continue migliorie al prodotto

Open Grid Services Architecture

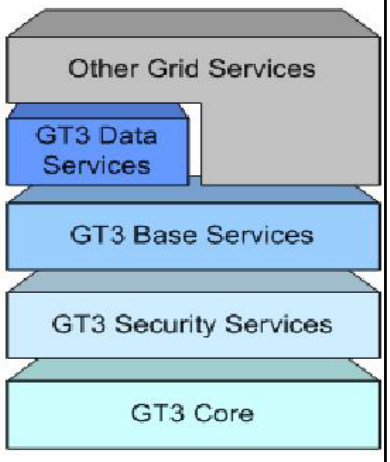
- Al Global Grid Forum (GGF4),
  - Globus Project e IBM hanno definito le linee dell'Open Grid Services Architecture (**OGSA**),
  - matrimonio e l'evoluzione di due tecnologie: *Grid Computing* e *Web Services*.
- OGSA introduce il concetto fondamentale di **Grid Service**, ovvero un GRID che dispone di interfacce che lo rendono manipolabile per mezzo di protocolli web service.
- **Open Grid Services Infrastructure** (**OGSI**) definisce le interfacce di base/standard e i comportamenti per servizi gestibili dal sistema.





Globus GRID Tool Kit

- Sicurezza (GSI)
- Gestione delle risorse (GRAM, Access and Management)
- Gestione dei dati (GASS, GridFTP, GRM)
- Servizi di informazione (GIS, security)
- Comunicazione (I/O, Nexus, MPICH)
- Supervisione dei processi e gestione guasti (MDS, HBM)



Resource Management Services

Tre componenti principali

1. **RSL (Resource Specification Language**) per comunicare i requisiti delle risorse
2. **Resource Broker**: gestisce il mapping tra le richieste ad alto livello delle applicazioni e le risorse individuali.
3. **GRAM** (Grid Resource Allocation Management) è responsabile di un set di risorse ed agisce da interfaccia verso vari Resource Management Tools (Condor,LSF,PBS, NQE, EASY-LL ma anche, semplicemente, un demone per la *fork*)

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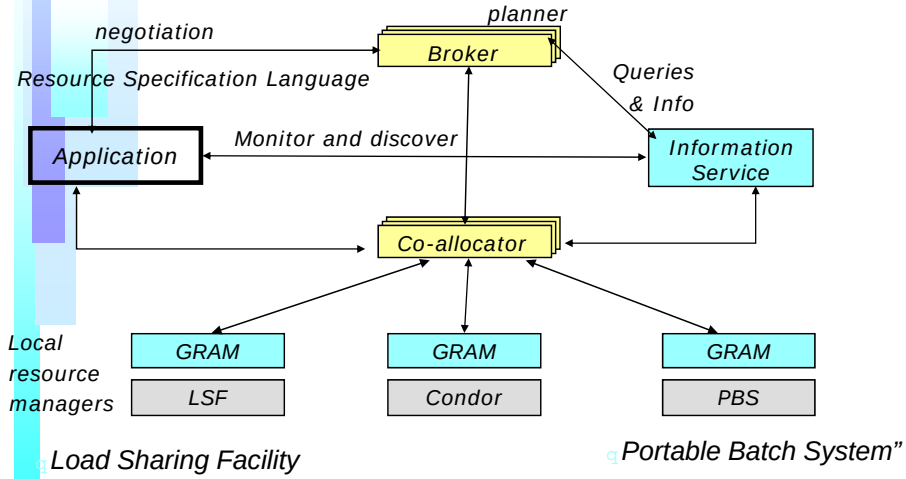
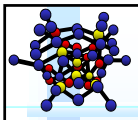
Resource Management Architecture



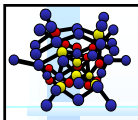
Load Sharing Facility

Portable Batch System"



Combinazione Globus e Condor

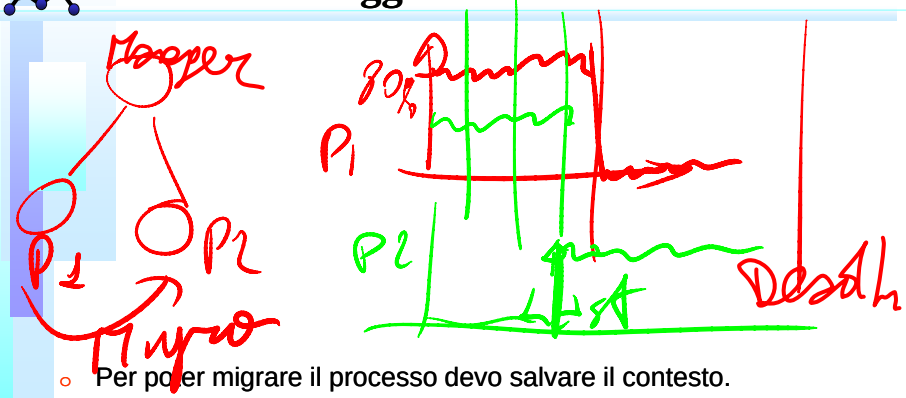
- ***Globus***
  - *Protocolli per comunicazioni sicure tra domini*
  - *Accesso standard a sistemi batch remoti*
- ***Condor***
  - *Job submission e allocation*
  - *Error recovery*
  - *Creazione di un ambiente di esecuzione*

CONDOR

- Nasce nel 1988, University of Madison
- Creazione di cluster di workstation PC
- Sfruttamento di momenti di scarsa attivita' della CPU;
  - Condor lascia la CPU se l'utente lavora sul PC
  - Salva il punto e poi riparte
  - ***Sposta/migra se necessario l'esecuzione del processo su un'altra CPU***
- Il codice non viene cambiato ma viene semplicemente linkato con lib speciali


Salvataggio del contesto



- Per poter migrare il processo devo salvare il contesto.
- Il contesto lo salvo ad intervalli regolari, per esempio ogni decimo del tempo di esecuzione.
- in questo caso ho uno spreco massimo di 1/10 del tempo di esecuzione, che deve essere vantaggioso rispetto al costo di spostamento del processo sull'altro nodo

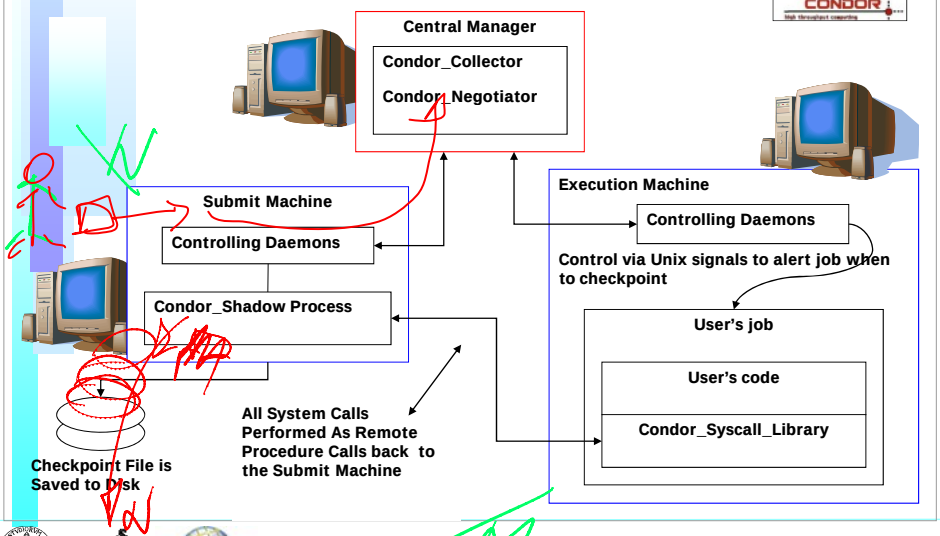
CONDOR

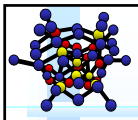
- A basso livello si basa su procolli di comunicazione diversi per gestire i processi (interoperabilita'):
  - **Vanilla:** permette di eseguire tutti i programmi che non possono essere re-linkati ed è utilizzato per shell scripts. Non sono implementate migrazione e chiamate di sistema.
  - **PVM:** per far girare sopra Condor programmi scritti per l'interfaccia PVM (Parallel Virtual Machine).
  - **MPI:** Questo ambiente risulta utile per eseguire i programmi scritti secondo il paradigma di Message Passing Interface (MPICH).
  - **Globus** Permette di eseguire i processi scritti …..
  - **Java:** Permette di eseguire i processi scritti per la Java Virtual Machine
  - ….

Sicurezza in CONDOR

- L'autenticazione di una comunicazione sotto Condor è realizzata grazie all'implementazione di alcuni protocolli: tra questi citiamo
  - GSI (basato su certificati X.509),
  - Kerberos,
  - e un meccanismo basato su file-system (Windows prevede un meccanismo di autenticazione proprietario).

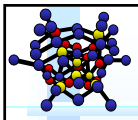
CONDOR architecture





CONDOR ruoli e servizi

- **Central Manager,** solo un Central Manager.
  - Raccoglie tutte le informazioni e negoziare tra le richieste e le offerte di risorse.
  - Affidabile e potente
- **Submit**
  - Altre macchine del pool (incluso il Central Manager) possono invece essere configurate per sottomettere jobs a Condor.
  - queste macchine necessitano di molto spazio libero su disco per salvare tutti i punti di checkpoint dei vari job sottomessi.
- **Execute (i nodi del GRID)**
  - Alcune macchine nel pool (incluso il Central Manager) possono essere configurate per eseguire processi Condor.
  - Essere una macchina di esecuzione non implica la richiesta di molte risorse.

CONDOR: Pregi e difetti

- ***Pregi:***
  - non necessita di modificare i vostri programmi
    - Differentemente da seti@home
  - set-up semplice
  - facilità di gestione della coda dei job
  - breve tempo necessario ad implementare una *"griglia"* funzionante.
  - estrema versatilità nel gestire svariati tipi di applicazioni (.exe).
  - trasparenza agli occhi degli utenti durante l'esecuzione.
- ***Difetti:***
  - I meccanismi di sicurezza implementati non garantiscono ancora il medesimo livello di protezione offerto da una vera soluzione *middleware*.
  - Limitato controllo sull'intera *grid*.
  - Bassa "tolleranza" ai guasti: se nessuna macchina del pool soddisfa i requisiti di un job, questo rimane in attesa senza andar mai in esecuzione e l'utente è costretto a rimuoverlo manualmente.



sommario
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Applicazioni per microGRID
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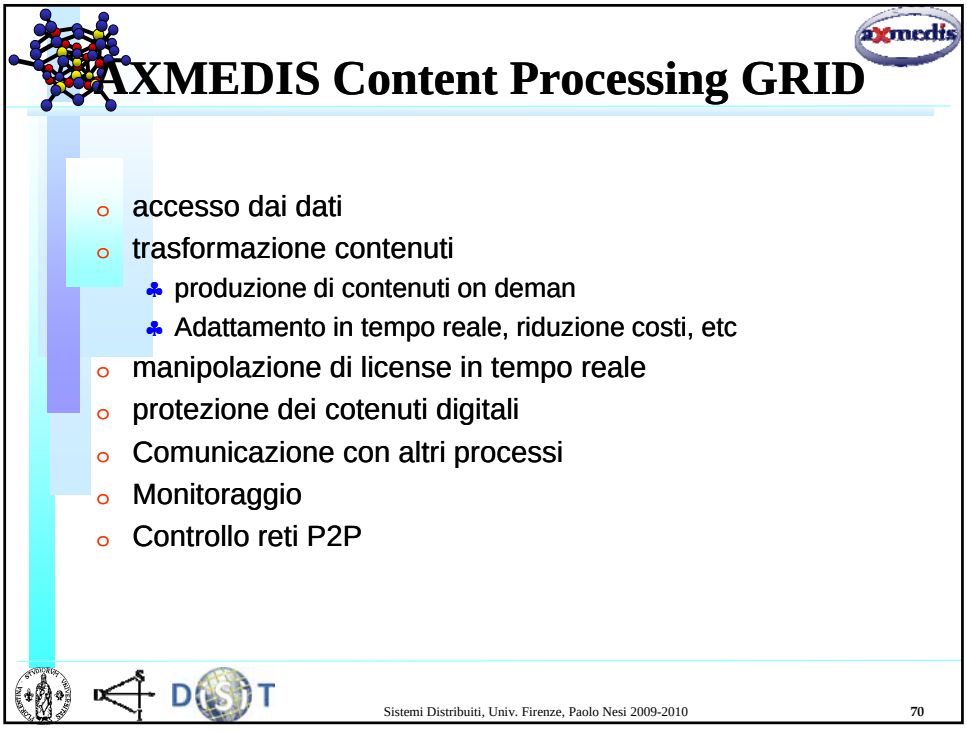
AXMEDIS Content Processing GRID
accesso dai dati
trasformazione contenuti
produzione di contenuti on deman
Adattamento in tempo reale, riduzione costi, etc
manipolazione di license in tempo reale
protezione dei cotenuti digitali
Comunicazione con altri processi
Monitoraggio
Controllo reti P2P
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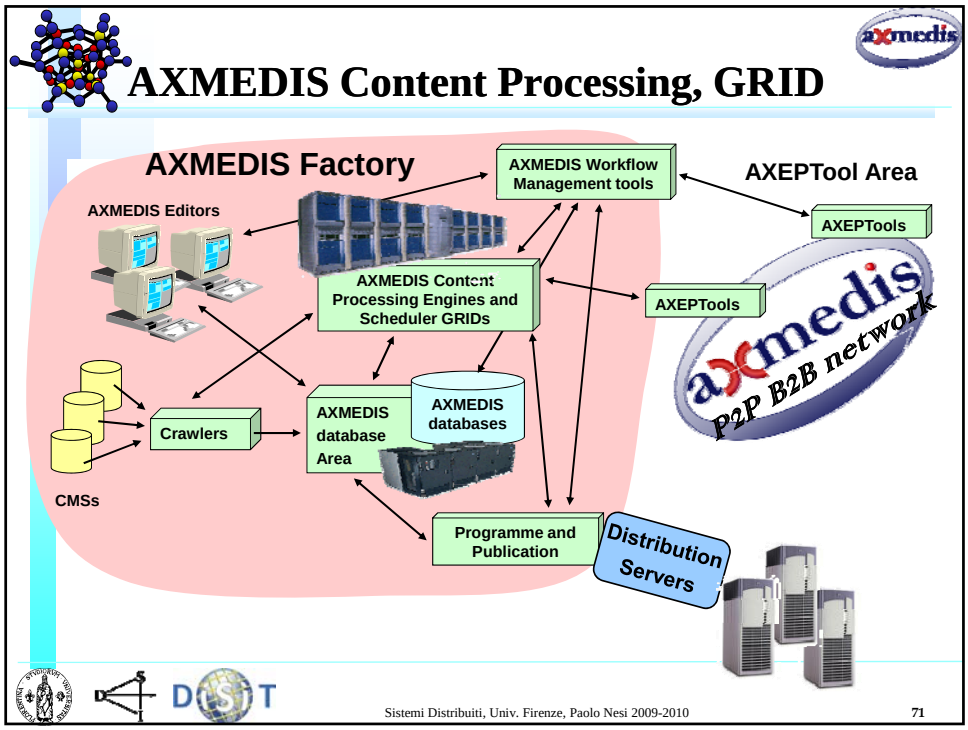
AXMEDIS Content Processing, GRID
AXMEDIS Factory
AXMEDIS Workflow Management tools
AXEPTool Area
AXMEDIS Editors
AXEPTools
AXMEDIS Content Processing Engines and Scheduler GRIDs
AXEPTools
axmedis P2P B2B network
AXMEDIS database Area
AXMEDIS databases
Crawlers
CMSs
Programme and Publication
Distribution Servers
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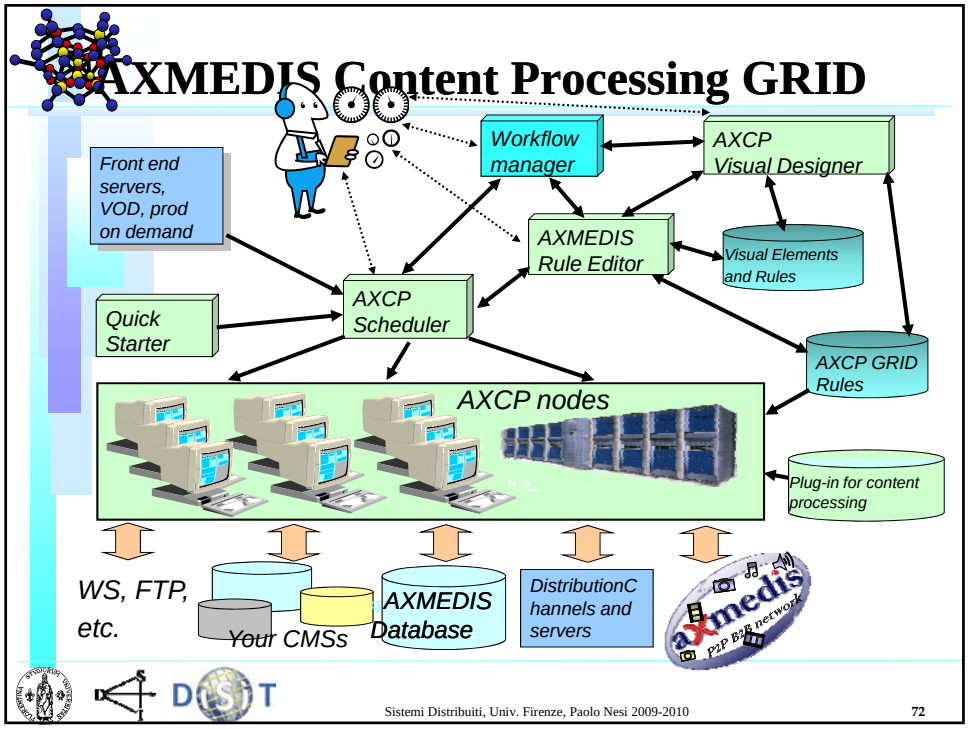
AXMEDIS Content Processing GRID
Front end servers, VOD, prod on demand
Workflow manager
AXCP Visual Designer
AXMEDIS Rule Editor
Visual Elements and Rules
Quick Starter
AXCP Scheduler
AXCP GRID Rules
AXCP nodes
Plug-in for content processing
WS, FTP, etc.
Your CMSs
AXMEDIS Database
DistributionChannels and servers
axmedis P2P B2B network
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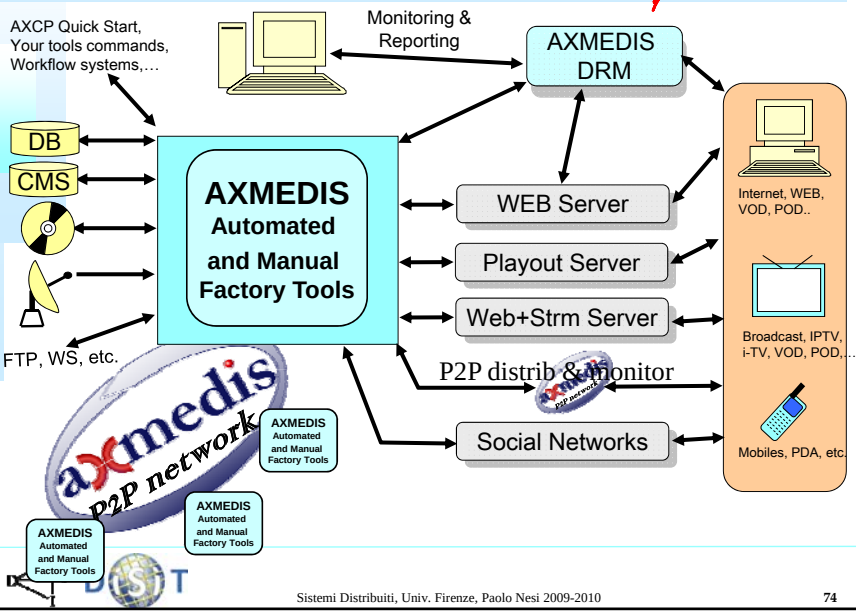
AXMEDIS Content Processing Area

