Memory of Master

Higher School of Sciences
and Techniques of Tunis

A Decentralized Approach for Resource Reservation in Desktop Grid

Realised by :

Nesrine KHOUZAMI

Outline

- Introduction
- Problematic
- Existing approaches
- BonjourGrid
- Proposed approach
- Implementations
- Experimentations
- Conclusion and perspectives

Introduction (1/2)

- Desktop grids
  - Goal
    - Collect many computers when they are inactive.
    - Address scientific problems that require intensive computing capacity.
  - Examples
    - SETI@Home, ClimatePrediction@Home, XtremWeb, etc.
  - Architectures
    - Centralized, hybrid, decentralized.
  - Specifications
    - Volatility
    - Dynamic environment
    - Unreliability
    - Failure of resources
    - Heterogeneity
    - Scalability
    - Voluntary participation

Introduction (2/2)

The problem of selfishness

Definition

- Exploit resources disposed by other peers without contributing its own to the system.
- Two types of peers:
  - Selfish
  - Contributor

Causes

- Additional cost.
- No differentiation between selfish and contributor peers.
- Lack of incentives.

Impacts

- Move towards the use of client/server paradigm
- Affect the quality of service.
- etc.

Outline

- Introduction
- Problematic
- Existing approaches
- BonjourGrid
- Proposed approach
- Implementations
- Experimentations
- Conclusion and perspectives

Problematic (1/3)

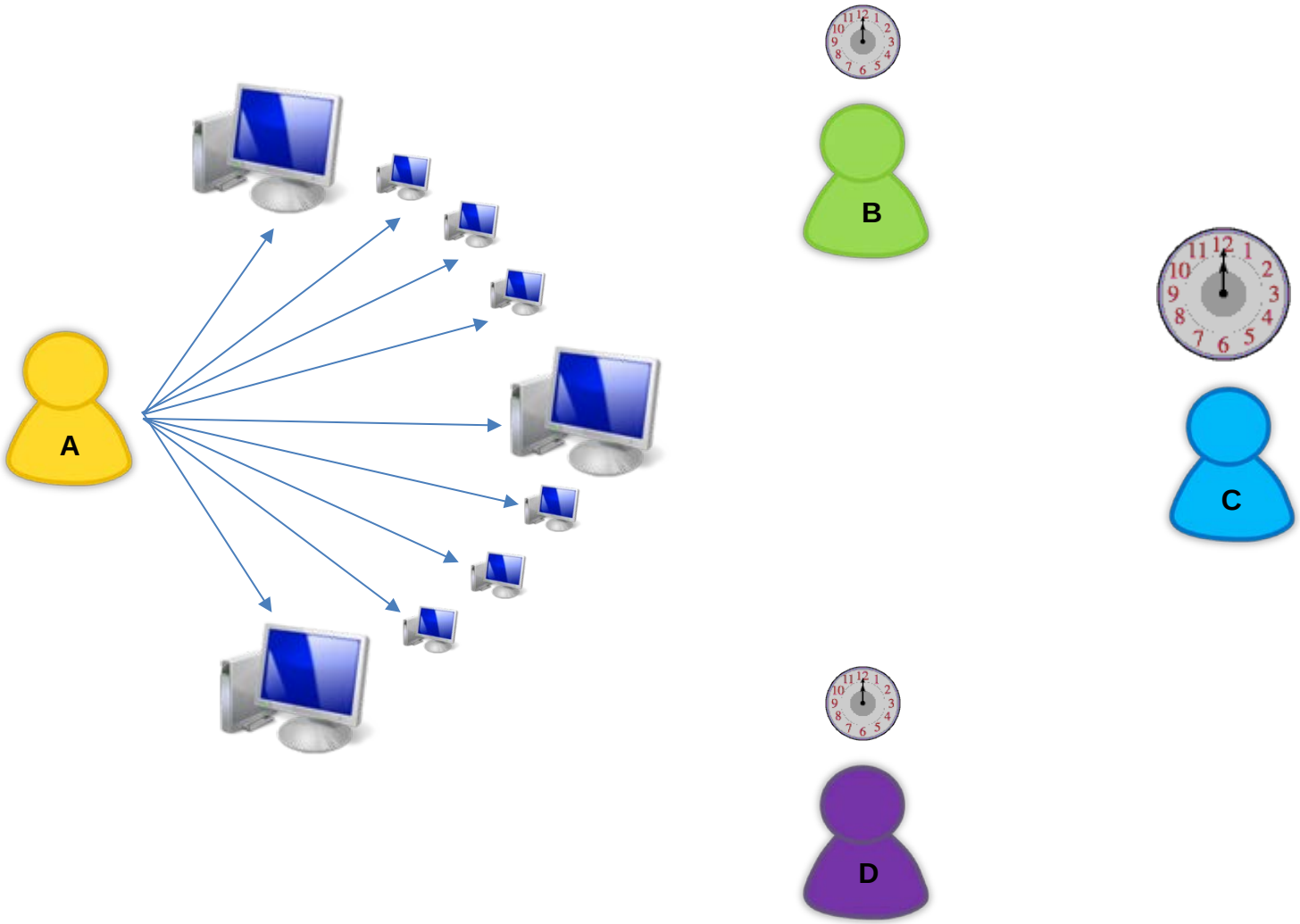
Absence of mechanism for resource reservation in BonjourGrid

Permanent occupation of resources notebly by selfish peers

Use of resources by peers to the detriment of others

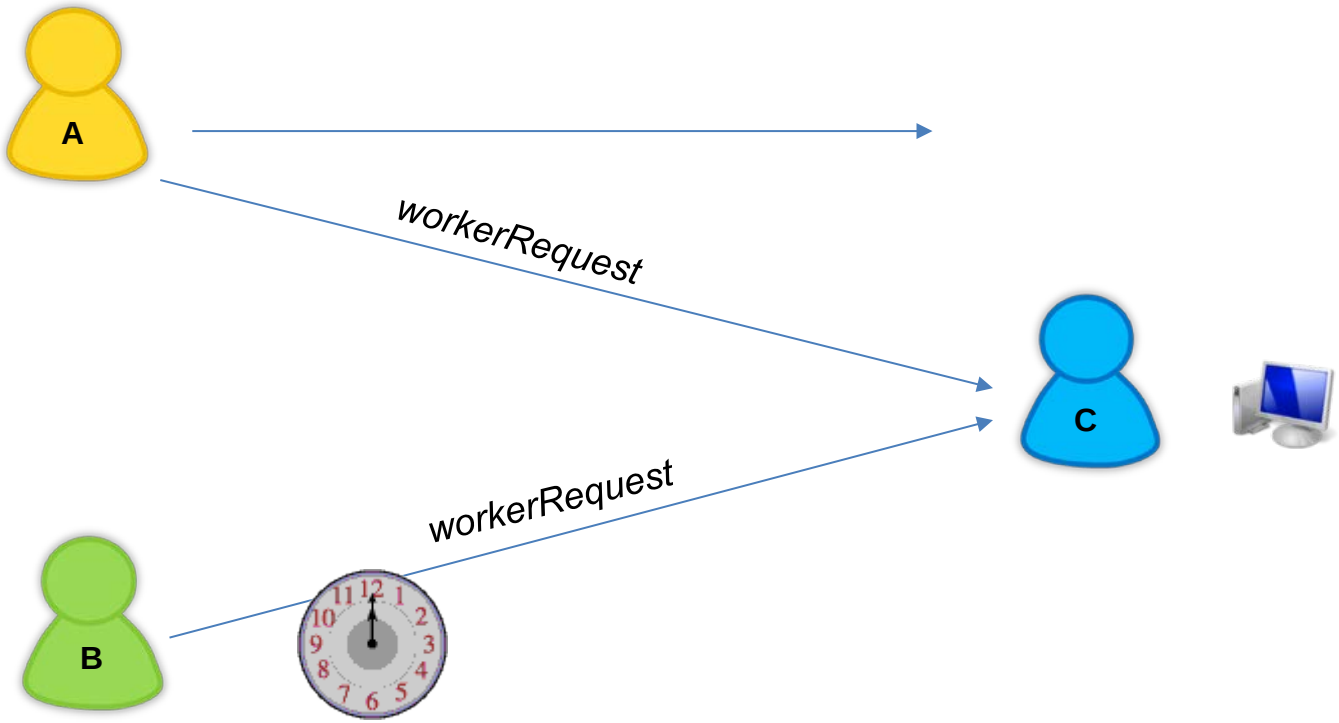
Problematic (2/3)

- Scenario 1



Problematic (3/3)

- Scenario 2



Outline

- Introduction
- Problematic
- Existing approaches
- BonjourGrid
- Proposed approach
- Implementations
- Experimentations
- Conclusion and perspectives

Existing approaches (1/3)

- Micropayment approaches
  - Definition
    - The exchange of resources requires a monetary transaction managed by a central authority.
    - Two modes of exchange :
      - Online
      - Offline
  - Exemples
    - PPay, FairPeers, Karma, etc.
  - Disadvantages
    - Centralization.
    - Persistent identifiers.
    - etc.