- GRID infrastructure **for**
  - **automatic production and processing content on the basis of rules**
  - ***AXCP Rules* which are**
    - **written as scripts by the *AXCP Rule Editor***
    - **executed in parallel and rationally using the computational resources accessible in the content factory**
    - ***AXCP Rule Engine*.**
- **AXCP area receives commands coming from the Workflow of the factory.**

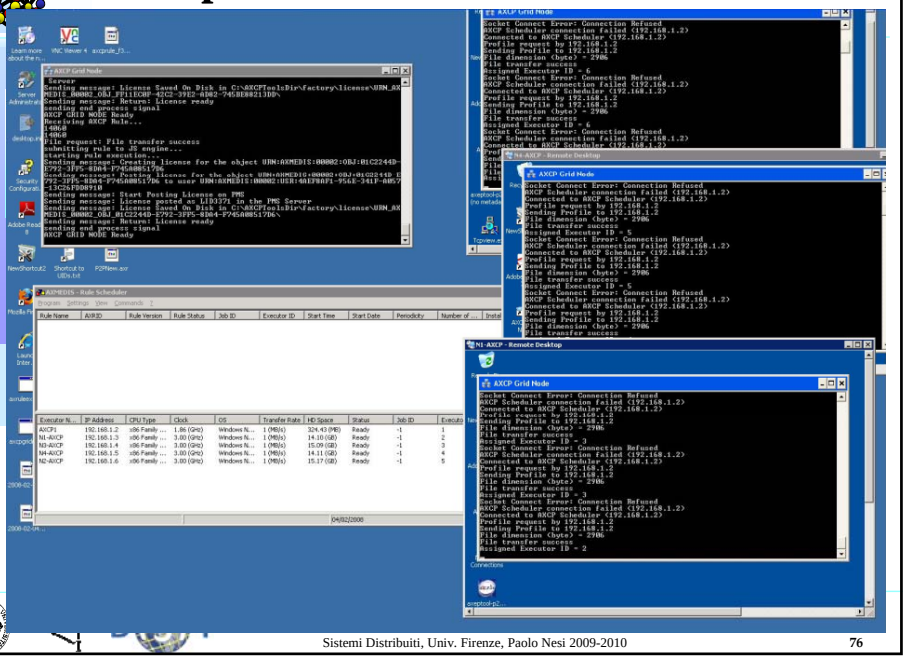
Factory and integration

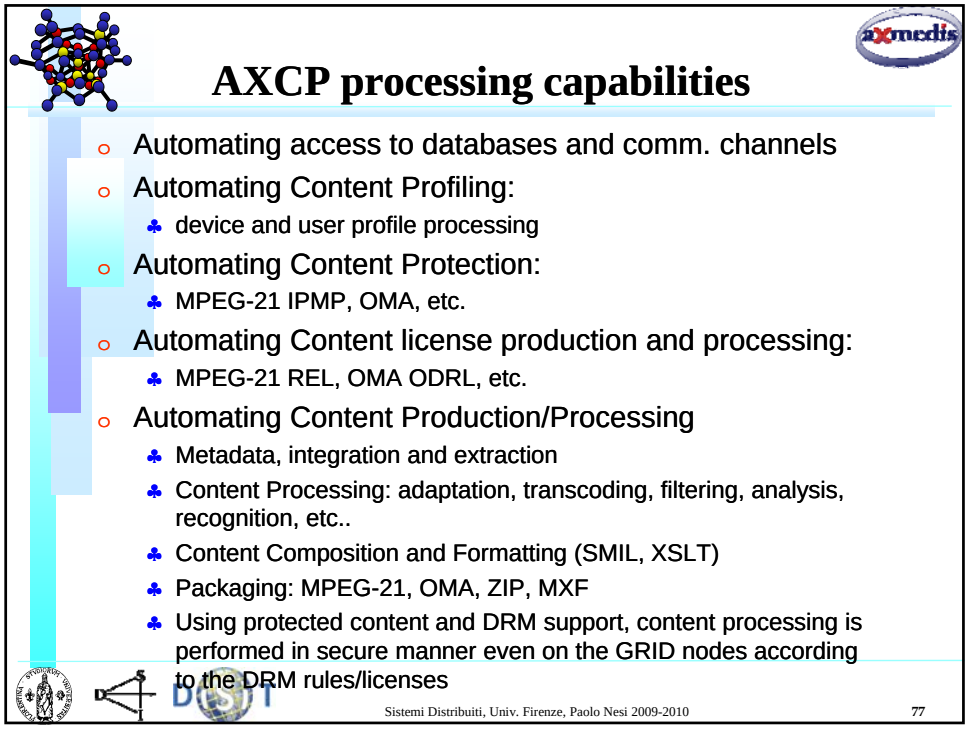


AXMEDIS Content Processing GRID

- **GRID per il Content Processing**
  - Discovery di risorse, nodi
    - Valutazione dello stato e delle pontenzialita dei nodi
  - Creazione di regole, processi
    - Un solo processo per nodo
  - Esecuzione di regole/processi, attivano anche processi locali scritti non in forma di regole
    - On demand, periodiche, collegate, asincrone
  - Allocazione ed ottimizzazione dei processi
  - Comunicazione con il gestore ma anche fra nodi
    - N to N
    - N to S, per monitor e/o invocazione di regole/processi
  - Tracciamento e controllo dei processi
  - Workflow, gestione di alto livello, integratione macchina Users

Snapshots of the GRID at work




AXCP processing capabilities
Automating access to databases and comm. channels
Automating Content Profiling:
device and user profile processing
Automating Content Protection:
MPEG-21 IPMP, OMA, etc.
Automating Content license production and processing:
MPEG-21 REL, OMA ODRL, etc.
Automating Content Production/Processing
Metadata, integration and extraction
Content Processing: adaptation, transcoding, filtering, analysis, recognition, etc..
Content Composition and Formatting (SMIL, XSLT)
Packaging: MPEG-21, OMA, ZIP, MXF
Using protected content and DRM support, content processing is performed in secure manner even on the GRID nodes according to the DRM rules/licenses
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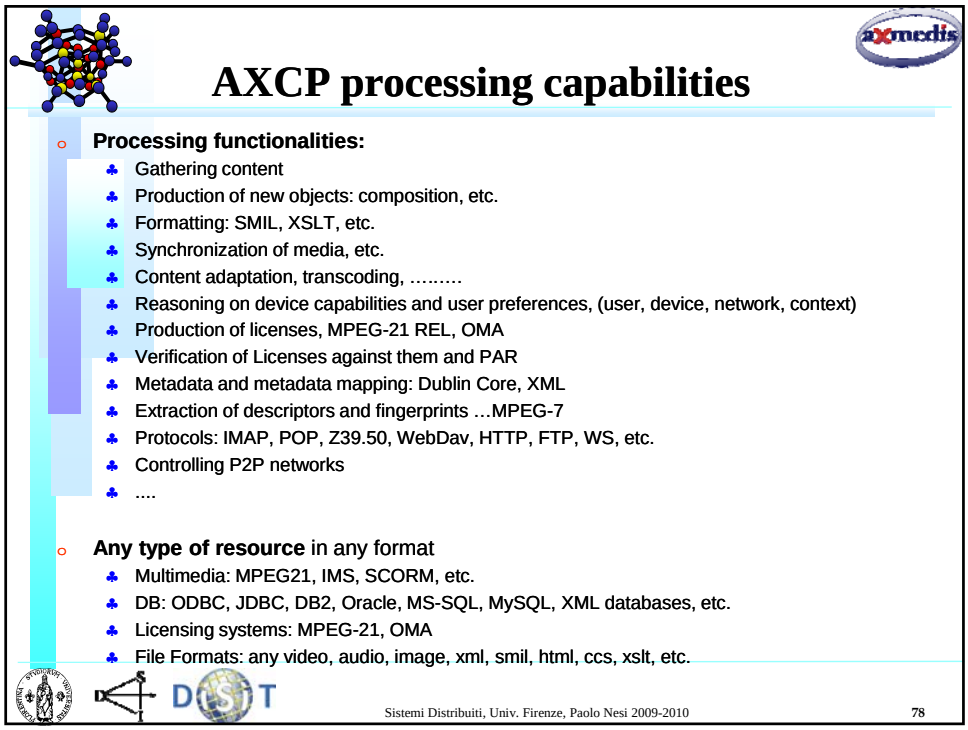
AXCP processing capabilities
Processing functionalities:
Gathering content
Production of new objects: composition, etc.
Formatting: SMIL, XSLT, etc.
Synchronization of media, etc.
Content adaptation, transcoding, ……
Reasoning on device capabilities and user preferences, (user, device, network, context)
Production of licenses, MPEG-21 REL, OMA
Verification of Licenses against them and PAR
Metadata and metadata mapping: Dublin Core, XML
Extraction of descriptors and fingerprints …MPEG-7
Protocols: IMAP, POP, Z39.50, WebDav, HTTP, FTP, WS, etc.
Controlling P2P networks
....
Any type of resource in any format
Multimedia: MPEG21, IMS, SCORM, etc.
DB: ODBC, JDBC, DB2, Oracle, MS-SQL, MySQL, XML databases, etc.
Licensing systems: MPEG-21, OMA
File Formats: any video, audio, image, xml, smil, html, ccs, xslt, etc.
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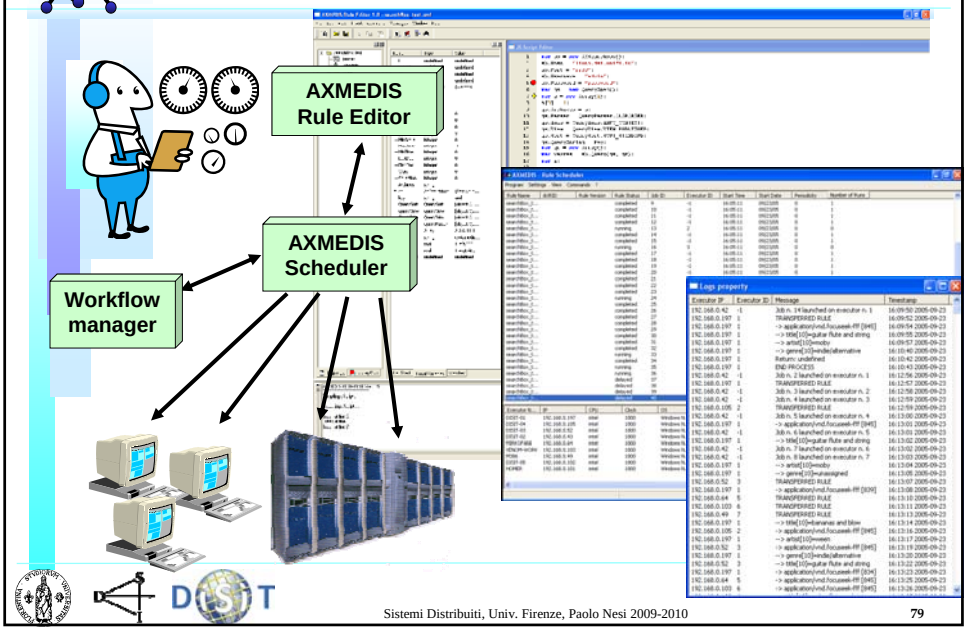
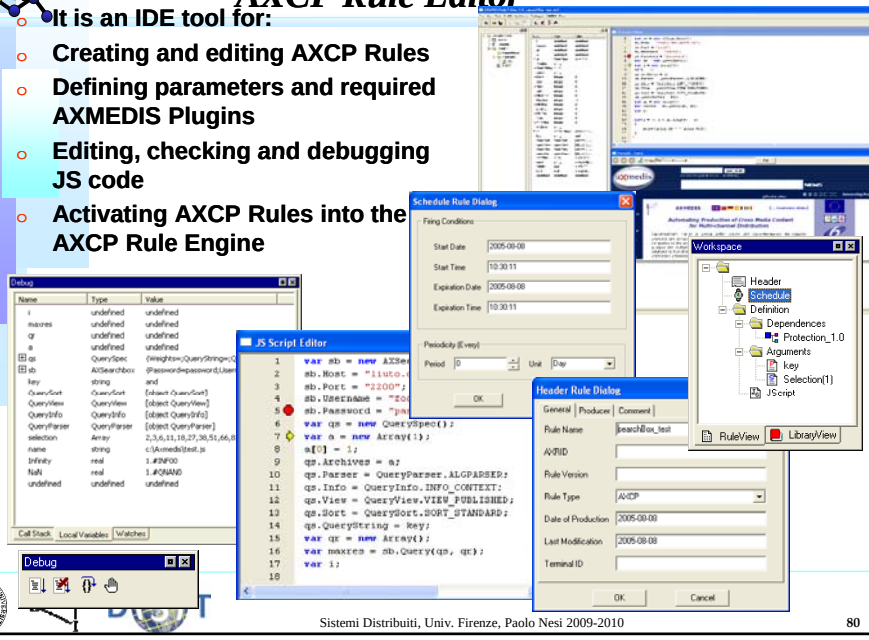
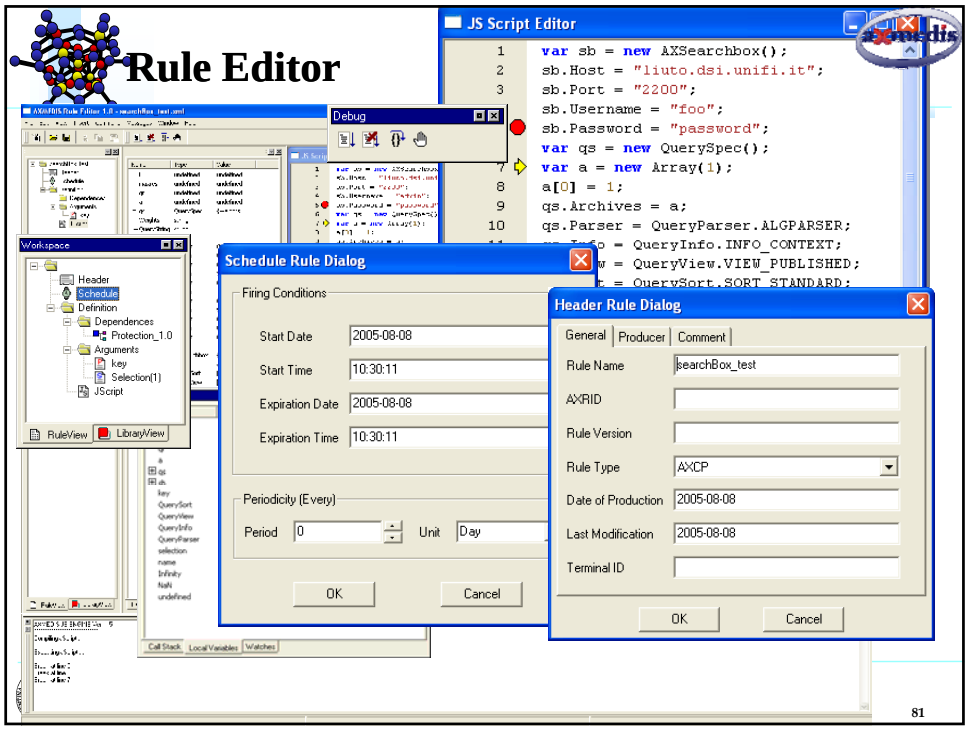
AXMEDIS Content Processing GRID

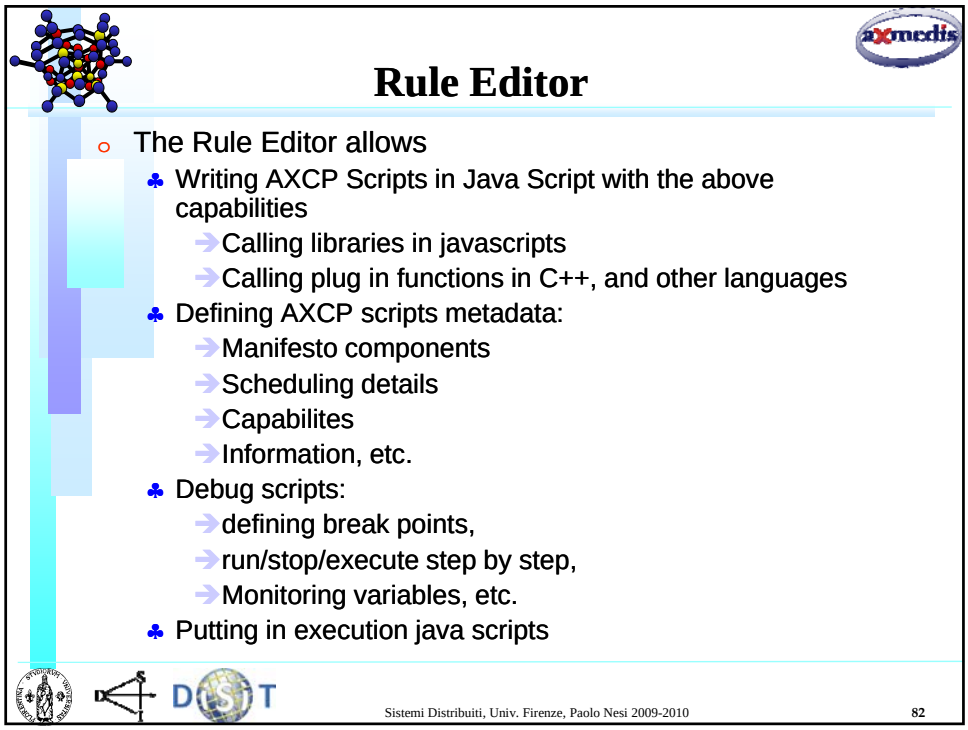


AXMEDIS Content Processing Area: *AXCP Rule Editor*

- It is an IDE tool for:
- Creating and editing AXCP Rules
- Defining parameters and required AXMEDIS Plugins
- Editing, checking and debugging JS code
- Activating AXCP Rules into the AXCP Rule Engine




Rule Editor
JS Script Editor
1 var sb = new AXSearchbox();
2 sb.Host = "liuto.dsi.unifi.it";
3 sb.Port = "2200";
4 sb.Username = "foo";
5 sb.Password = "password";
6 var qs = new QuerySpec();
7 var a = new Array(1);
8 a[0] = 1;
9 qs.Archives = a;
10 qs.Parser = QueryParser.ALGPARSER;
Debug
Workspace
Header
Schedule
Definition
Dependences
Protection_1.0
Arguments
key
Selection(1)
JScript
RuleView
LibraryView
Schedule Rule Dialog
Firing Conditions
Start Date 2005-08-08
Start Time 10:30:11
Expiration Date 2005-08-08
Expiration Time 10:30:11
Periodicity (Every)
Period 0
Unit Day
OK
Cancel
Header Rule Dialog
General
Producer
Comment
Rule Name searchBox_test
AXRID
Rule Version
Rule Type AXCP
Date of Production 2005-08-08
Last Modification 2005-08-08
Terminal ID
OK
Cancel
81


Rule Editor
The Rule Editor allows
Writing AXCP Scripts in Java Script with the above capabilities
Calling libraries in javascripts
Calling plug in functions in C++, and other languages
Defining AXCP scripts metadata:
Manifesto components
Scheduling details
Capabilites
Information, etc.
Debug scripts:
defining break points,
run/stop/execute step by step,
Monitoring variables, etc.
Putting in execution java scripts
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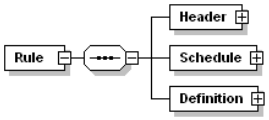
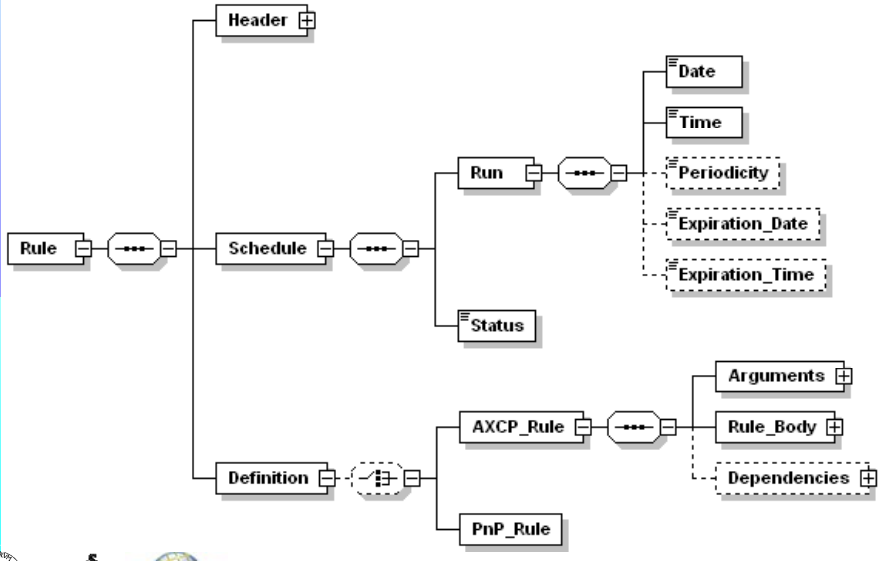
AXMEDIS Content Processing Area: *AXCP Rule*

- **AXCP Rules include metadata for heading information (*Header*) and firing (*Schedule*)**
- **AXCP Rules contain algorithms for composition, formatting, adaptation, transcoding, extraction of fingerprint and descriptors, protection, license manipulation, potential available rights manipulation, resource manipulation, load and save from databases and file system, content migration etc. (*Definition*)**



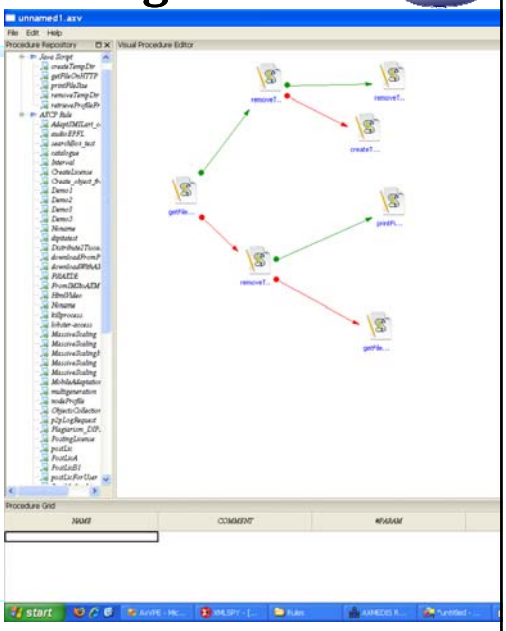
- **Algorithms are written by using JavaScript programming language**
- **JS was extended**
  - with data types derived from AXMEDIS Framework, MPEG21, and general resource definition such as: images, documents, video, licenses, etc.
  - to use different functionalities for content processing by means the AXMEDIS Plugin technology (adaptation, fingerprint, etc…)

Regole AXCP, formalizzazione XML



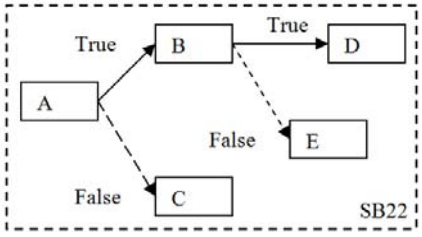
AXCP visual designer

- Fast and simple Visual Programming of AXCP GRID processes
- Composing Blocks as JS modules to create AXCP rules
- Composing AXCP Rules to create sequences of actions to be scheduled according to their dependencies

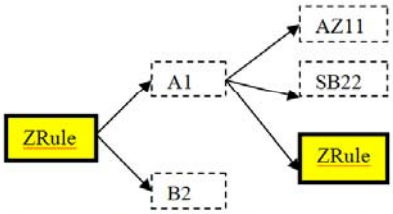


Visual Designer

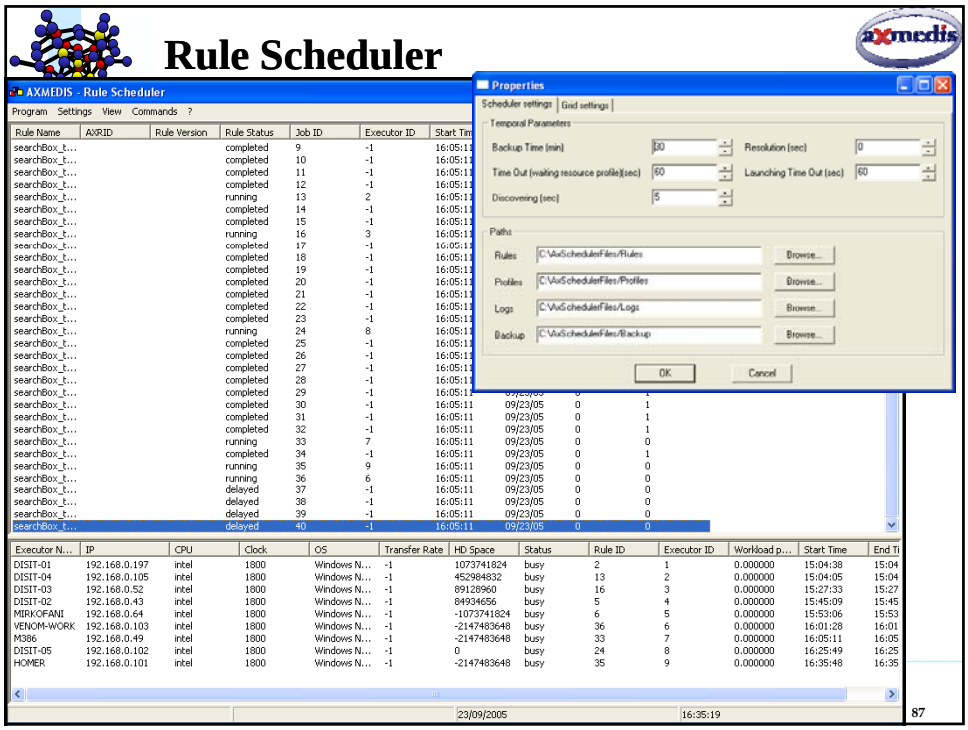
- Visual language for GRID programming
  - RuleBlock::= {JSBlock} | <defined in JS as JS rule>
  - JSBlock::= <defined in JS as JSBlock>
- ManRuleBlock as specific manager for its child processing rules.

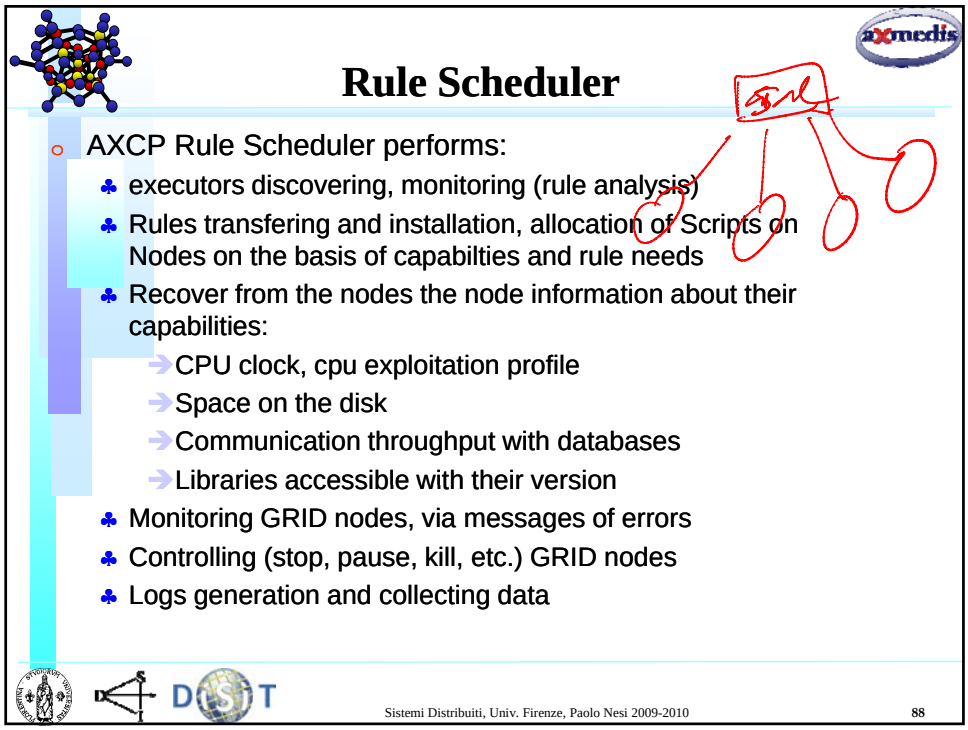


A sequence of JSBlocks creating RuleBlock SB22



ZRule ManRuleBlock defined to manage Rules on grid.


Rule Scheduler
AXMEDIS - Rule Scheduler
Program Settings View Commands ?
Properties
Scheduler settings
Grid settings
Temporal Parameters
Backup Time (min)
Resolution (sec)
Time Out (waiting resource profile)(sec)
Launching Time Out (sec)
Discovering (sec)
Paths
Rules
Profiles
Logs
Backup
Browse...
OK
Cancel
23/09/2005
16:35:19
87


Rule Scheduler
AXCP Rule Scheduler performs:
executors discovering, monitoring (rule analysis)
Rules transfering and installation, allocation of Scripts on Nodes on the basis of capabilties and rule needs
Recover from the nodes the node information about their capabilities:
CPU clock, cpu exploitation profile
Space on the disk
Communication throughput with databases
Libraries accessible with their version
Monitoring GRID nodes, via messages of errors
Controlling (stop, pause, kill, etc.) GRID nodes
Logs generation and collecting data
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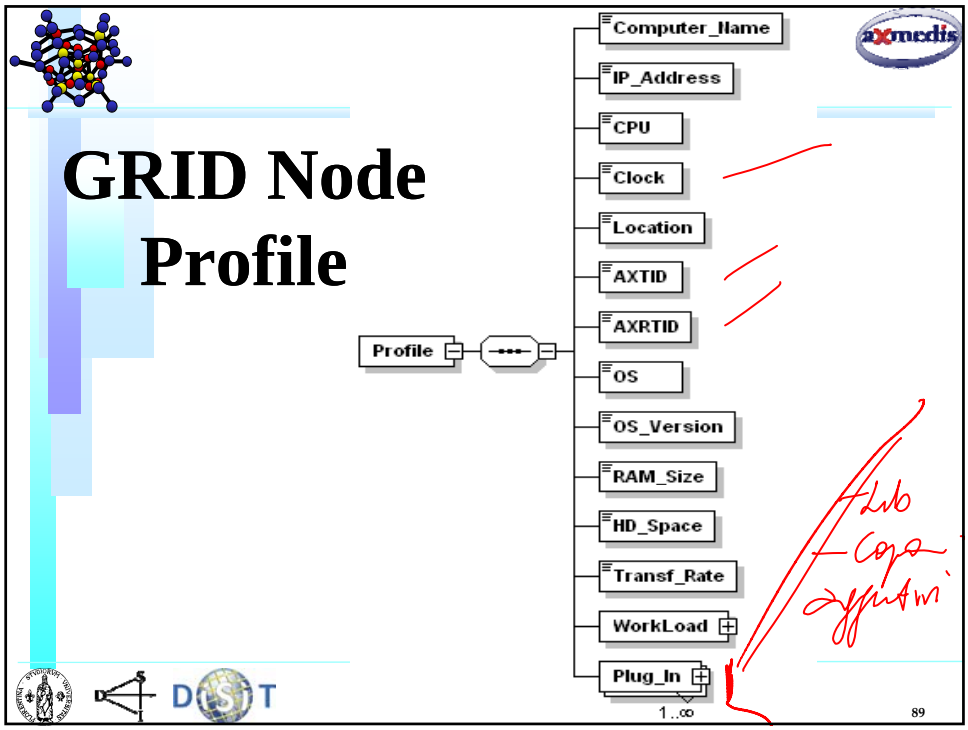
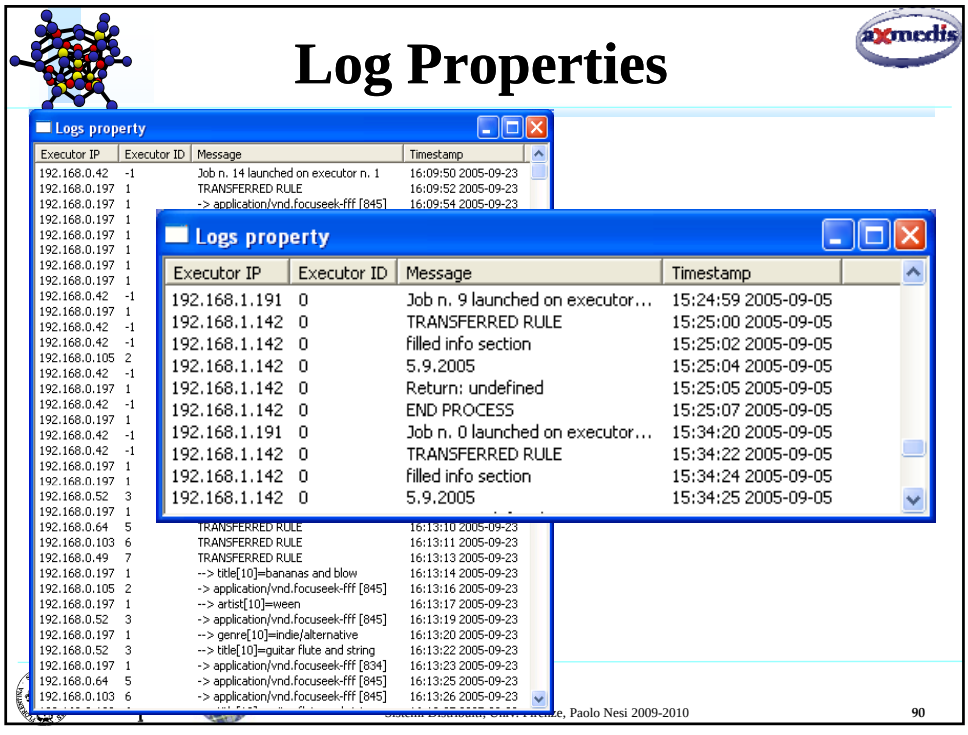

GRID Node Profile
Profile
Computer_Name
IP_Address
CPU
Clock
Location
AXTID
AXRTID
OS
OS_Version
RAM_Size
HD_Space
Transf_Rate
WorkLoad
Plug_In
1..∞
89