Existing approaches (2/3)

- Reciprocity approaches
  - Definition
    - Prioritizing peers according to their quality of service provided based on historical behavior.
    - Two types of reciprocity:
      - Direct.
      - Indirect.
  - Examples
    - BitTorrent, PSH.
  - Disadvantages
    - Sustainability of peers connections.
    - Cost of peers searching.

Existing approaches (3/3)

- Reputation appraoches
  - Definition
    - The level of confidence in such a peer is proportional to its reputation score as a result of its previous interactions.
    - Two types of reputation :
      - Local.
      - Global.
  - Properties and challenges
    - Calculation model
    - Metric of reputation
    - Type of reputation
    - Fiability
    - Local control
    - Cost of communication
    - Cost of storage
    - Scalability
  - Examples
    - PeerTrust, EigenTrust, Gupta & al, NICE, H-Trust, XRep.

Outline

- Introduction
- Problematic
- Existing approaches
- BonjourGrid
- Proposed approach
- Implementations
- Experimentations
- Conclusion and perspectives

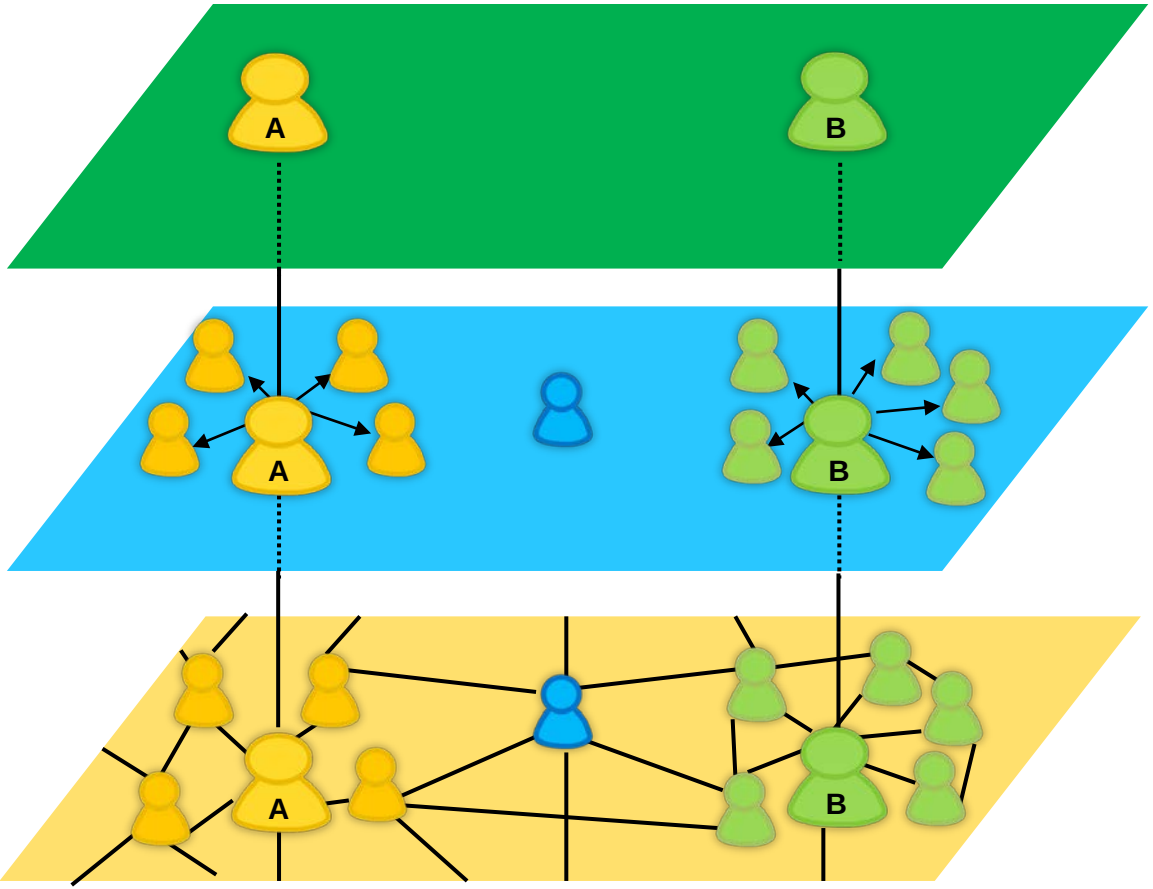
BonjourGrid (1/5)

Goal

- Reduce the factor of centralization.
- Benefit from the existing decentralized tools of resources discovery
- Build an execution environment in a decentralized, dynamic and autonomous manner.
- Create a computing element composed of a coordinator and participating machines.

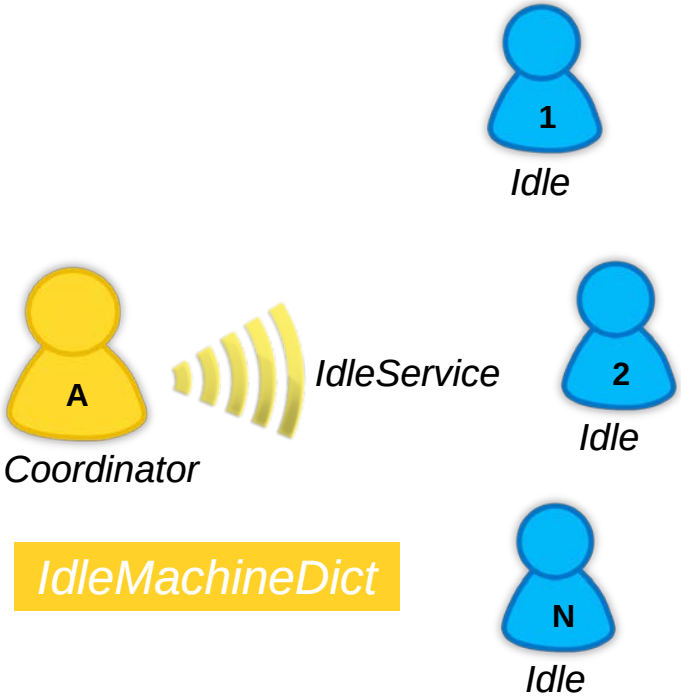
BonjourGrid (2/5)

- Levels of BonjourGrid



BonjourGrid (3/5)

- Construction of computing element



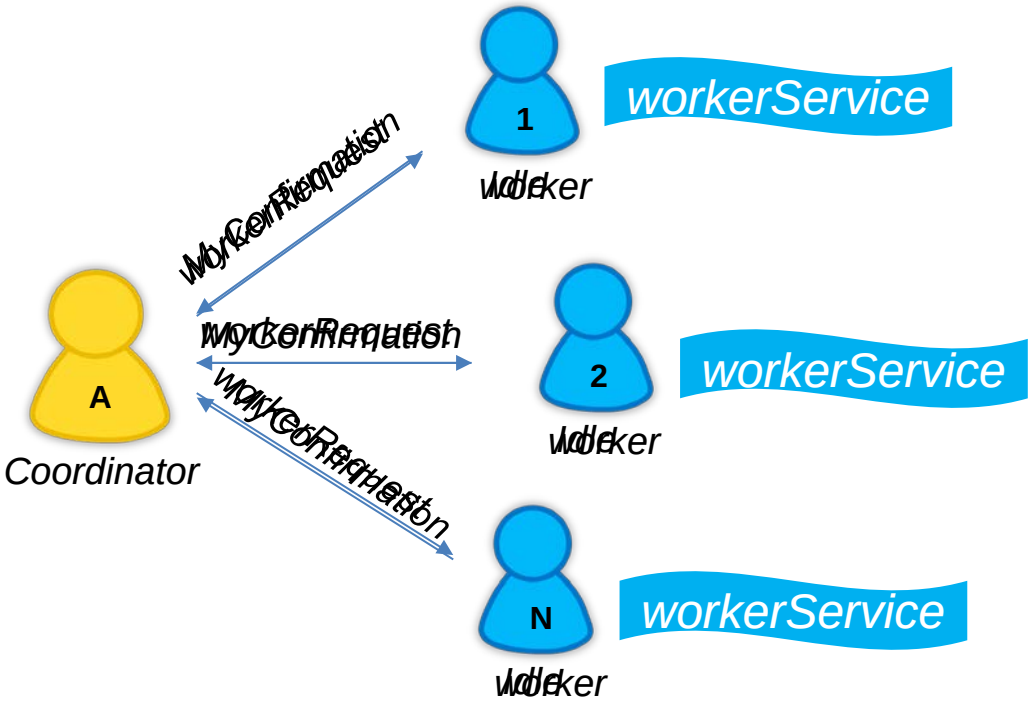
- CPU frequency
- Type of processor
- Size of the volatile memory
- etc.