Log Properties
Logs property
Executor IP
Executor ID
Message
Timestamp
192.168.1.191 0 Job n. 9 launched on executor... 15:24:59 2005-09-05
192.168.1.142 0 TRANSFERRED RULE 15:25:00 2005-09-05
192.168.1.142 0 filled info section 15:25:02 2005-09-05
192.168.1.142 0 5.9.2005 15:25:04 2005-09-05
192.168.1.142 0 Return: undefined 15:25:05 2005-09-05
192.168.1.142 0 END PROCESS 15:25:07 2005-09-05
192.168.1.191 0 Job n. 0 launched on executor... 15:34:20 2005-09-05
192.168.1.142 0 TRANSFERRED RULE 15:34:22 2005-09-05
192.168.1.142 0 filled info section 15:34:24 2005-09-05
192.168.1.142 0 5.9.2005 15:34:25 2005-09-05
Paolo Nesi 2009-2010
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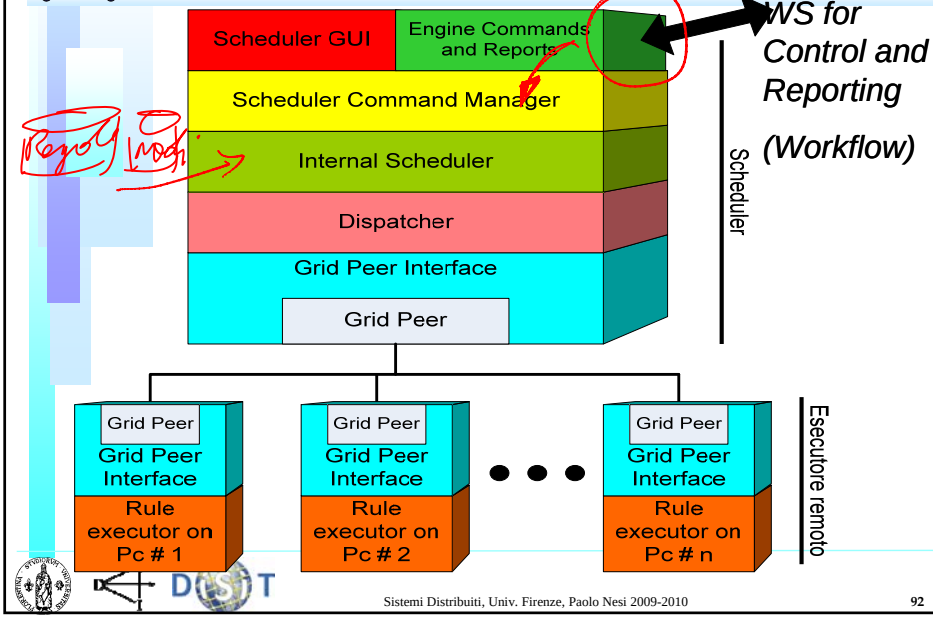
Esempio di esecuzione

Logs property

Executor IP	Executor ID	Message	Timestamp
192.168.0.42	-1	Job n. 14 launched on executor n. 1	16:09:50 2005-09-23
192.168.0.197	1	TRANSFERRED RULE	16:09:52 2005-09-23
192.168.0.197	1	-> application/vnd.focuseek-fff [845]	16:09:54 2005-09-23
192.168.0.197	1	--> title[10]=guitar flute and string	16:09:55 2005-09-23
192.168.0.197	1	--> artist[10]=moby	16:09:57 2005-09-23
192.168.0.197	1	--> genre[10]=indie/alternative	16:10:40 2005-09-23
192.168.0.197	1	Return: undefined	16:10:42 2005-09-23
192.168.0.197	1	END PROCESS	16:10:43 2005-09-23
192.168.0.42	-1	Job n. 2 launched on executor n. 1	16:12:56 2005-09-23
192.168.0.197	1	TRANSFERRED RULE	16:12:57 2005-09-23
192.168.0.42	-1	Job n. 3 launched on executor n. 2	16:12:58 2005-09-23
192.168.0.42	-1	Job n. 4 launched on executor n. 3	16:12:59 2005-09-23
192.168.0.105	2	TRANSFERRED RULE	16:12:59 2005-09-23
192.168.0.42	-1	Job n. 5 launched on executor n. 4	16:13:00 2005-09-23
192.168.0.197	1	-> application/vnd.focuseek-fff [845]	16:13:01 2005-09-23
192.168.0.42	-1	Job n. 6 launched on executor n. 5	16:13:01 2005-09-23
192.168.0.197	1	--> title[10]=guitar flute and string	16:13:02 2005-09-23
192.168.0.42	-1	Job n. 7 launched on executor n. 6	16:13:02 2005-09-23
192.168.0.42	-1	Job n. 8 launched on executor n. 7	16:13:03 2005-09-23
192.168.0.197	1	--> artist[10]=moby	16:13:04 2005-09-23
192.168.0.197	1	--> genre[10]=unassigned	16:13:05 2005-09-23
192.168.0.52	3	TRANSFERRED RULE	16:13:07 2005-09-23
192.168.0.197	1	-> application/vnd.focuseek-fff [839]	16:13:08 2005-09-23
192.168.0.64	5	TRANSFERRED RULE	16:13:10 2005-09-23
192.168.0.103	6	TRANSFERRED RULE	16:13:11 2005-09-23
192.168.0.49	7	TRANSFERRED RULE	16:13:13 2005-09-23
192.168.0.197	1	--> title[10]=bananas and blow	16:13:14 2005-09-23
192.168.0.105	2	-> application/vnd.focuseek-fff [845]	16:13:16 2005-09-23
192.168.0.197	1	--> artist[10]=ween	16:13:17 2005-09-23
192.168.0.52	3	-> application/vnd.focuseek-fff [845]	16:13:19 2005-09-23
192.168.0.197	1	--> genre[10]=indie/alternative	16:13:20 2005-09-23
192.168.0.52	3	--> title[10]=guitar flute and string	16:13:22 2005-09-23
192.168.0.197	1	-> application/vnd.focuseek-fff [834]	16:13:23 2005-09-23
192.168.0.64	5	-> application/vnd.focuseek-fff [845]	16:13:25 2005-09-23
192.168.0.103	6	-> application/vnd.focuseek-fff [845]	16:13:26 2005-09-23

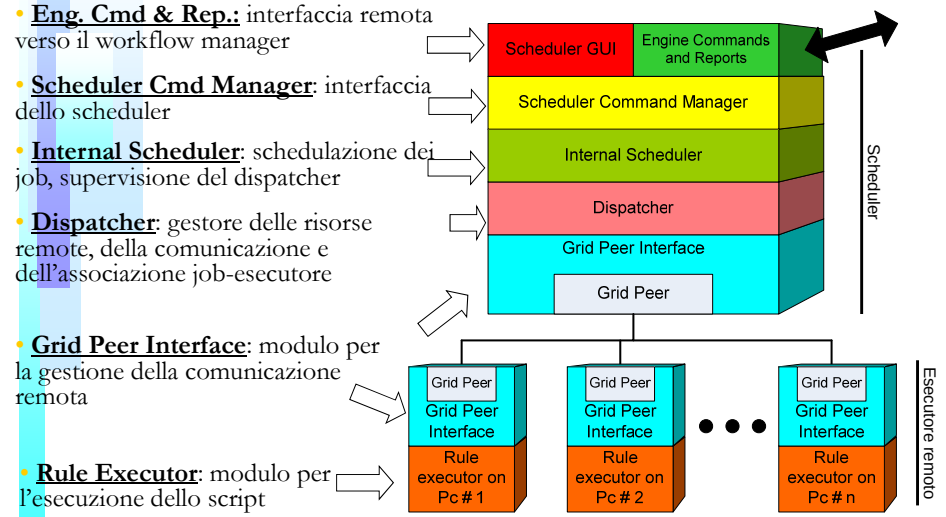
```
var sb = new AXSearchbox();
sb.Host = "liuto.dsi.unifi.it";
sb.Port = "2200";
sb.Username = "admin";
sb.Password = "password";
var qs = new QuerySpec();
var a = new Array(1);
a[0] = 1;
qs.Archives = a;
qs.Parser = QueryParser.ALGPARSER;
qs.Info = QueryInfo.INFO_CONTEXT;
qs.View = QueryView.VIEW_PUBLISHED;
qs.Sort = QuerySort.SORT_STANDARD;
qs.QueryString = key;
qs.FirstDoc = 0;
qs.LastDoc = 10;
var qr = new Array();
var maxres = sb.Query(qs, qr);
var i, j;
for(i = 0; i < qr.length; ++i)
{
        var doc = sb.GetDocument(qr[i].ID);
        var meta = sb.GetDocumentMetadata(qr[i].ID);
print("-> "+doc.MimeType+" ["+doc.Size+"]"+"\n"
        for(j = 0; j < meta.length; ++j)
        {
                var m = meta[j];
print("--> "+meta[j].Key+
"["+meta[j].Slice+"]="+meta[j].Value+"\n");
        }
}
```


AXMEDIS CP GRID, technical view



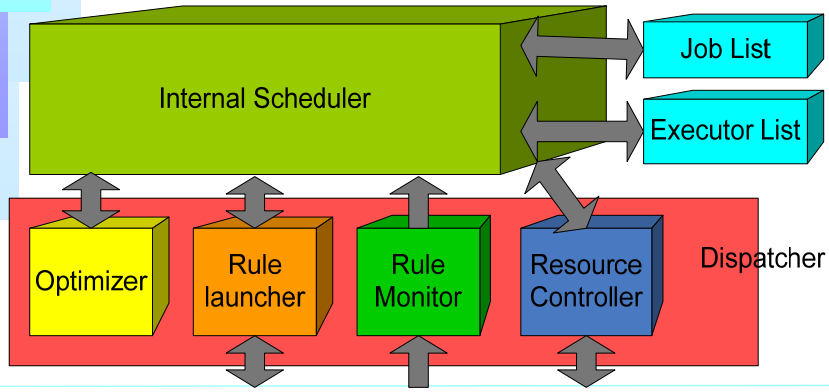
Realizzazione: Rule Engine

- **Eng. Cmd & Rep.:** interfaccia remota verso il workflow manager
- **Scheduler Cmd Manager**: interfaccia dello scheduler
- **Internal Scheduler**: schedulazione dei job, supervisione del dispatcher
- **Dispatcher**: gestore delle risorse remote, della comunicazione e dell'associazione job-esecutore
- **Grid Peer Interface**: modulo per la gestione della comunicazione remota
- **Rule Executor**: modulo per l'esecuzione dello script



Internal Scheduler

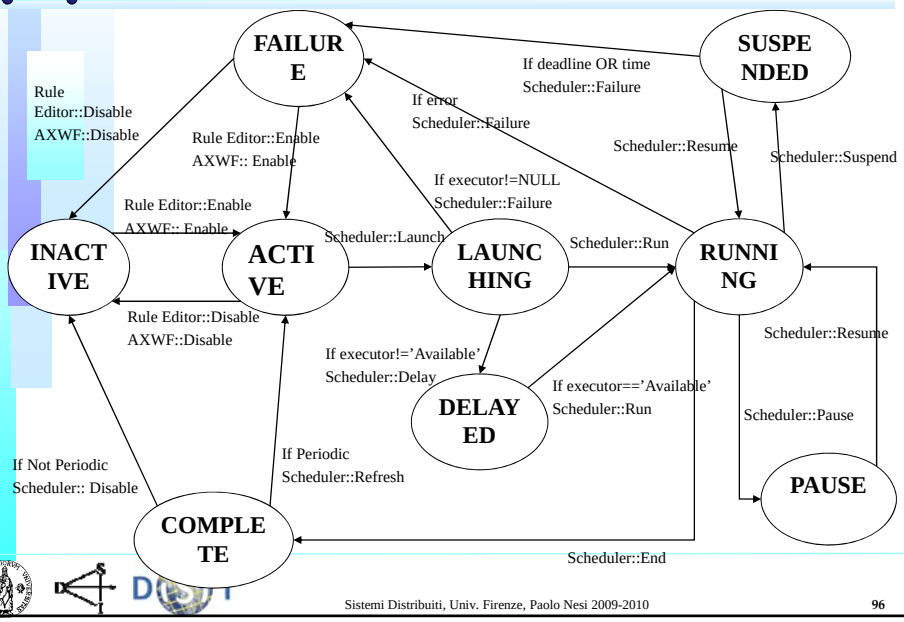
- permette la scelta dei job da mandare in esecuzione e l'aggiornamento della periodicità, il controllo sulla scadenza, il controllo e l'aggiornamento delle liste dei job e degli esecutori

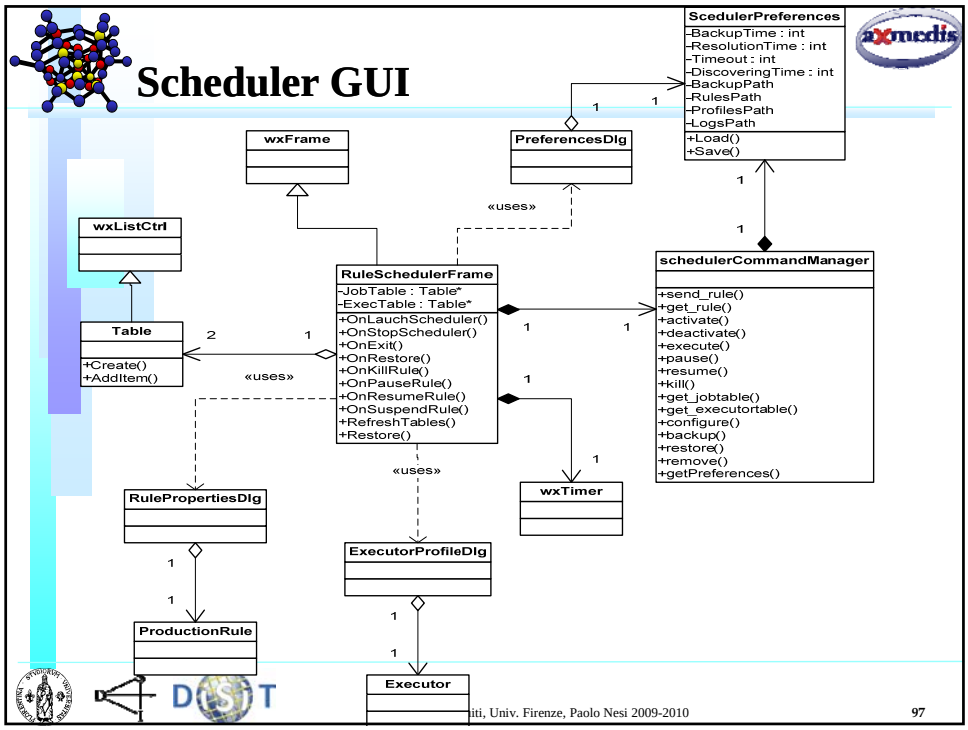


Dispatcher

- riunisce le funzionalità di associazione, lancio e controllo:
  - **Resource Controller:** controllo dello stato degli esecutori e la richiesta del loro profilo
  - **Optimizer:** associazione degli esecutori con i job da mandare in esecuzione in funzione del profilo e politica FCFS
  - **Rule Launcher:** invio di comandi e del file del job agli esecutori remoti
  - **Rule Monitor:** controllo sulle notifiche inviate dagli esecutori e dai job in esecuzione

Evolution of Rule's State




Scheduler GUI
ScedulerPreferences
-BackupTime : int
-ResolutionTime : int
-Timeout : int
-DiscoveringTime : int
-BackupPath
-RulesPath
-ProfilesPath
-LogsPath
+Load()
+Save()
wxFrame
PreferencesDlg
«uses»
wxListCtrl
RuleSchedulerFrame
-JobTable : Table*
-ExecTable : Table*
+OnLauchScheduler()
+OnStopScheduler()
+OnExit()
+OnRestore()
+OnKillRule()
+OnPauseRule()
+OnResumeRule()
+OnSuspendRule()
+RefreshTables()
+Restore()
schedulerCommandManager
+send_rule()
+get_rule()
+activate()
+deactivate()
+execute()
+pause()
+resume()
+kill()
+get_jobtable()
+get_executortable()
+configure()
+backup()
+restore()
+remove()
+getPreferences()
Table
+Create()
+AddItem()
2
1
«uses»
wxTimer
RulePropertiesDlg
ExecutorProfileDlg
ProductionRule
Executor
DIST
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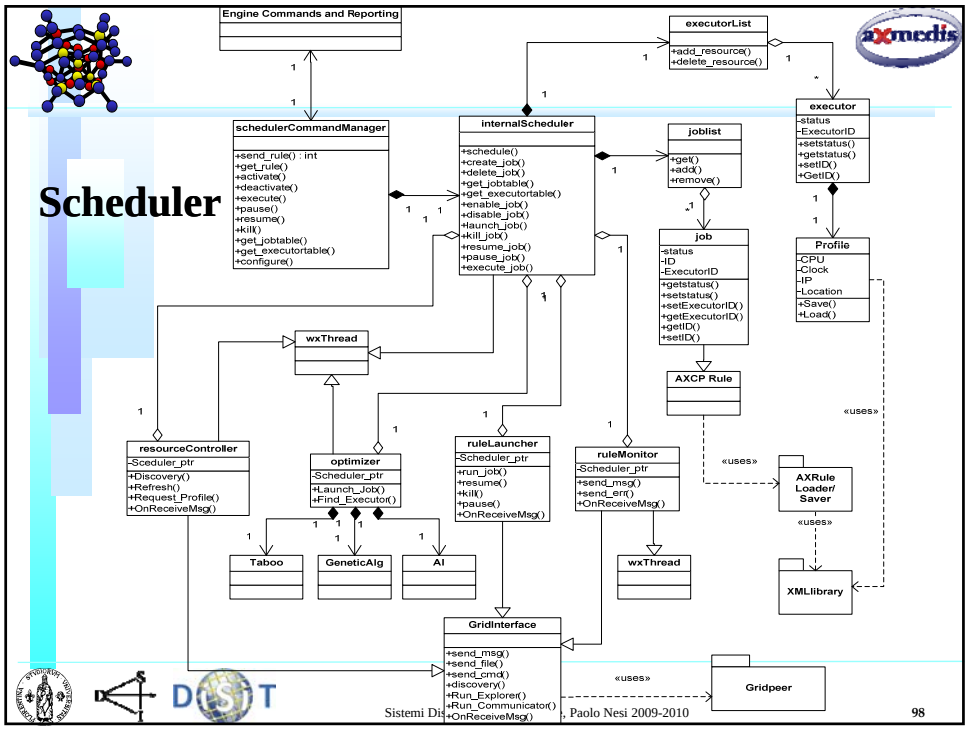
Scheduler
Engine Commands and Reporting
executorList
+add_resource()
+delete_resource()
executor
-status
-ExecutorID
+setstatus()
+getstatus()
+setID()
+GetID()
schedulerCommandManager
+send_rule() : int
+get_rule()
+activate()
+deactivate()
+execute()
+pause()
+resume()
+kill()
+get_jobtable()
+get_executortable()
+configure()
internalScheduler
+schedule()
+create_job()
+delete_job()
+get_jobtable()
+get_executortable()
+enable_job()
+disable_job()
+launch_job()
+kill_job()
+resume_job()
+pause_job()
+execute_job()
joblist
+get()
+add()
+remove()
job
-status
-ID
-ExecutorID
+getstatus()
+setstatus()
+setExecutorID()
+getExecutorID()
+getID()
+setID()
Profile
-CPU
-Clock
-IP
-Location
+Save()
+Load()
wxThread
AXCP Rule
«uses»
resourceController
-Sceduler_ptr
+Discovery()
+Refresh()
+Request_Profile()
+OnReceiveMsg()
optimizer
-Scheduler_ptr
+Launch_Job()
+Find_Executor()
ruleLauncher
-Scheduler_ptr
+run_job()
+resume()
+kill()
+pause()
+OnReceiveMsg()
ruleMonitor
-Scheduler_ptr
+send_msg()
+send_err()
+OnReceiveMsg()
AXRule Loader/ Saver
Taboo
GeneticAlg
AI
wxThread
XMLlibrary
GridInterface
+send_msg()
+send_file()
+send_cmd()
+discovery()
+Run_Explorer()
+Run_Communicator()
+OnReceiveMsg()
Gridpeer
DIST
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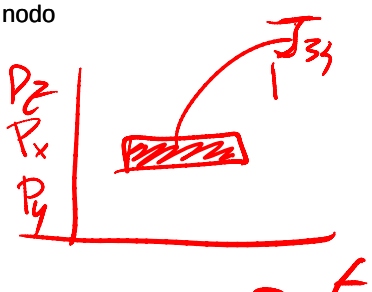
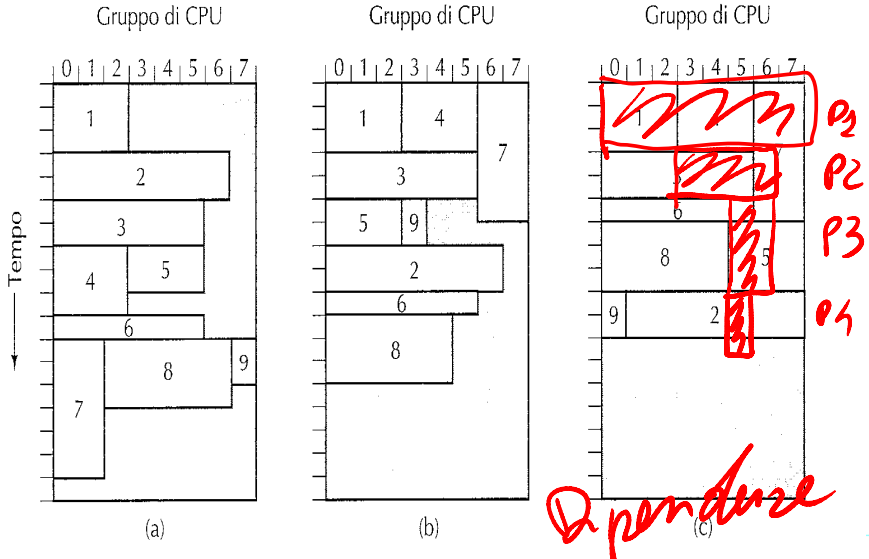
Ottimizzazione della Pianificazione

Allocazione dei processi sui nodi

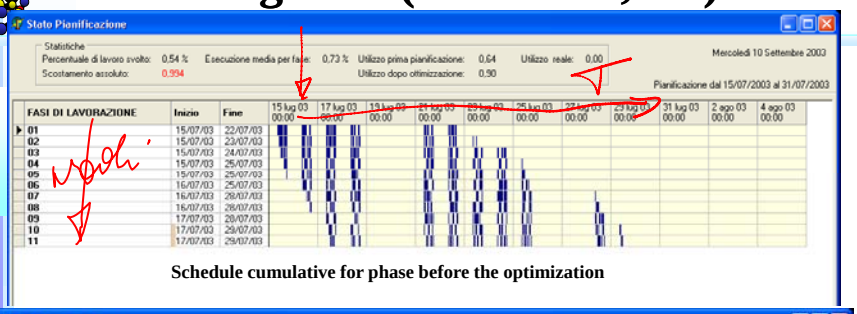
- Valutazione del profilo dei Nodi
  - Capabilities dei nodi
  - Potenza computazionale
  - Network Capabilities
- Valutazione delle necessità delle regole/processi
  - Componenti necessari, funzioni necessarie
  - Scadenza temporale, **deadline**
  - Architettura per la sua esecuzione se multi nodo
- Scelta della soluzione ottima:
  - Bilanciamento del carico
  - Soddisfazione dei vincoli
- Algoritmi di allocazione
  - Deadline monotonic
  - Taboo Search
  - Genetic Algorithms



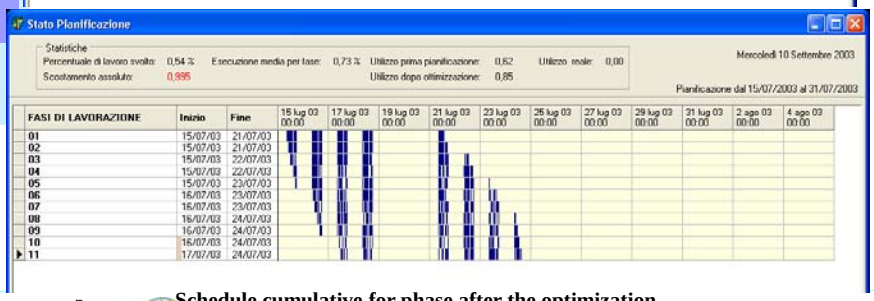
Pianificazione dei processi



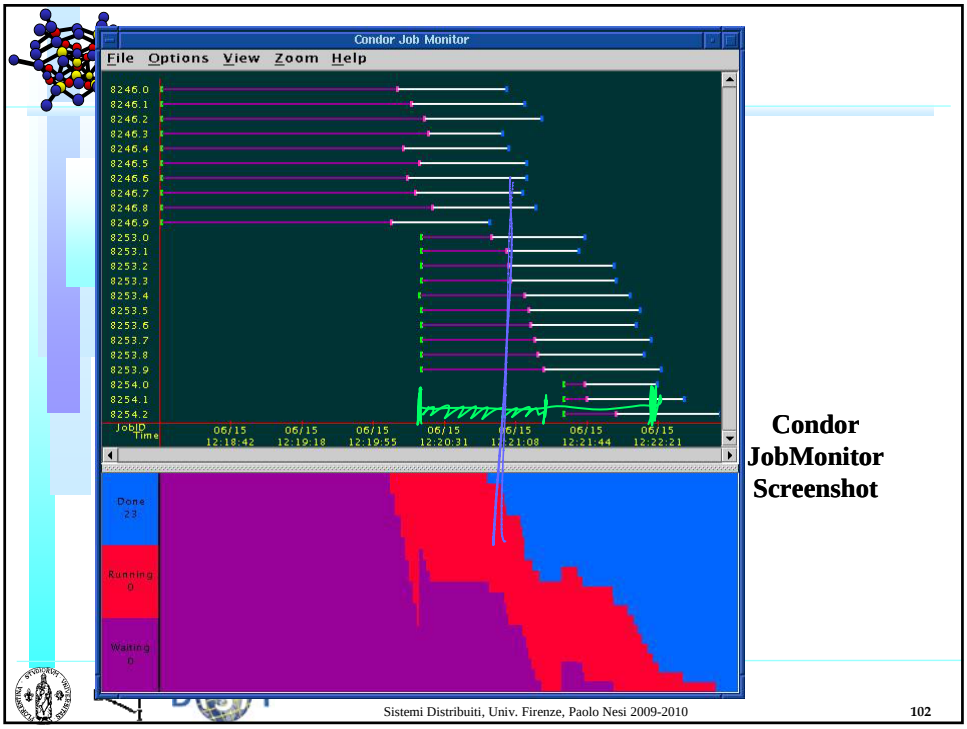
Gantt Diagrams (OPTAMS, TS)



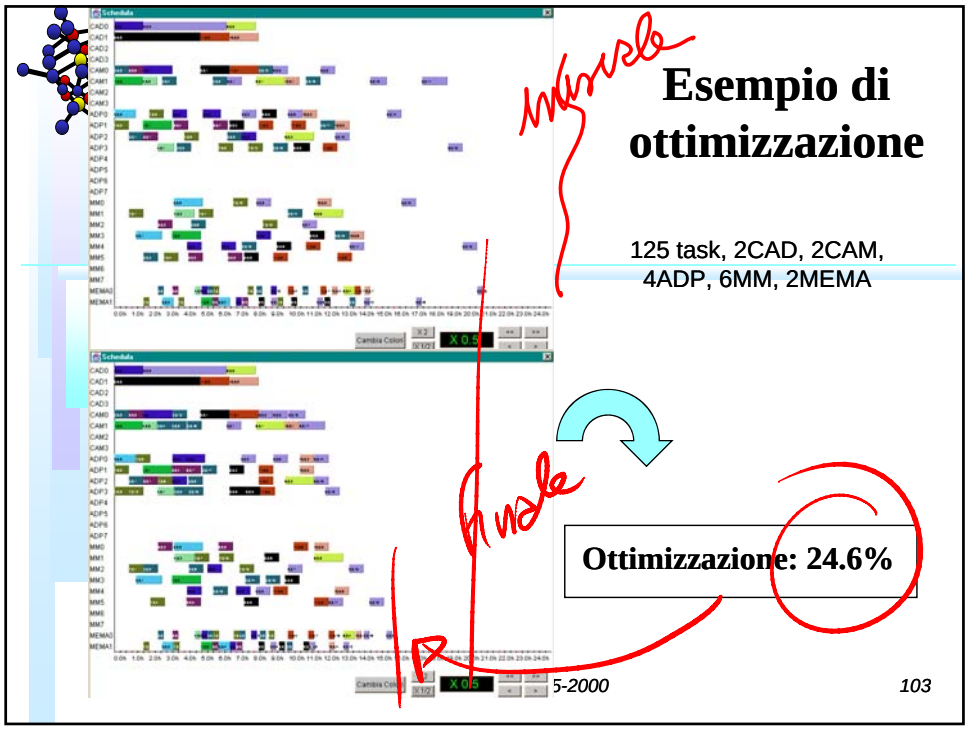
Schedule cumulative for phase before the optimization

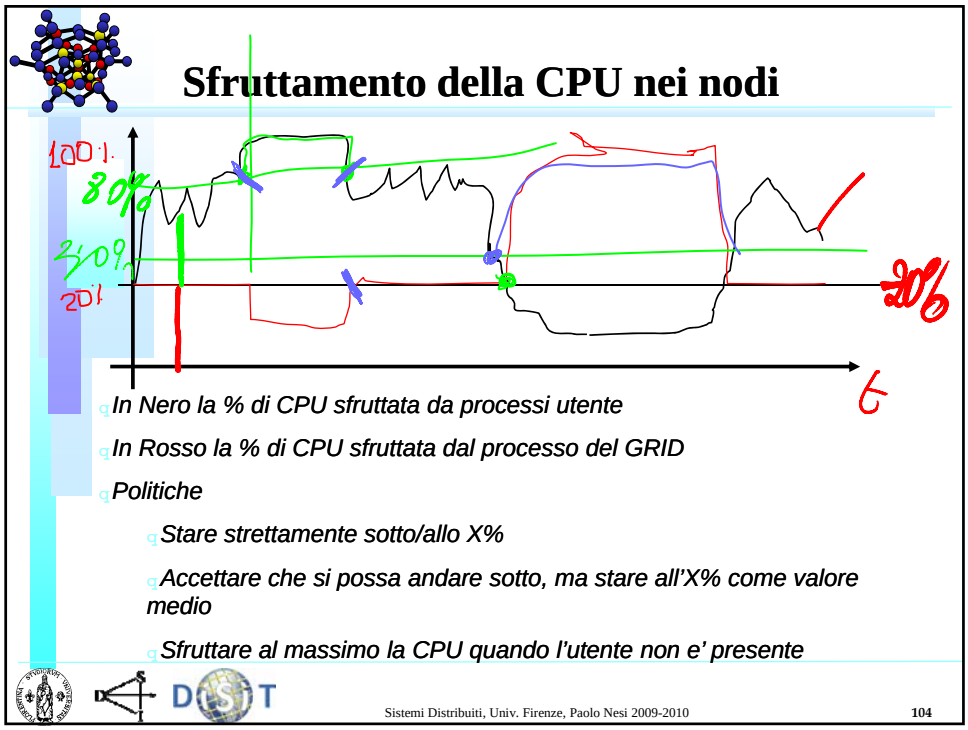


Schedule cumulative for phase after the optimization



Condor JobMonitor Screenshot


Esempio di ottimizzazione
125 task, 2CAD, 2CAM, 4ADP, 6MM, 2MEMA
Ottimizzazione: 24.6%
5-2000
103


Sfruttamento della CPU nei nodi
In Nero la % di CPU sfruttata da processi utente
In Rosso la % di CPU sfruttata dal processo del GRID
Politiche
Stare strettamente sotto/allo X%
Accettare che si possa andare sotto, ma stare all'X% come valore medio
Sfruttare al massimo la CPU quando l'utente non e' presente
Sistemi Distribuiti, Univ. Firenze, Paolo Nesi 2009-2010
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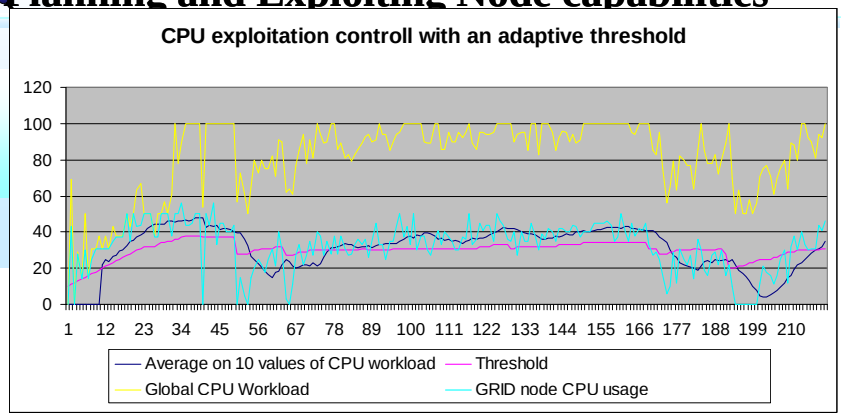
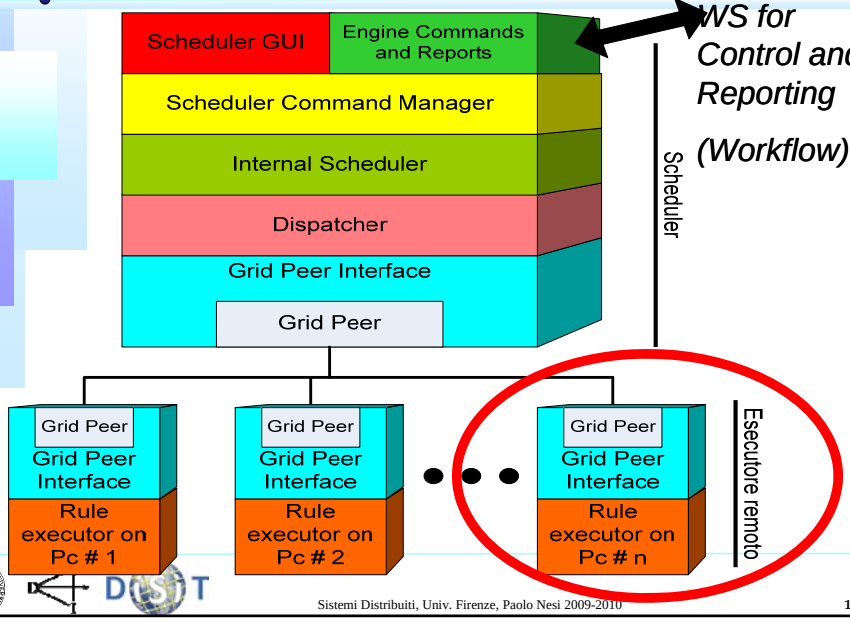
Planning and Exploiting Node capabilities



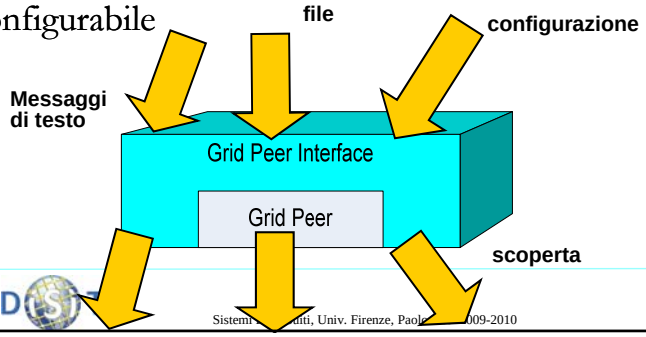
- GRID node has a profile describing its capabilities: time profile, memory, HD, communication, tools and plug ins, etc.