MyWorkersDict

Nbre N required

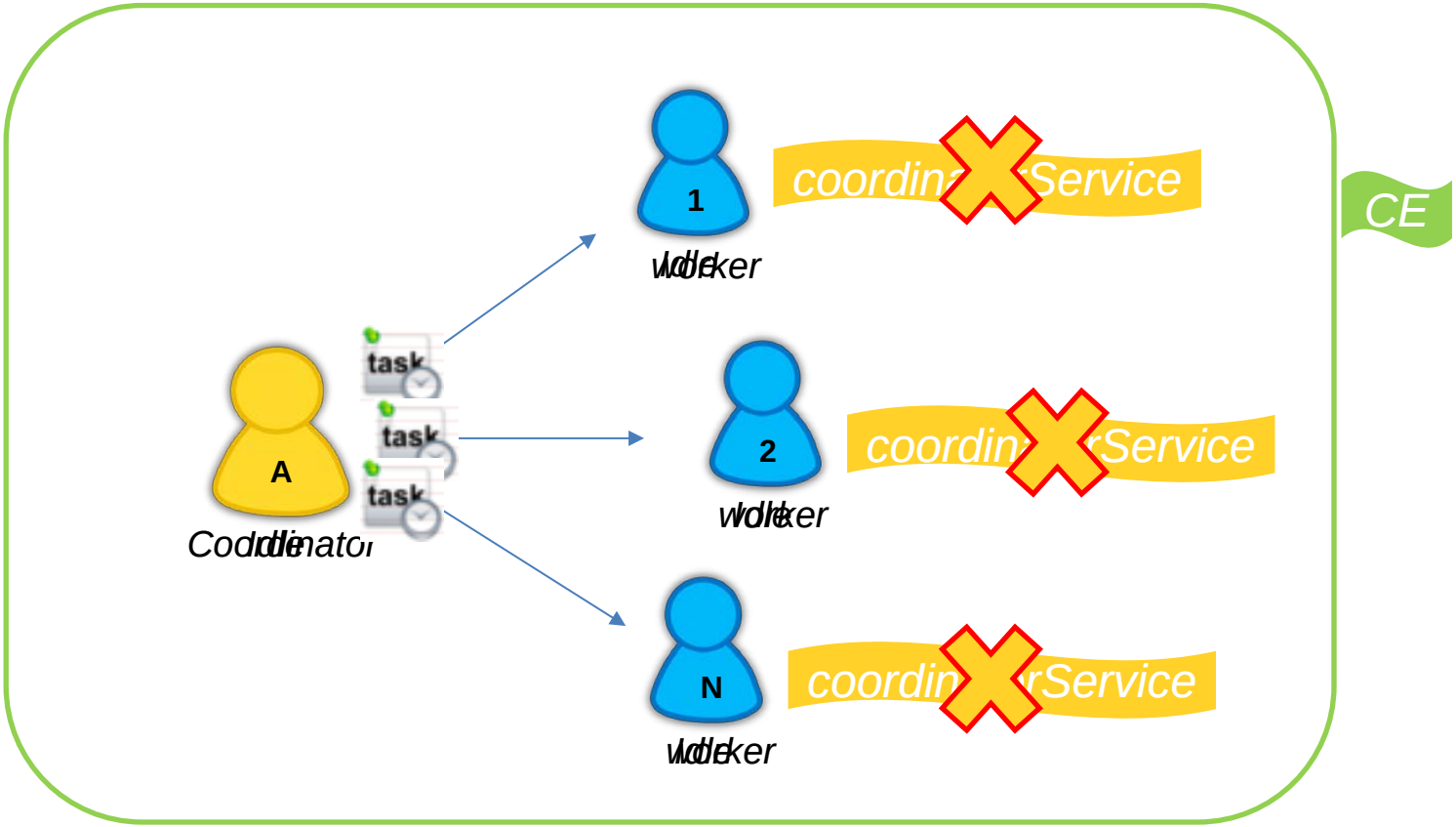
BonjourGrid (4/5)

- Construction of computing element



BonjourGrid (5/5)

- Construction of computing element



Outline

- Introduction
- Problematic
- Existing approaches
- BonjourGrid
- Proposed approach
- Implementations
- Experimentations
- Conclusion and perspectives

Proposed approach (1/12)

- Contribution

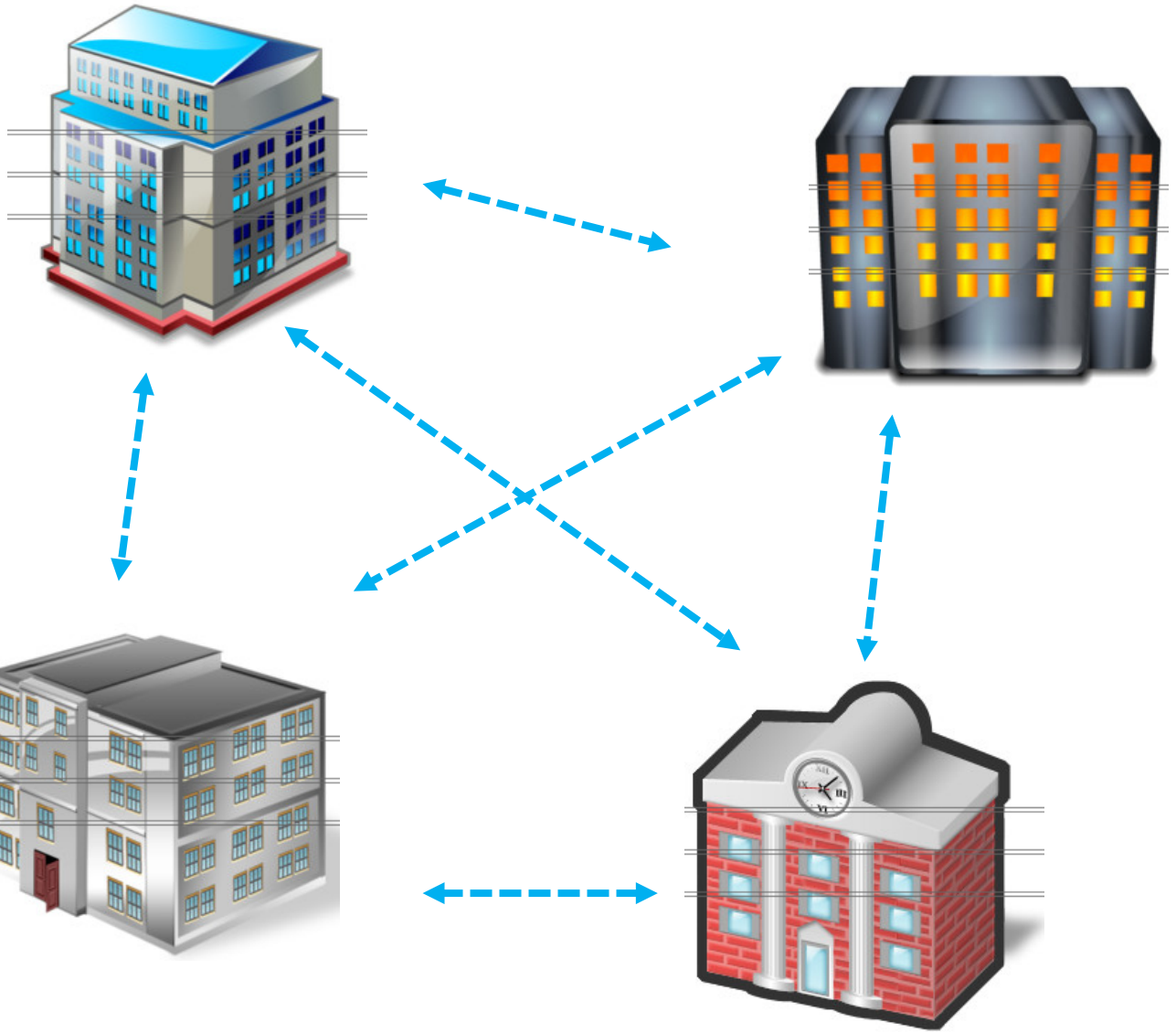
Integration of a decentralized mechanism for resource reservation in BonjourGrid based on scores of peers

The score of a peer is related to its consumption and provision of resources

Privilege the most deserving peer and curb any selfish behavior

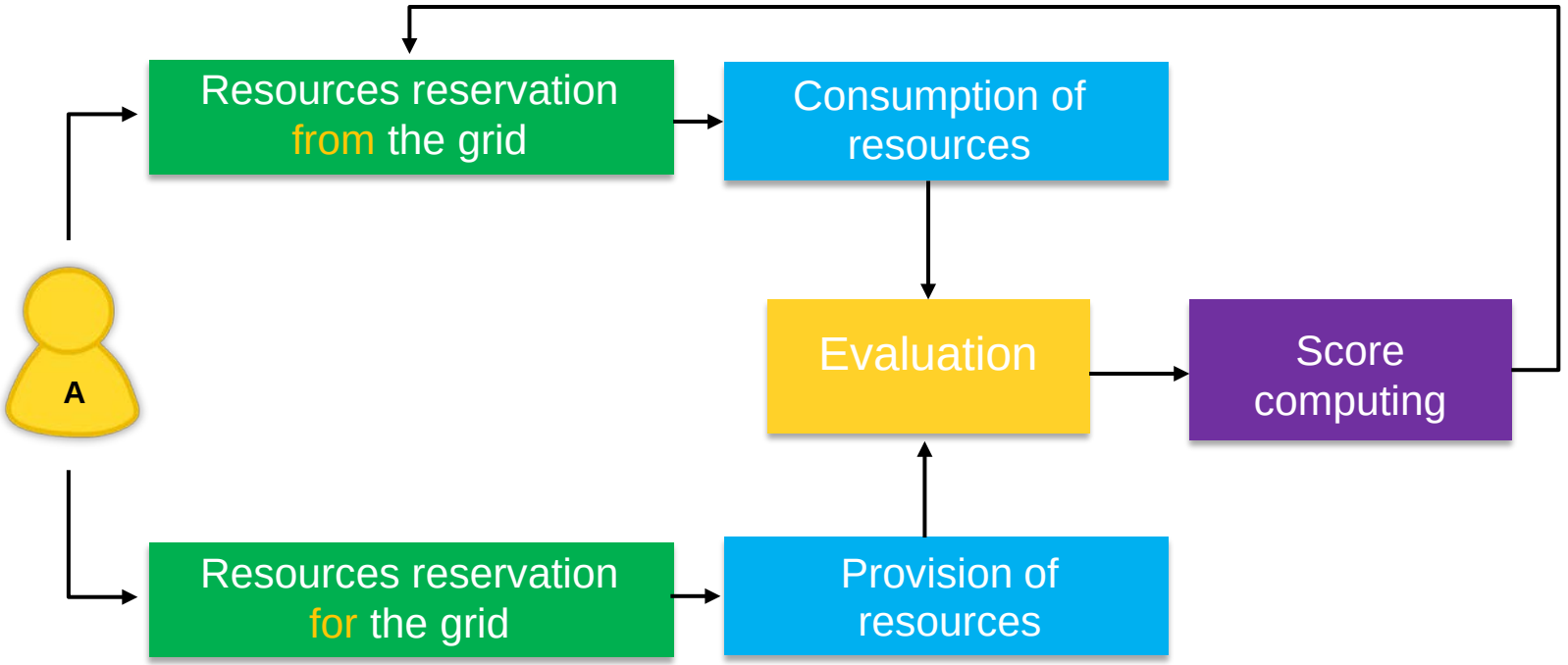
Proposed approach (2/12)

- Adopted context



Proposed approach (3/12)

- General overview



Proposed approach (4/12)

- The evaluation of a reservation

t_{exec} = *dateEndAlloc - dateStartAlloc*

↓

Cost = t_{exec} * $freq_B$

↓

Evaluation of cost

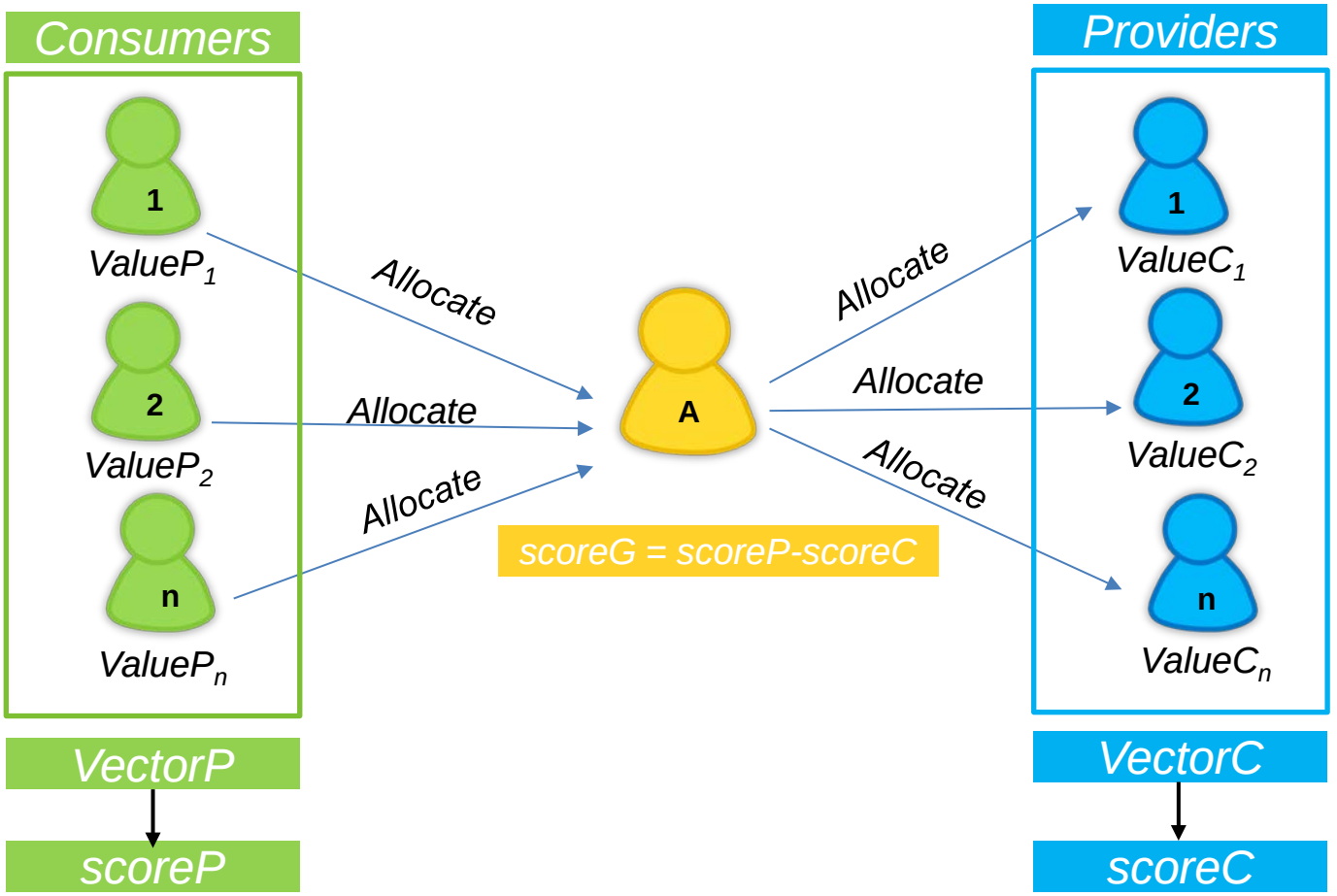
Proposed approach (5/12)