AXMEDIS CP GRID, technical view

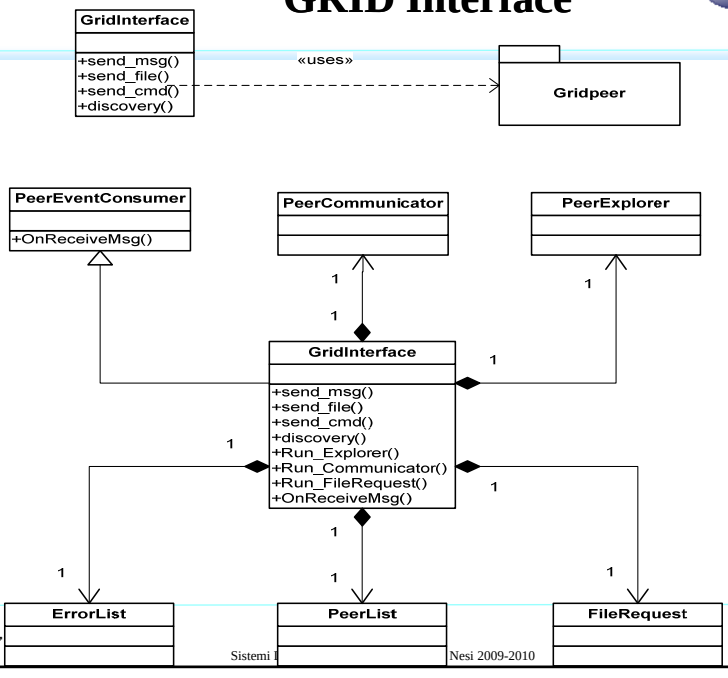


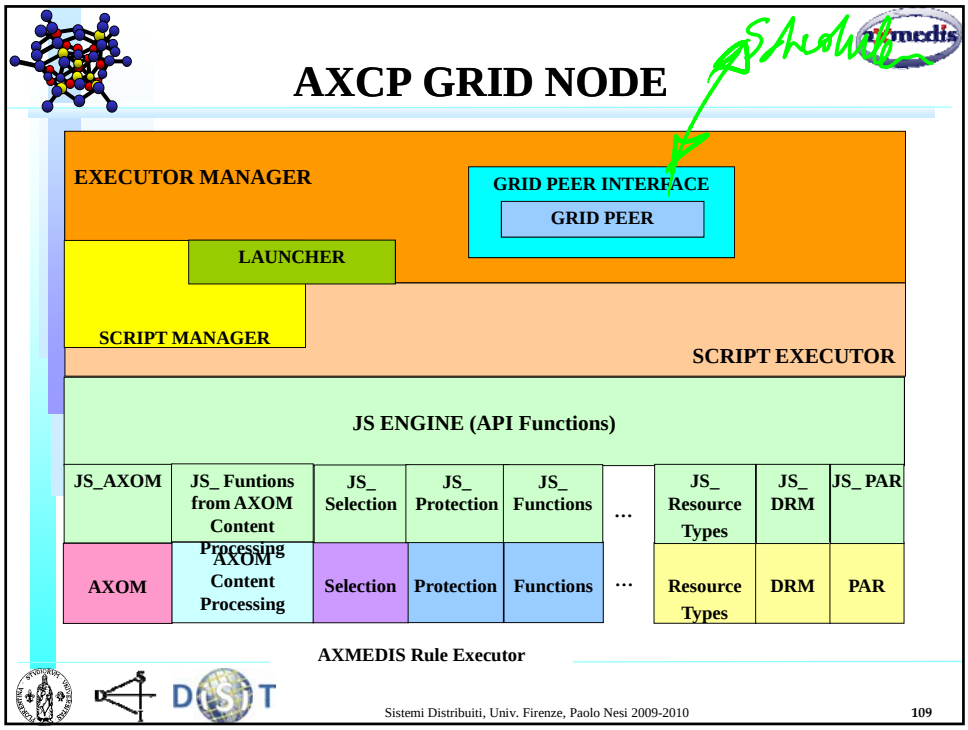
Realizzazione: Grid Peer Interface e Grid Peer

- La Grid Peer Interface rende il sistema indipendente dal tipo di strato di comunicazione utilizzato
- Permette l'invio e la ricezione di messaggi di testo
- Permette l'invio e la ricezione di file
- Permette la scoperta degli esecutori e connessione
- E' configurabile



GRID Interface




AXCP GRID NODE
EXECUTOR MANAGER
GRID PEER INTERFACE
GRID PEER
LAUNCHER
SCRIPT MANAGER
SCRIPT EXECUTOR
JS ENGINE (API Functions)
JS_AXOM
JS_ Funtions from AXOM Content Processing
JS_ Selection
JS_ Protection
JS_ Functions
...
JS_ Resource Types
JS_ DRM
JS_ PAR
AXOM
AXOM Content Processing
Selection
Protection
Functions
...
Resource Types
DRM
PAR
AXMEDIS Rule Executor
Sistemi Distribuiti, Univ. Firenze, Paolo Nesi 2009-2010
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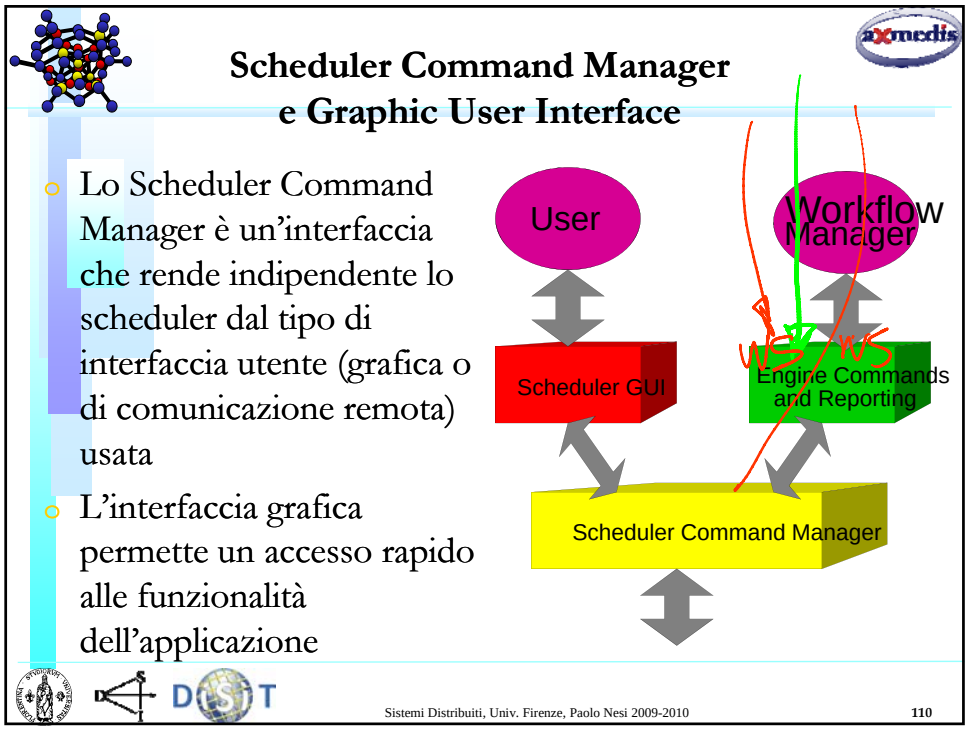
Scheduler Command Manager
e Graphic User Interface
Lo Scheduler Command Manager è un'interfaccia che rende indipendente lo scheduler dal tipo di interfaccia utente (grafica o di comunicazione remota) usata
L'interfaccia grafica permette un accesso rapido alle funzionalità dell'applicazione
User
Workflow Manager
Scheduler GUI
Engine Commands and Reporting
Scheduler Command Manager
Sistemi Distribuiti, Univ. Firenze, Paolo Nesi 2009-2010
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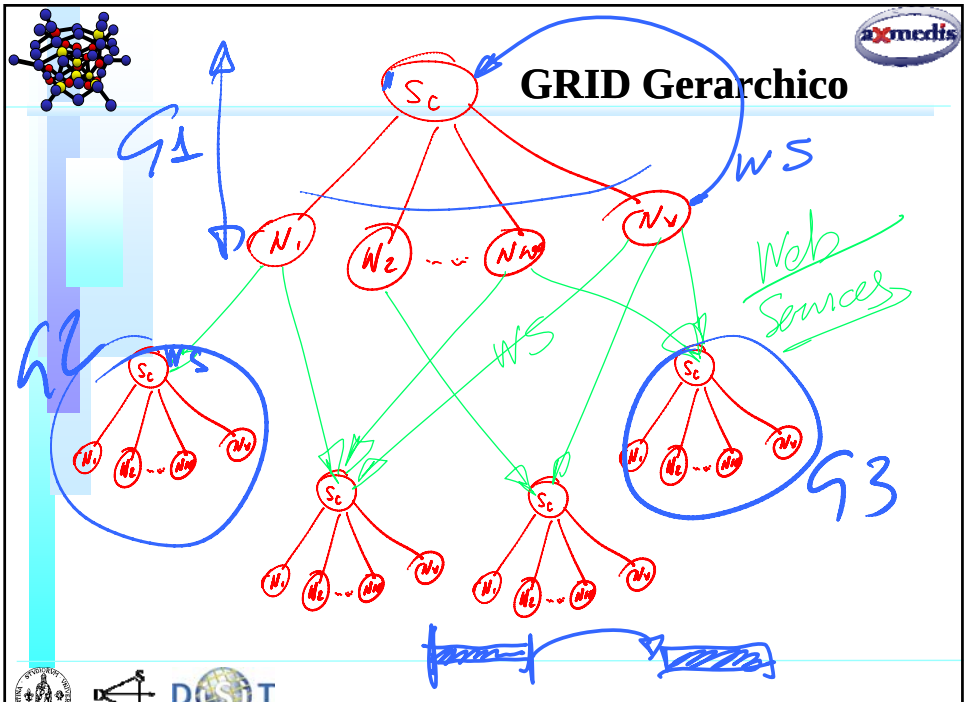
Gestione Gerarchica di microGRID

- Ogni Scheduler identifica un microGRID
- Da ogni nodo del GRID e' possibile inviare richieste ad altri Scheduler e pertanto ad altri microGRID
  - Le richieste vengono inviate tramite chiamate a Web Services
- Si viene a greare una gerarchia di grid e di nodi in tali grid
- I singoli MicroGRID possono essere distirbuiti anche geograficamente, si veine a creare un vero e proprio GRID geografico
- I nodi foglia possono inviare richieste allo scheduler radice, etc.

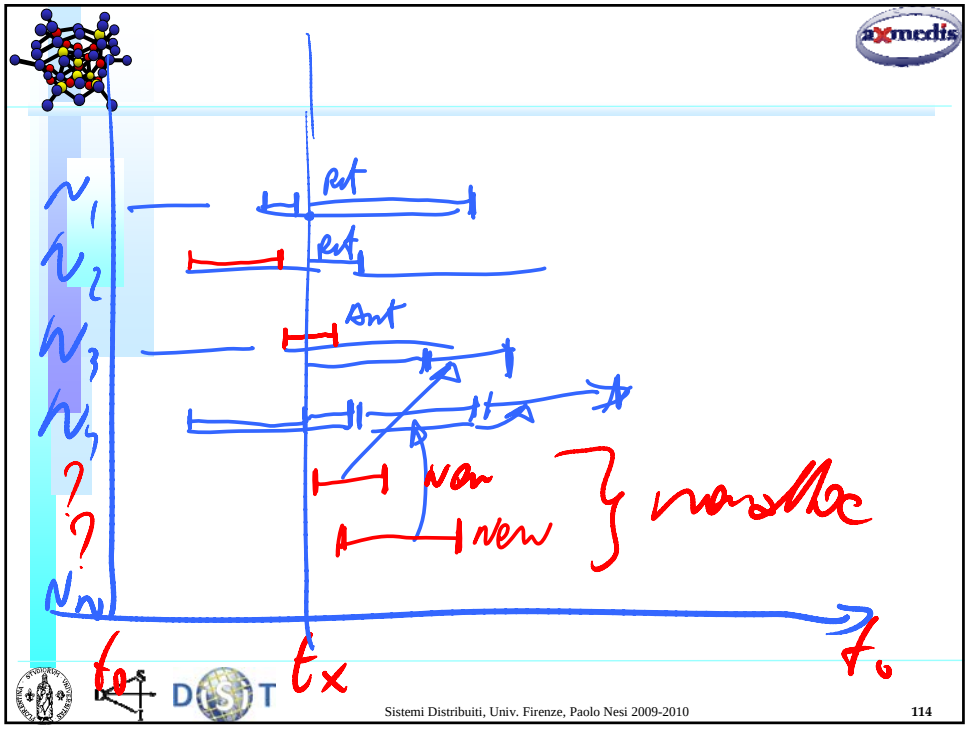
GRID Gerarchico

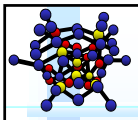


Pianificazione e Ripianificazione

Nell'ottica del controllo della QoS

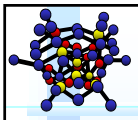
- Sul microGRID come sul GRID viene effettuata una pianificazione dei processi allocandoli sulle risorse (CPU) (righe blu nella prossima slide)
  - Nella pianificazione si devono tenere conto di vari vincoli come: deadline, dipendenze, requisiti computaizone, requisiti in termini di librerie e programmi, memoria, CPU, etc.
- Questa allocazione non e'detto che si verifichi
  - Alcuni processi possono essere eseguiti piu' velocemente, altri piu' lentamente, riespetto ai tempi previsti, etc. (processi rossi nella prossima slide)
- Ogni tanto e'necessario fare una ripianificazione e correzione della situazione (processi verdi nella prossima slide).





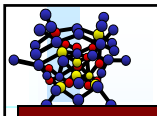
sommario

- Contesto tecnologico
- Architetture Parallele
- The GRID, definizione e motivazioni
- Concetti estesi dei GRID, microgrid
- Applicazioni e problemi dei GRID
- Soluzioni GRID...Globus, Condor
- Soluzioni MicroGRID: AXCP grid
- Confronto fra GRID
- Applicazioni per microGRID

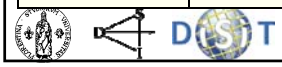
Aspetti e caratteristiche di alto livello

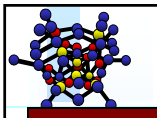
- **Portabilita'**:
  - Su diversi OS e piattaforme
  - Come java script
- **modularita'**:
  - Si possono aggiungere facilmente nuove funzionalita'
- **Riusabilita'**:
  - Si possono aggiungere facilmente nuove funzionalita'
  - Gli script sono parametrizzati
- **Expandibilita'**:
  - Si possono aggiungere facilmente nuove funzionalita'
- **Flessibilita'**:
  - Si possono aggiungere facilmente nuove funzionalita'

GRID comparison 1

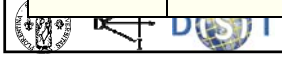
	axmedis	Condor	Globus	Legion	Unicore
Description	Content processing GRID for media	*Network batch and resource manager*	*Bag of Grid Technologies*	*MetaSystem object based*	*Vertical Grid system*
Category	Small Scale	Small Scale Grid	MiddleWare	MiddleWare	MiddleWare
Resource Manager	Central machine Manager	Central machine Manager	GRAM	Collector, Scheduler, Enactor	Incarnation DataBase on Vsite
Resouce Discovery	manifesto	ClassAds	MDS (handles resource informations)	limited	Target System Interface (TSI)
Communication	WS	Remote System Call	Nexus, Globus I/O	Asynchronous message-passing system, LOIDs	Asynchronous Transaction
Fault Tolerance	none	Checkpoint & Migration	Heart Beat Monitor (HBM)	Checkpoint via libraries	Failure Flag
Security	DRM	GSI (X.509) Kerberos (User/Ip based) UIDs	GSI (X.509) SSL (Secure Sockets Layer)	Public-key cryptography based on RSAREF 2.0 Three message-layer security modes MayI (classes security)	SSL X.509
Architecture	hierarchical	Universes structured	"Hourglass" architecture	Everything is an object…	"Three-tier model"

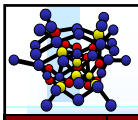




GRID comparison 2

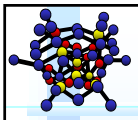
	AXMEDIS	Condor	Globus	Legion	Unicore
OGSA Compliant	NO	No	yes	no	yes
Parallelism	Yes, not internal	No	yes	yes	–
Parameters Studies	Yes	No	yes	yes	–
Necessary changes to user's source code	No, + Extended JS	Re-link with Condor libraries	Re-link with Globus libraries, changes to support parallelism	Directive embedded in Fortran Code; use of MPL to parallelize C++ application; interface for PVM and MPI application	–
Platform	Windows XP, and server	MacOS Linux RedHat 7.x, 8.0, 9 Solaris 2.6, 2.7, 8, 9 IRIX 6.5 Hp-Unix. *Windows NT4, 2000, Xp (con funzionalità ridotte)*	*Server:* Linux *Client:* Linux Any platform that supports JDK	Solaris 5.x IRIX 5.x, 6.5 Linux RedHat 5.x AIX 4.2.1, 4.3 Hp-Unix 11.x Cray Unicos (as a virtual host only)	*Server:* Unix Linux *Client:* Any platform that support Java (J2RE) 1.4 o superiori





GRID comparison 3

	AXMEDIS	Condor	Globus	Legion	Unicore
Languages	Any language is viable, JS is the glue to put in execution	*Application:* C C++ Java	*Application:* C Java	*Application:* C++ MPL (an extension of C++) Fortran	*Application:* Java *Middleware:* Java 2.0
Requirements	Windows	On Windows: at least 50 MBytes of free disk space NTFS or FAT	–	250–300 MB of free disk space at least 256 MB virtual memory /bin/ksh installed	–
Licence	Source code available	Source code available on mail request	(Open source)	Binaries packages only	Open source
Links	www.axmedis.org	www.cs.wisc.edu/condor (necessary state name, e-mail and organization)	www.globus.org	www.legion.virginia.edu (Legion RSA libraries are available separately; from 1/1/03 contact Avaki.com for all inquiries about Legion)	www.unicorepro.com

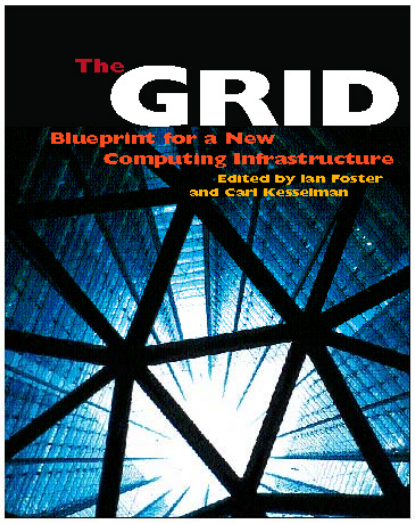


Multimedia GRIDs for the future applications Comparison (IEEE Multimedia March 2009)

	Content management	Content analysis	Media streaming	Interactive controls	Parallel processing
Access Grid	Y	Y	Y		
GridCast	Y		Y	Y	
mmGrid		Y	Y	Y	
gMOD	Y		Y	Y	
MediaGrid	Y		Y	Y	Y
AE@SG	Y				
Parallel-Horus	Y	Y			Y
Context Aware MM Middleware	Y	Y	Y		Y
AXMEDIS	Y	Y	Y	Y	Y

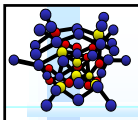
For More Information

- Globus Project™
  - www.globus.org
- Grid Forum
  - www.gridforum.org
- Book (Morgan Kaufman)
  - www.mkp.com/grids
- Survey + Articoli
  - www.mcs.anl.gov/~foster



references

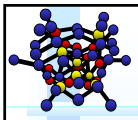
- *I. Foster, C. Kesselman, The Grid, 2nd ed. Morgan Kaufmann, 2004.*
- *F. Berman, G. Fox, T. Hey, Grid Computing, Wiley, 2003.*
- *Burkhardt J. , et al., Pervasive Computing, Addison Wesley, 2002.*
- *Hansmann U., Merk L., Nicklous M.S., Stober T., Pervasive Computing, Springer Professional Computing, 2nd ed., 2003.*
- *A. S. Tanenbaum, M. Van Steen, "Distributed Systems", Prentice Hall, 2002*



Grid Project References

- Open Science Grid
  - www.opensciencegrid.org
- Grid3
  - www.ivdgl.org/grid3
- Virtual Data Toolkit
  - www.griphyn.org/vdt
- GriPhyN
  - www.griphyn.org
- iVDGL
  - www.ivdgl.org
- PPDG
  - www.ppdg.net
- AXMEDIS
  - www.axmedis.org
- CHEPREO
  - www.chepreo.org
- UltraLight
  - www.ultralight.org
- Globus
  - www.globus.org
- Condor
  - www.cs.wisc.edu/condor
- WLCG
  - www.cern.ch/lcg
- EGEE
  - www.eu-egee.org

- *From AXMEDIS you can download the installable tool to set up your GRID*

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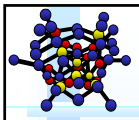
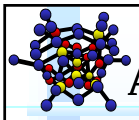