- The evaluation of a reservation

```
<?xml version="1.0" ?>
        <root>
                <value num = "1">
                        <cost>
                                <costmin>0</costmin>
                                <costmax>1000</costmax>
                        </cost>
                        <valueCP>5</valueCP>
                </value>
                <value num = "2">
                        <cost>
                                <costmin>1000</costmin>
                                <costmax>1500</costmax>
                        </cost>
                        <valueCP>10</valueCP>
                </value>
                <value num = "3">
                        <cost>
                                <costmin>1500</costmin>
                                <costmax>2000</costmax>
                        </cost>
                        <valueCP>15</valueCP>
                </value>
        </root>
```

Proposed approach (6/12)

- Phase of score computing



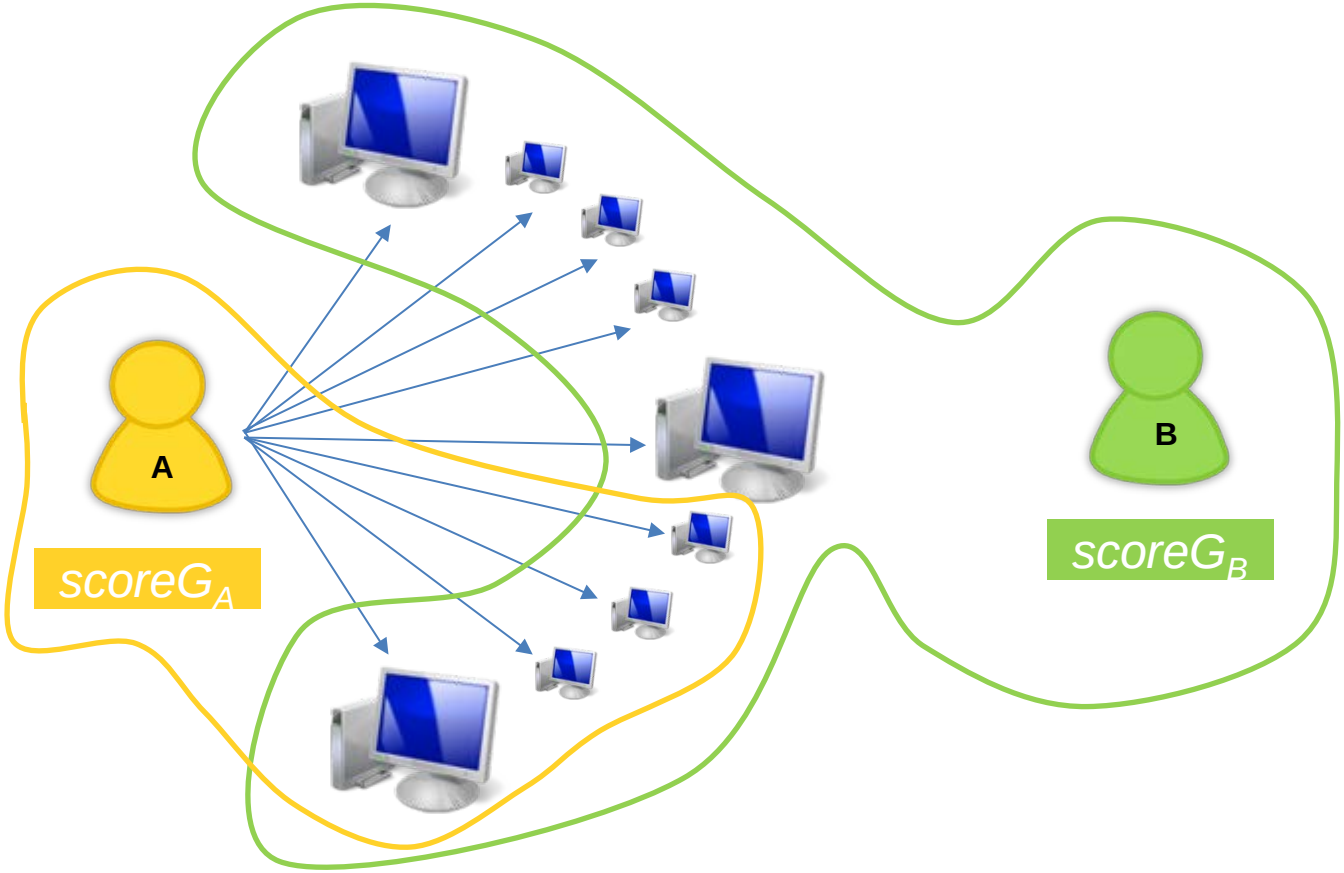
Proposed approach (7/12)

- Phase of score computing

```
<?xml version="1.0" ?>
    <root>
        <hostname>graphene-1 </hostname>
        <reputationscore>250</reputationscore>
        <providers>
            <provider>
                <hostnamep>graphene-2</hostnamep>
                <ValueC>100</ValueC>
            </provider>
            <provider>
                <hostnamep>graphene-3</hostnamep>
                <ValueC>150</ValueC>
            </provider>
        </providers>
        <consumers>
            <consumer>
                <hostnamec>graphene-4</hostnamec>
                <ValueP>200</ValueP>
            </consumer>
            <consumer>
                <hostnamec>graphene-5</hostnamec>
                <ValueP>300</ValueP>
            </consumer>
        </consumers>
    </root>
```

Proposed approach (8/12)

- The model of reservation



$scoreG_B > scoreG_A$

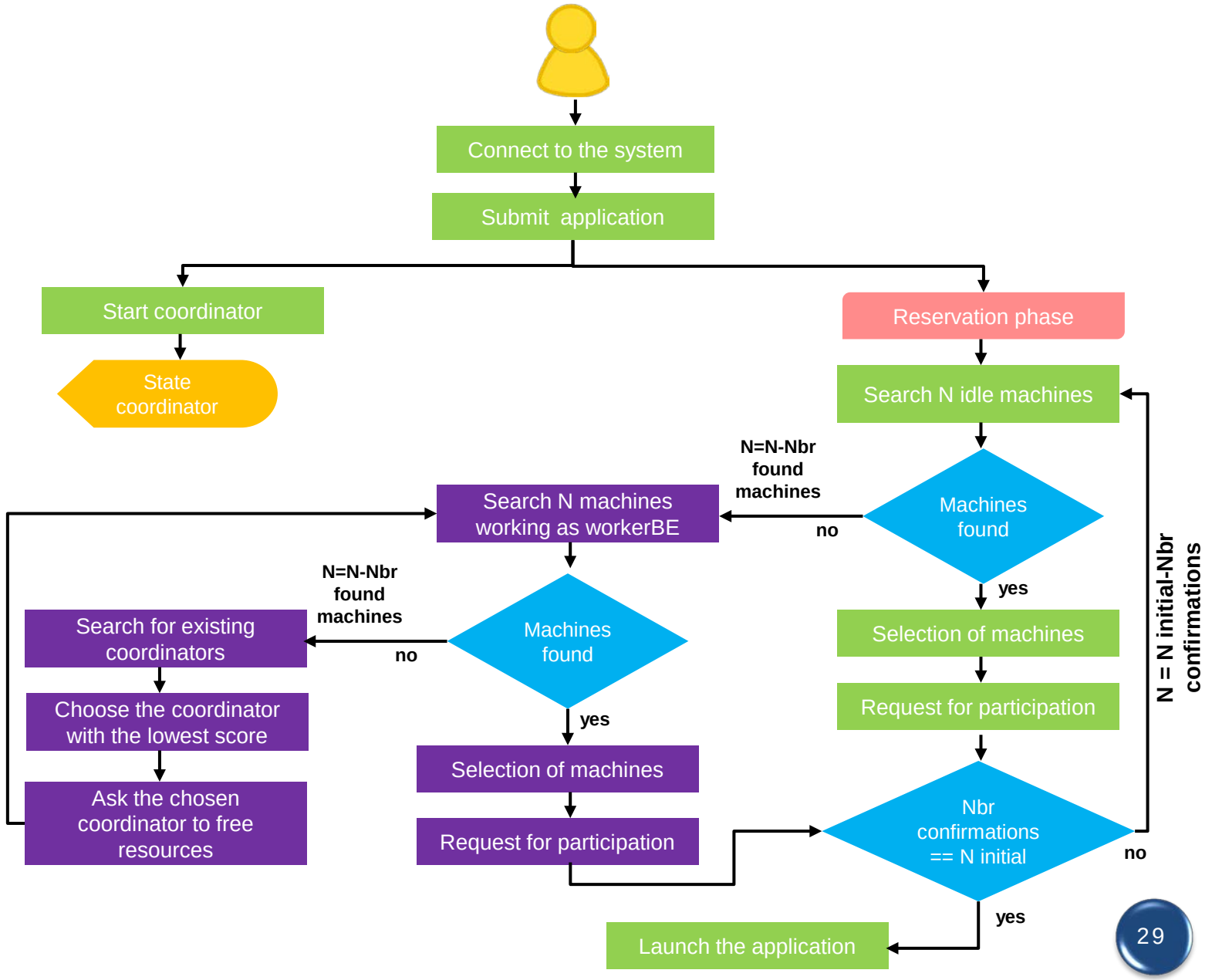
Proposed approach (9/12)