Key Issue: dynamic and real time

- **Devices and content formats** are not static
  - Emerging devices and formats
  - Dynamic market in terms of possibilities and content types and formats
  - Players with support for numerous content types and formats
  - Players accessible on different devices..
    - ➔Interoperability
- **Back office computing** for
  - Content Management Systems, Media Management Systems and Social Networks, Content Delivering Network, etc...
  - reccomendations, suggestion, indexing, etc.
  - Similarity distance, ...
  - Crawling di dati e contenuti
  - Content processing
    - ➔Content composition and formatting

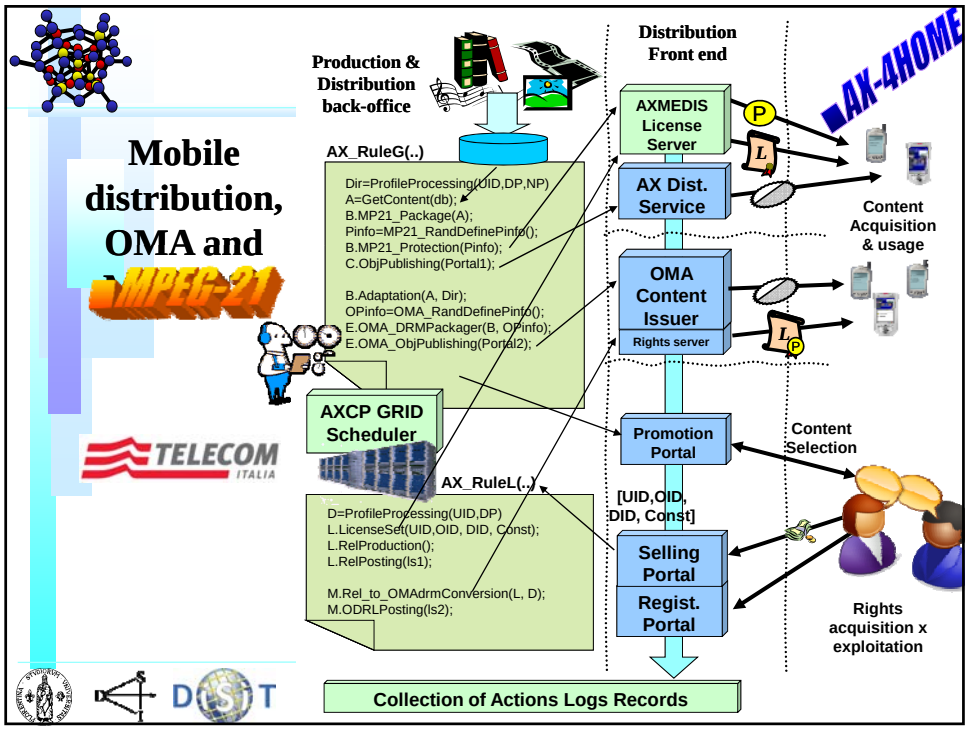


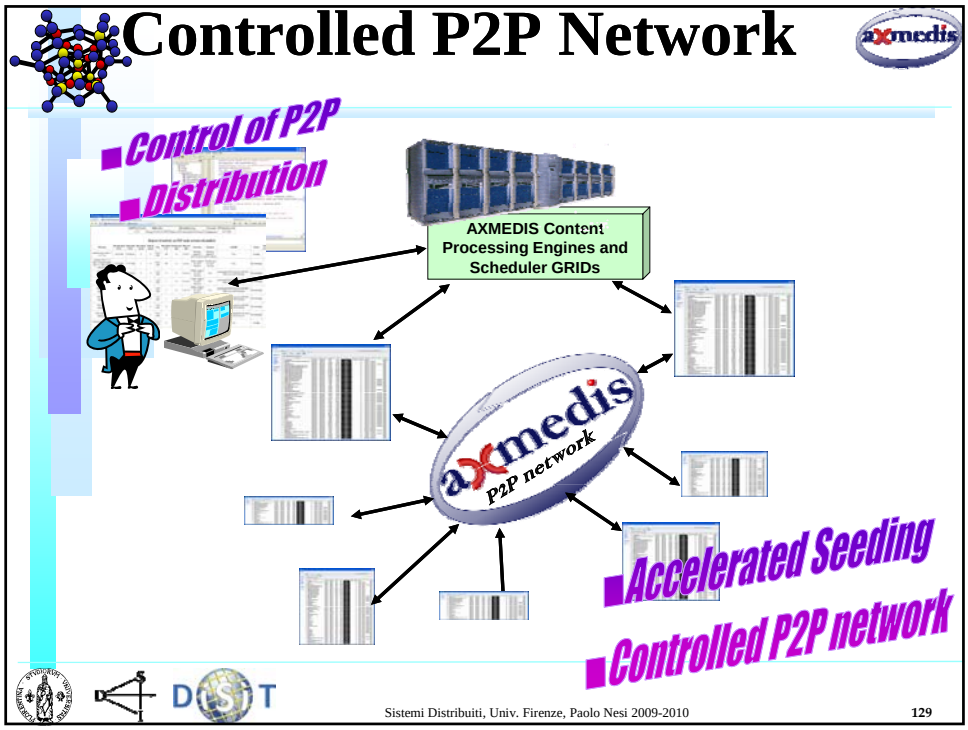
Applicazioni AXMEDIS GRID, AXCP

- **On-demand** distribution:
  - Production on the basis of requests and profiling (user device, network, etc.), etc.
  - Request depending adaptation and processing
- **Multi-channel** distribution
  - Differing receiving devices, Differing distribution modalities
  - Multiple interoperable DRMs, license chain processing
- **Profile management and processing**
  - user profile, network capabilites, device capability
  - deciding about content production and adapation
  - activites have to be done in real time for VOD,
  - production on demand, etc.

Applicazioni AXCP GRID come piattaforma

- **Monitoring**:
  - Broadcast channels and networks,
  - Peer-To-Peer networks, Websites, etc.
  - streams of audio and/or video signals
  - Real time estimation of Fingerprint/watermark
    - Canali internet gateway, P2P, Broadcast
- **query and indexing** on distributed databases
  - decomposizione dello spazio di ricerca
- Definition of fault tolerant architectures for data and/or processing GRID
  - Distributed computing and database




Controlled P2P Network
Control of P2P Distribution
AXMEDIS Content Processing Engines and Scheduler GRIDs
axmedis P2P network
Accelerated Seeding
Controlled P2P network
Sistemi Distributi, Univ. Firenze, Paolo Nesi 2009-2010
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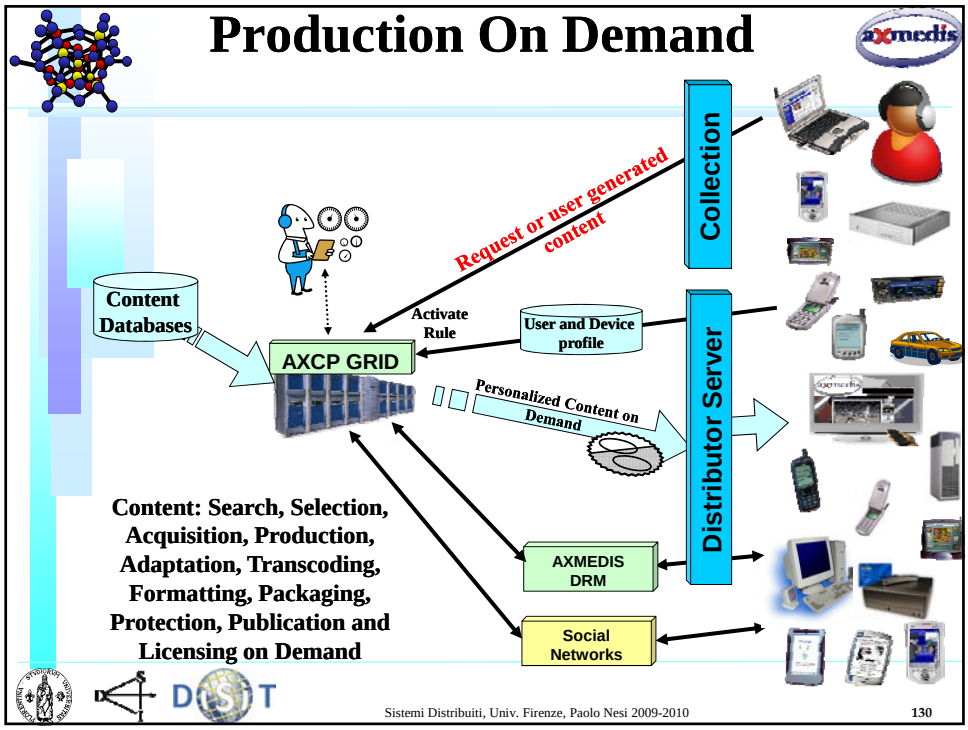
Production On Demand
Request or user generated content
Collection
Content Databases
Activate Rule
User and Device profile
AXCP GRID
Personalized Content on Demand
Distributor Server
Content: Search, Selection, Acquisition, Production, Adaptation, Transcoding, Formatting, Packaging, Protection, Publication and Licensing on Demand
AXMEDIS DRM
Social Networks
Sistemi Distributi, Univ. Firenze, Paolo Nesi 2009-2010
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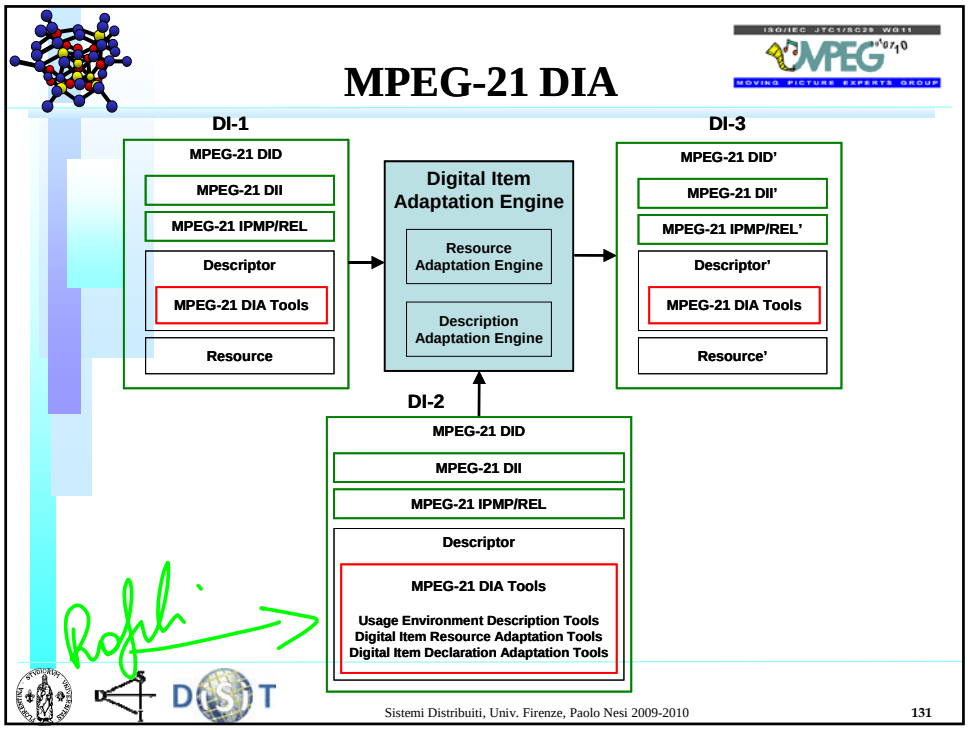
MPEG-21 DIA
DI-1
MPEG-21 DID
MPEG-21 DII
MPEG-21 IPMP/REL
Descriptor
MPEG-21 DIA Tools
Resource
Digital Item Adaptation Engine
Resource Adaptation Engine
Description Adaptation Engine
DI-3
MPEG-21 DID'
MPEG-21 DII'
MPEG-21 IPMP/REL'
Descriptor'
MPEG-21 DIA Tools
Resource'
DI-2
MPEG-21 DID
MPEG-21 DII
MPEG-21 IPMP/REL
Descriptor
MPEG-21 DIA Tools
Usage Environment Description Tools
Digital Item Resource Adaptation Tools
Digital Item Declaration Adaptation Tools
Sistemi Distribuiti, Univ. Firenze, Paolo Nesi 2009-2010
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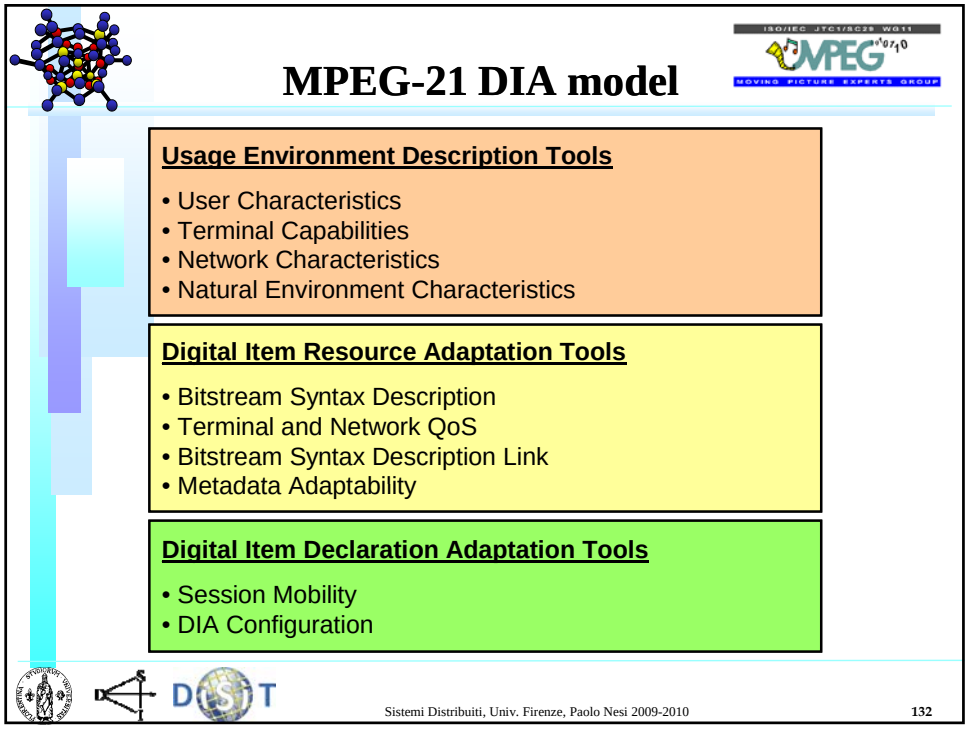
MPEG-21 DIA model
Usage Environment Description Tools
• User Characteristics
• Terminal Capabilities
• Network Characteristics
• Natural Environment Characteristics
Digital Item Resource Adaptation Tools
• Bitstream Syntax Description
• Terminal and Network QoS
• Bitstream Syntax Description Link
• Metadata Adaptability
Digital Item Declaration Adaptation Tools
• Session Mobility
• DIA Configuration
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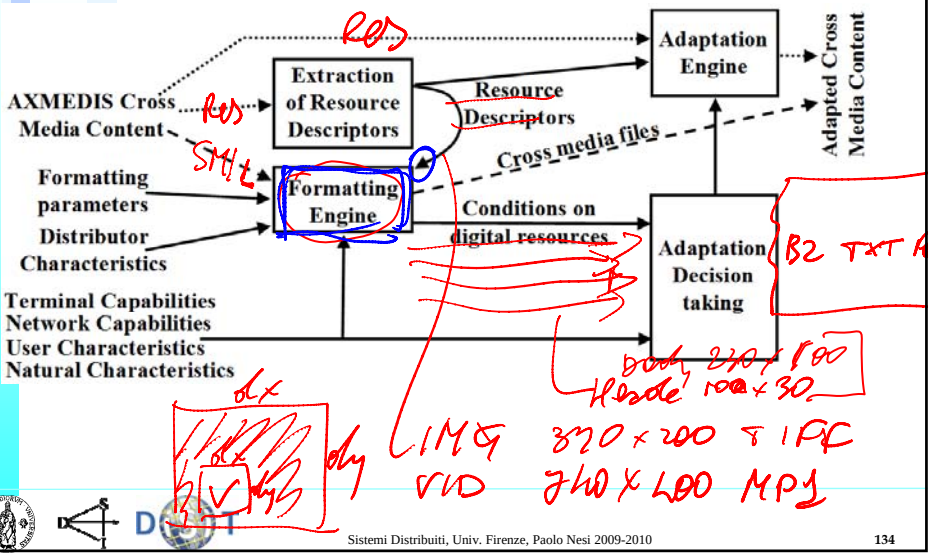
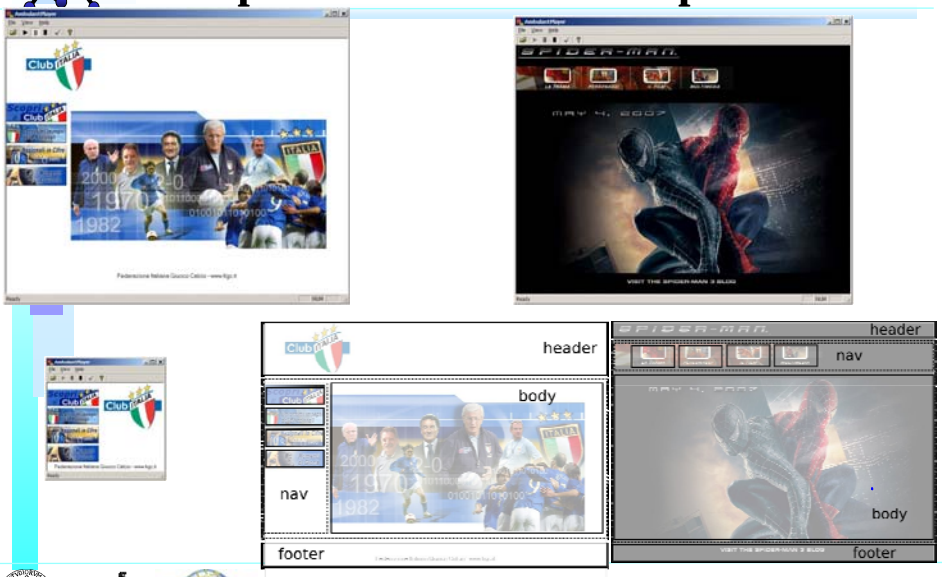
Profiling, MPEG-21 DIA

- The *device/terminal capabilities* include codec capabilities (specific parameters for each codec), display capabilities, included players features, interactivity features, power consumption, memory, CPU power in terms of MIPS or MFLOPS, storage, etc.
- The *network capabilities* (such as: maximum capacity, minimum bandwidth, quality indicators, etc.) and conditions (such as: delay and errors related to capabilities, etc.).
- The *user characteristics* such as: user information in MPEG-7; user preferences; user history including (e.g., the actions performed on DIs), presentation preferences such as preferred rendering of audiovisual and textual information, accessibility features (for example, audio left/right balance and color arrangement), location characteristics (such as: mobility characteristics and destination, for example for describing the user movements).
- The *natural environment characteristics* are related to the physical environment such as light conditions, time, location, environmental noise, etc.