- The model of reservation

```
<?xml version="1.0" ?>
        <root>
                <value num = "1">
                        <score>
                                <scoremin>-10</scoremin>
                                <scoremax>0</scoremax>
                        </score>
                        <nbreMachineSure>3</nbreMachineSure>
                </value>
                <value num = "2">
                        <score>
                                <scoremin>10</scoremin>
                                <scoremax>20</scoremax>
                        </score>
                        <nbreMachineSure>4</nbreMachineSure>
                </value>
                <value num = "3">
                        <score>
                                <scoremin>20</scoremin>
                                <scoremax>30</scoremax>
                        </score>
                        <nbreMachineSure>5</nbreMachineSure>
                </value>
        </root>
```

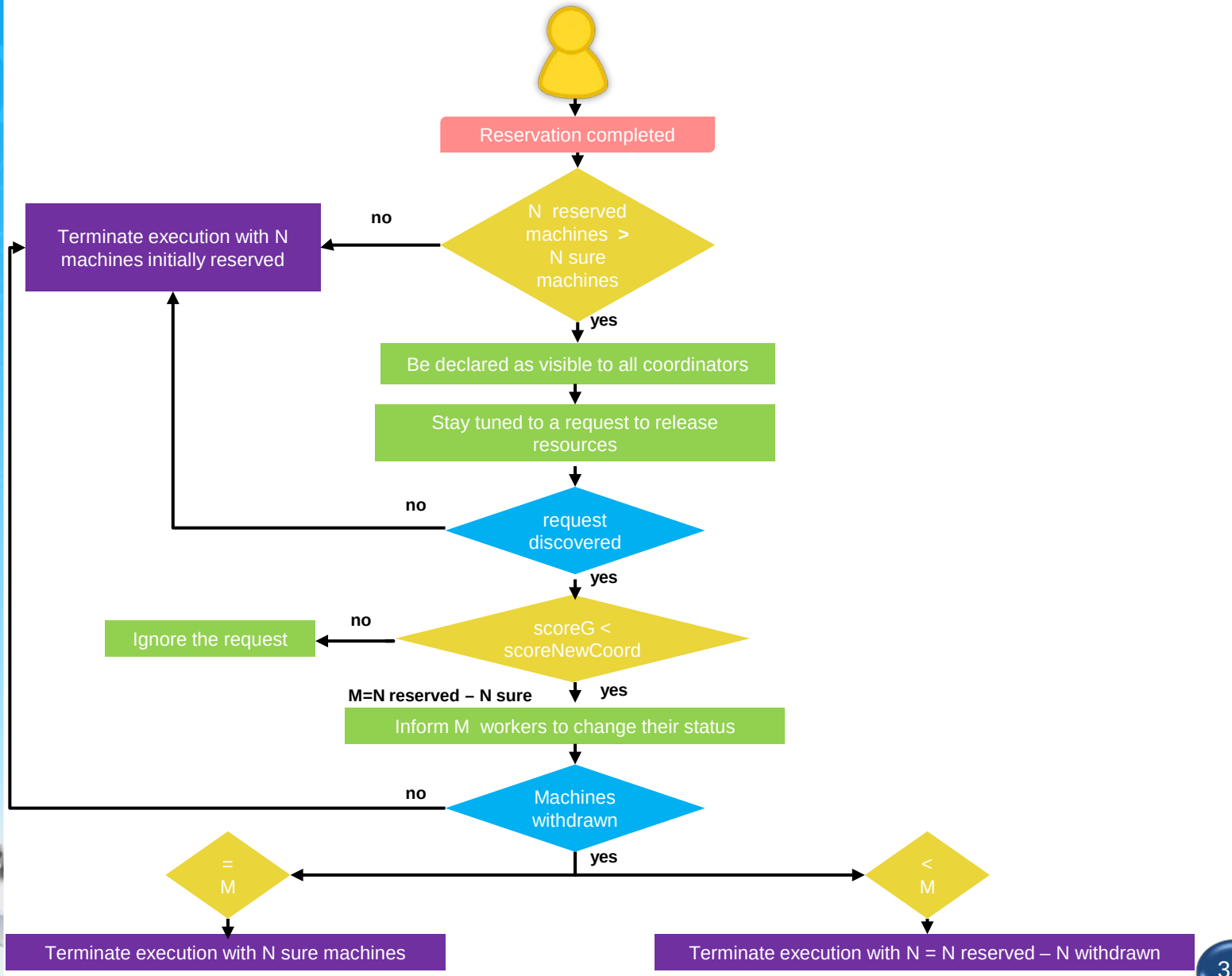
Proposed approach (10/12)

The model of reservation



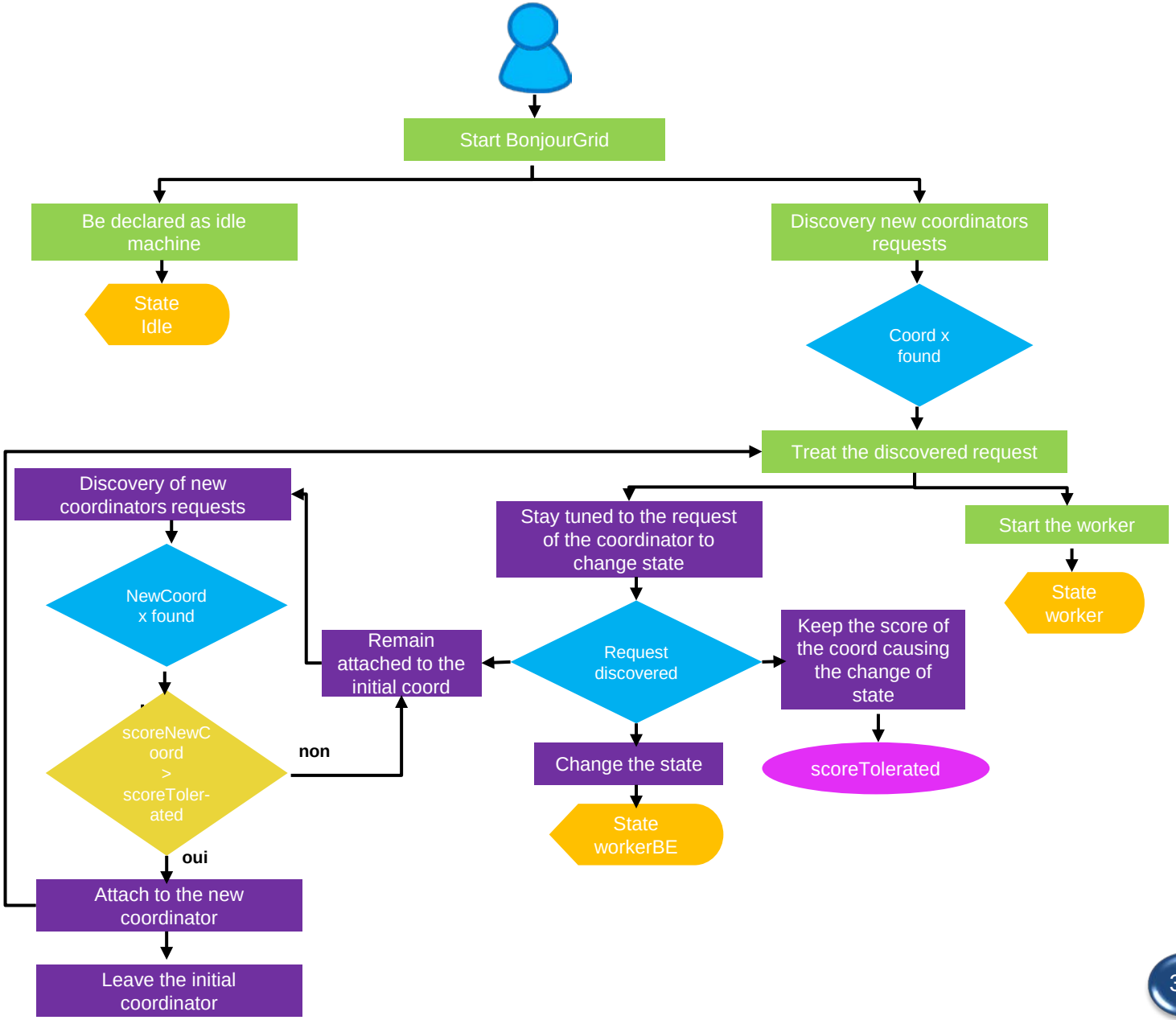
Proposed approach (11/12)