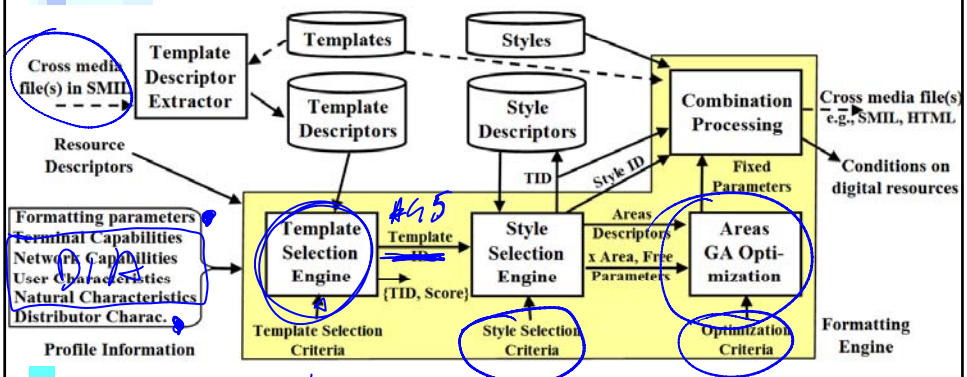
Cross media Content Adptation



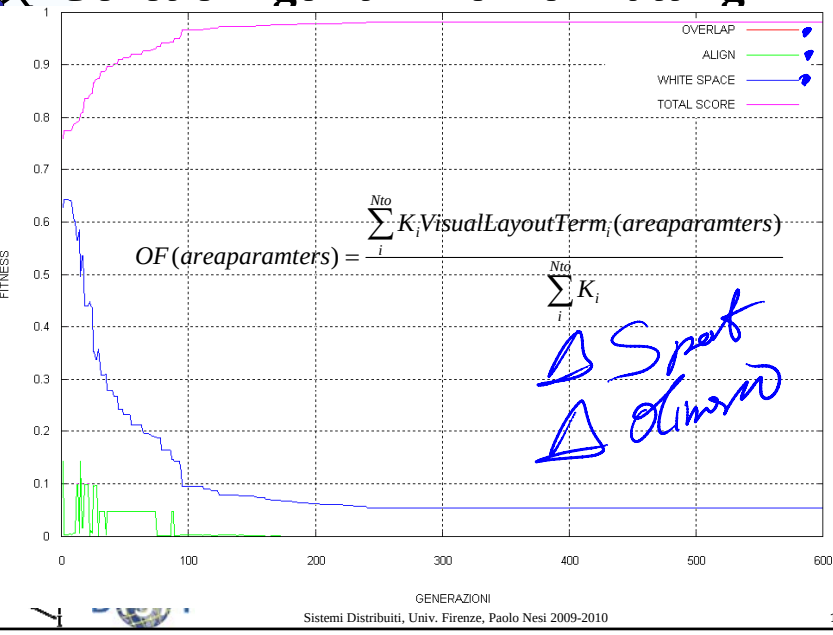
Examples of Cross media Adapation



Formatting Engine



Genetic Algorithm for formatting



$$OF(areaparamters) = \frac{\sum_{i}^{Nto} K_i VisualLayoutTerm_i(areaparamters)}{\sum_{i}^{Nto} K_i}$$

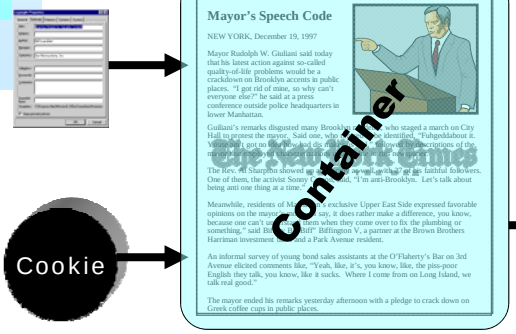
Adaptation of audio content

- Functionalities:
  - Support a variety of file formats and codecs (mp3, wav, aiff, wma…)
  - Supports down-sampling and channel-mixing
  - Allows selecting precisely a piece of a file
  - Support for MPEG-21 Digital Item Adaptation descriptors:
    - adapt to a particular user's presentation or rendering preferences
    - adapt to a particular user's auditory deficiency
    - adapt to output capabilities of the terminal

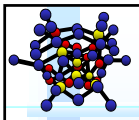
Adaptation of multimedia content

- Functionalities
  - Allows creating generic multimedia files (3GP, MP4 ISMA compliant)
  - Adaptation of aggregated simple media files (MPEG-4 audio and video, MPEG-1/2 audio and video, JPEG images, AVI files, SRT subtitles…)
  - Media tracks may be added, removed and delayed
  - Extraction of single track from multimedia files
  - File splitting by size or time
  - Concatenation of multimedia files
  - Conversion between different multimedia scene formats (MP4, BT, XMT, SWF, X3D, SMIL…)

Watermark: Persistent Association



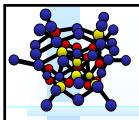
- Watermark
- Encryption



Watermark

- What is the watermark (also called steganographic)
  - a technology to embed an information in the content: image, video, text, audio, etc
- Which information is watermarked:
  - Object ID
  - Owner ID
  - Distributor ID
  - Eventual coding of the license (governed object)
  - Etc.
- Once read it can be used
  - to hide IDs to demonstrate the ownership of the content
  - To hide a sort of license





Watermark features

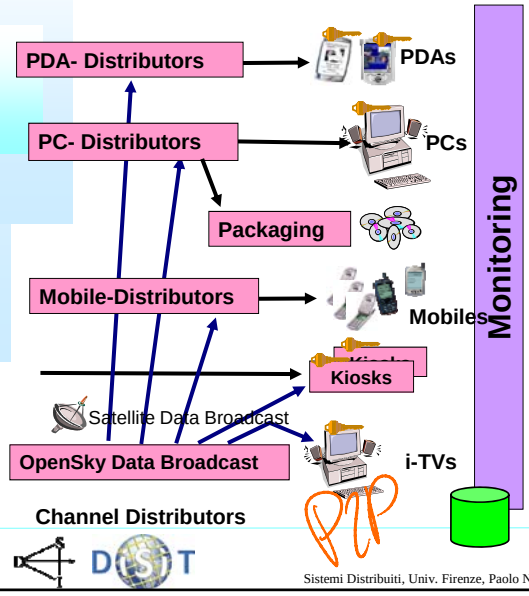
- Transparency: visible, invisible
- Robustness: tolerance to attacks
  - Adaptation, DA-AD
- Capacity: amount of information embedded
- Blindness: reference to the source image Hidden or visible
- Removable or not:
  - when it is separable from the digital resource obtaining the original digital resource
- Single of multiple:
  - when more than one Watermark is present
- Readable
  - by all or only by the owner: when there is not need to have a special key/parameters to read it
  - with an absolute certainty or with some statistical confidence
  - To be estimated during streaming
- Etc.



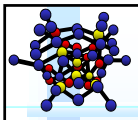
Usage of Watermark

- **Content Producers/Distributor**
  - ♣ watermark the content (images, audio, video, etc.)
- **Content integrators and distributors**
  - ♣ are informed and may add one more watermark with their code or reference
- **End users**
  - ♣ are not aware about that, if it is undetectable is easy
- **The terminal**
  - ♣ may or may not be capable to read it

Usage of Watermark

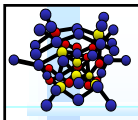


- Then Content Owners, may monitor
  - ♣ distribution channels
  - ♣ published content collection
  - ♣ Etc.
- Reading the WM
  - ♣ To detect the passage of their content
  - ♣ To verifying the presence of violations of IPR



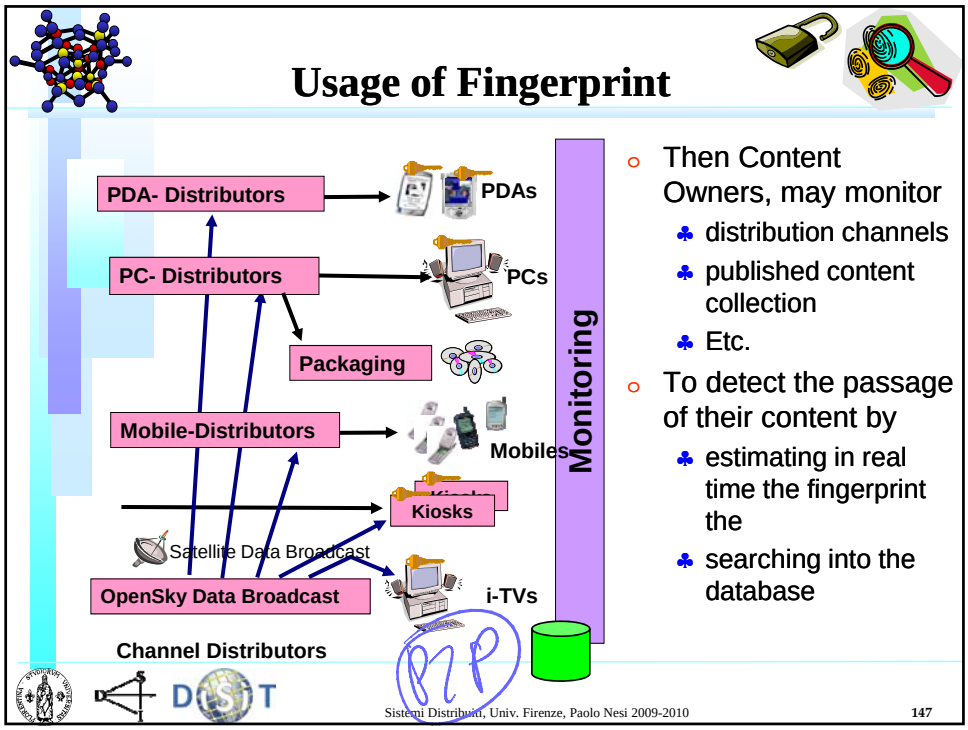
Fingerprint and descriptors

- **What is the Fingerprint**
  - It is an ID-code estimated on the digital content or resource that present in practical an high probability to be unique for that content with respect to other similar content
  - To make the recognition of the digital content possible
    - Indexing into the database
- **Fingerprint as a high level content descriptor**
  - Resources
    - Audio: Rhythm, tonality, duration, genre, etc.
    - Video: number of scenes, description of the scene, etc.
    - Text: main keywords, summary, topics, etc.
  - Collected as MPEG-7 descriptors
  - Vectors of those features, etc.
  - Independent on the resolution, format, etc.
  - May be Computationally intensive
  - Etc.



Fingerprint Features

- **Features**:
  - Never included with the content if its aim is the usage for content protection
  - Included in the content (package) only if it is used as content descriptor
  - Robust to adaptation processing: Scaling: time, space, color, etc.
  - Short and concise
  - Repeatable
  - Light to be estimated
    - estimable during streaming, on the basis of a short duration of the content streaming
  - Robust to eventual watermark addition
  - Etc.
- **Typically more computational intensive** with respect to WM:
  - The WM code is read/extracted from the content
  - The FP code has to be estimated from the content


Usage of Fingerprint
PDA- Distributors
PDAs
PC- Distributors
PCs
Packaging
Mobile-Distributors
Mobiles
Kiosks
Satellite Data Broadcast
OpenSky Data Broadcast
i-TVs
Channel Distributors
Monitoring
Then Content Owners, may monitor
distribution channels
published content collection
Etc.
To detect the passage of their content by
estimating in real time the fingerprint the
searching into the database
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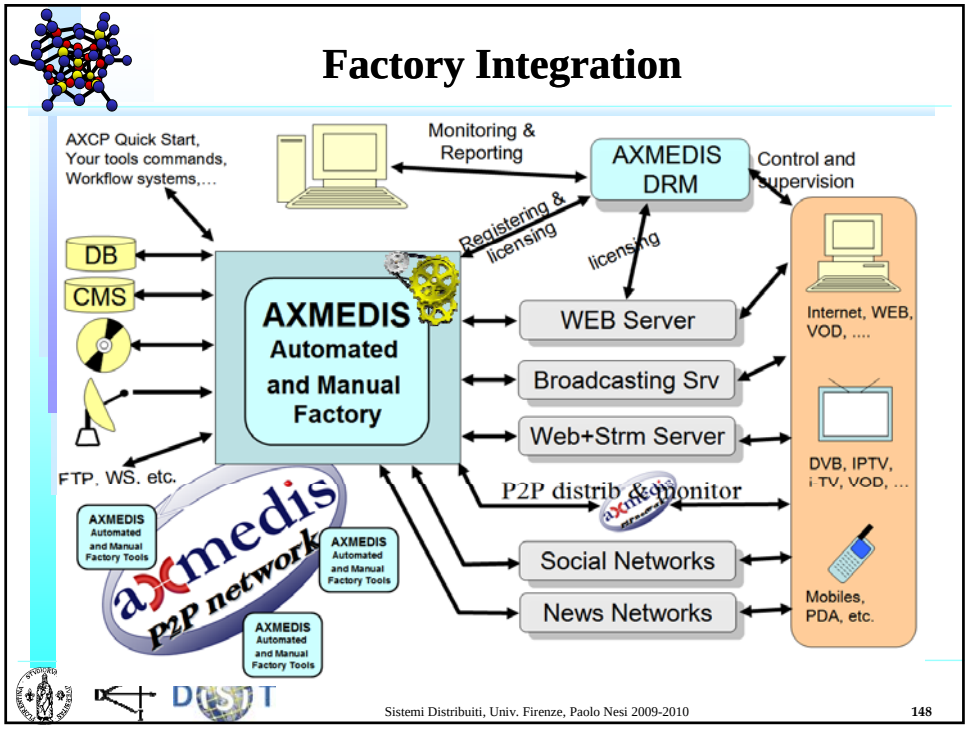
Factory Integration
AXCP Quick Start,
Your tools commands,
Workflow systems,...
Monitoring & Reporting
AXMEDIS DRM
Control and supervision
Registering & licensing
licensing
DB
CMS
FTP, WS, etc.
AXMEDIS Automated and Manual Factory
WEB Server
Broadcasting Srv
Web+Strm Server
P2P distrib & monitor
Social Networks
News Networks
Internet, WEB, VOD, ...
DVB, IPTV, i TV, VOD, ...
Mobiles, PDA, etc.
axmedis P2P network
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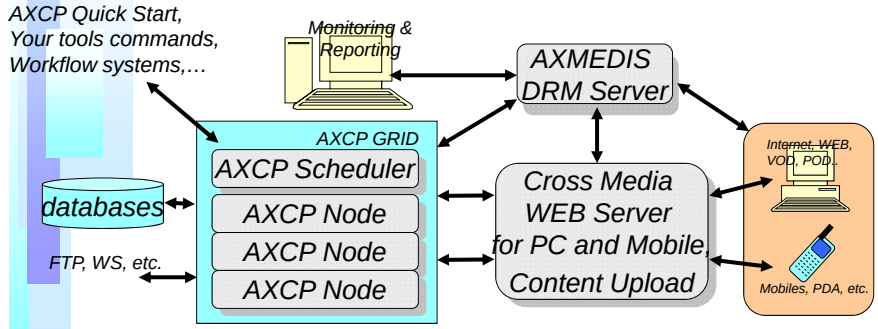
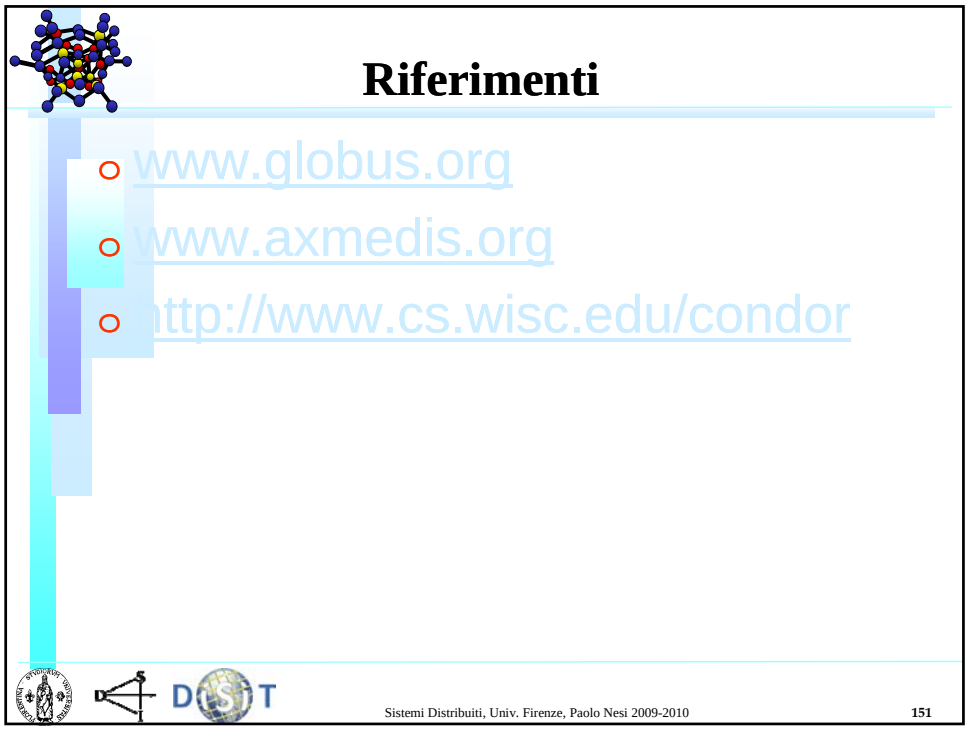
Mobile Medicine



Cross Media distribution portal for multichannel:
PC, PDA, iPhone, iPod, mobile, etc.
Production tools and players, for PC and PDA
AXMEDIS AXCP GRID backoffice server: **semantic computing**
AXMEDIS DRM: for rights control and security

AXCP on Social Network

- GRID computing viene utilizzato per:
  - Calcolo delle raccomandazioni:
    - UtentiUtenti, ContentUtenti, GruppiU, CC, etc.
  - Indexing e reindexing content: audio video, images, ..
  - Indexing e reindex testo: comments, documents, etc.
    - multi lingue, ml metadati, full text,
    - Similarity distance via fuzzy analysis
    - text analysis for ontology population
  - Adattamento e trascodifica per diversi terminali
  - Gestione del back office e workflow
  - Social network analysis: UU, UO, OO, clusters,..
  - Etc.


Riferimenti
www.globus.org
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