The model of reservation



Proposed approach (12/12)

- The model of reservation



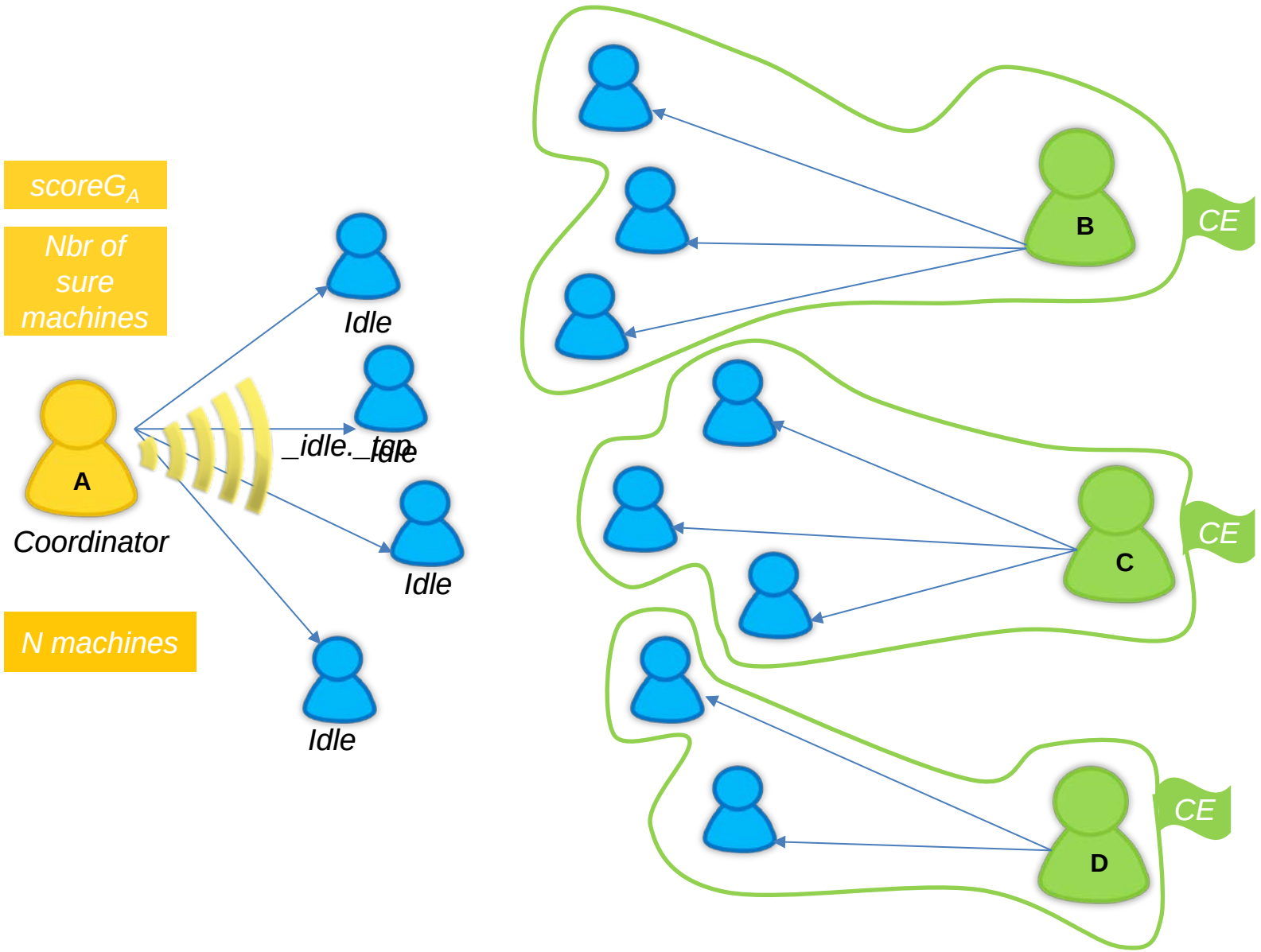
Outline

- Introduction
- Problematic
- Existing approaches
- BonjourGrid
- Proposed approach
- Implementations
- Experimentations
- Conclusion and perspectives

Implementations (1/8)

- **master** : published by any coordinator whose number of reserved machines exceeds the sure machines.
- **nameCoord-masterBE** : published by a coordinator who wants to withdraw resources of *nameCoord* having the lowest score.
- **nameCoord-masterBE-nameWorker** : notify the worker *nameWorker* to change his status to *workerBE*.
- **workerBE** : published by a worker who changed his status to *workerBE*.
- **nameCoord-Quit** : published by a worker when he left his initial coordinator.

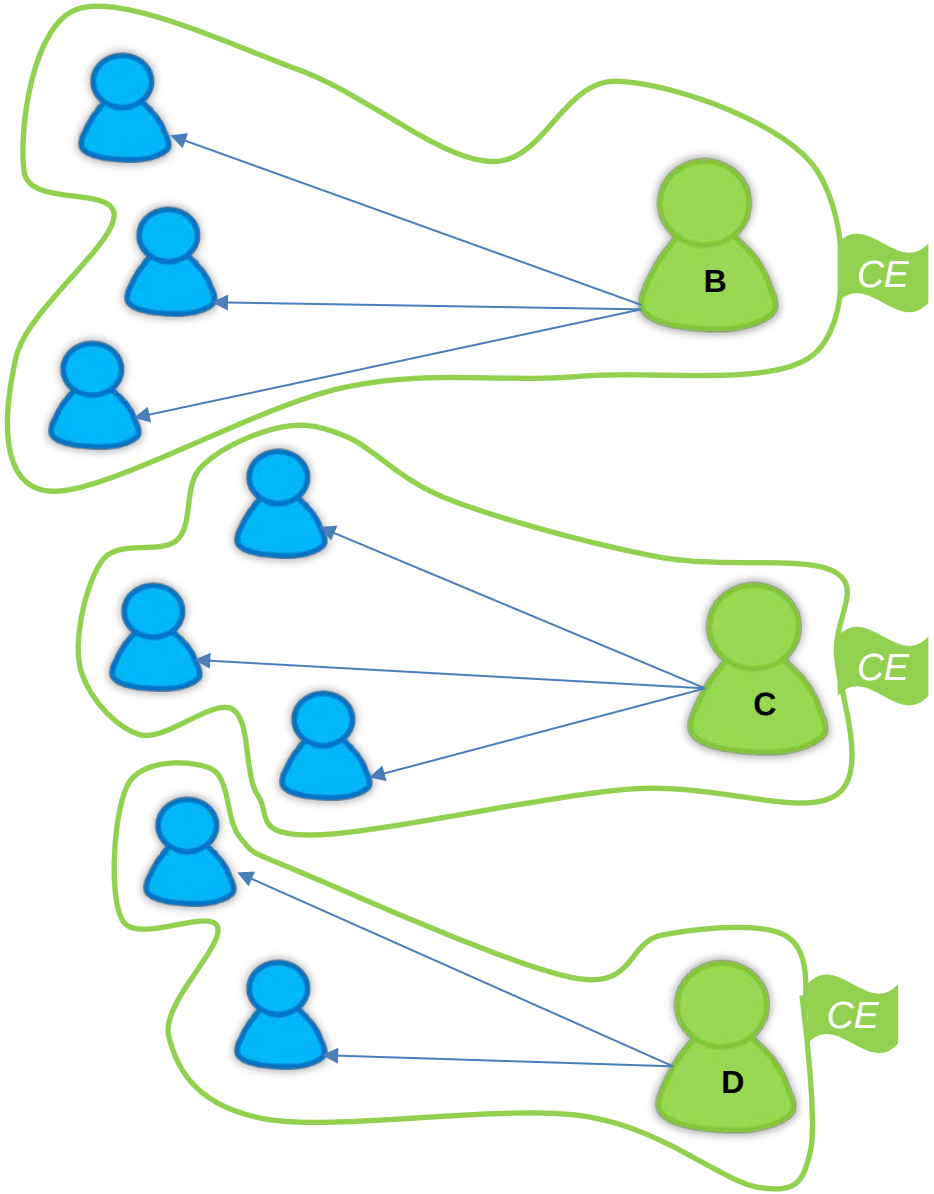
Implementations (2/8)



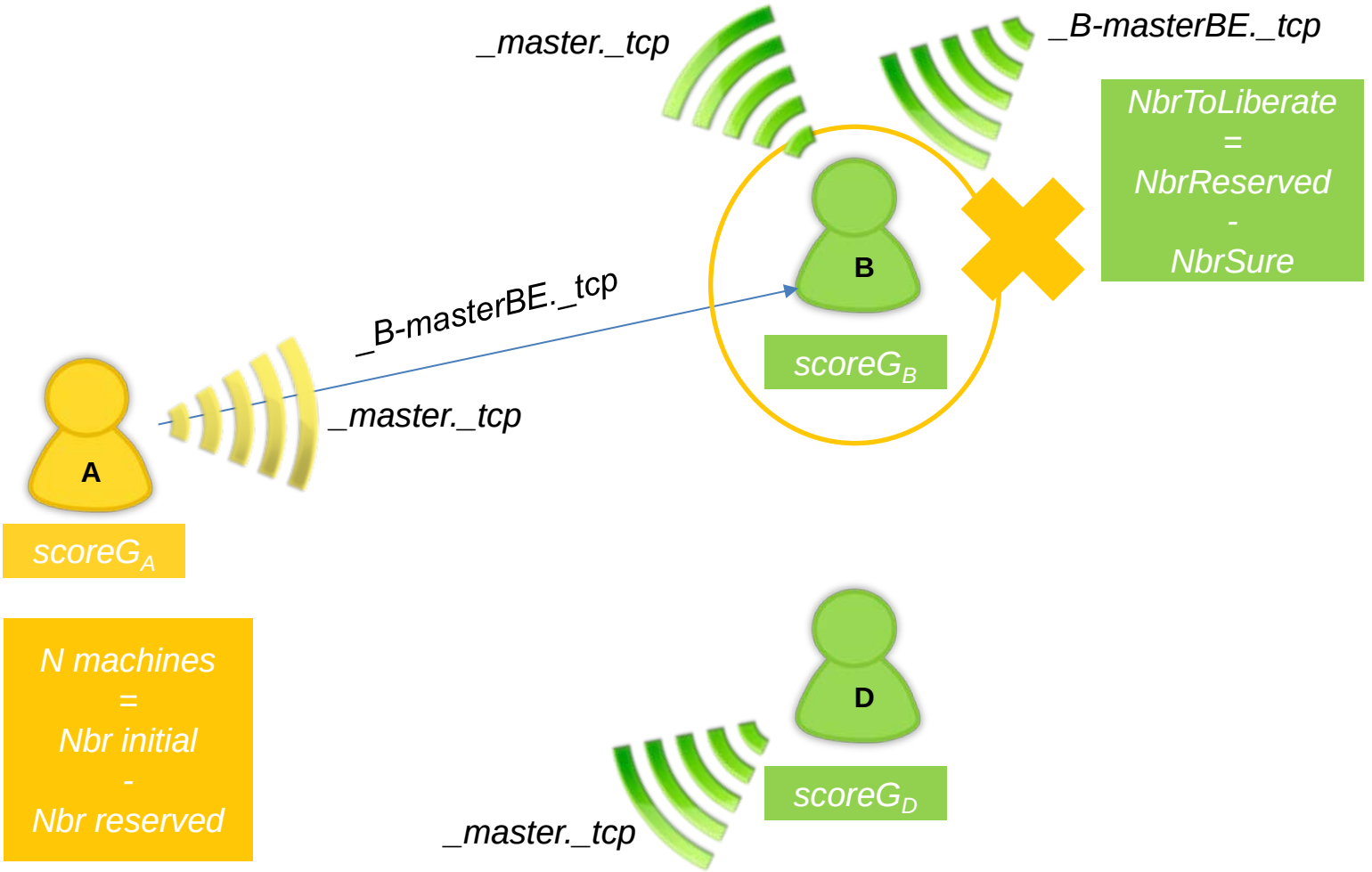
Implementations (3/8)

Coordinator

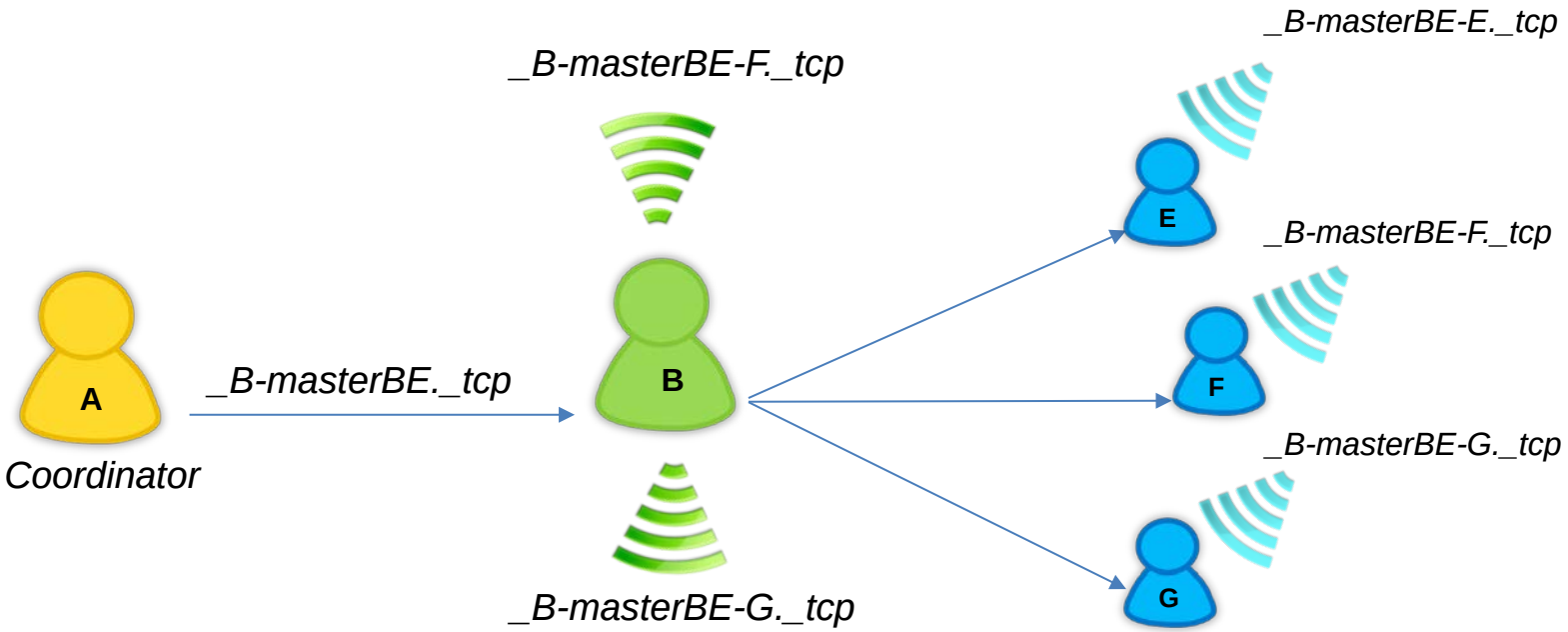
N machines
=
Nbre initial
-
Nbre reserved



Implementations (4/8)



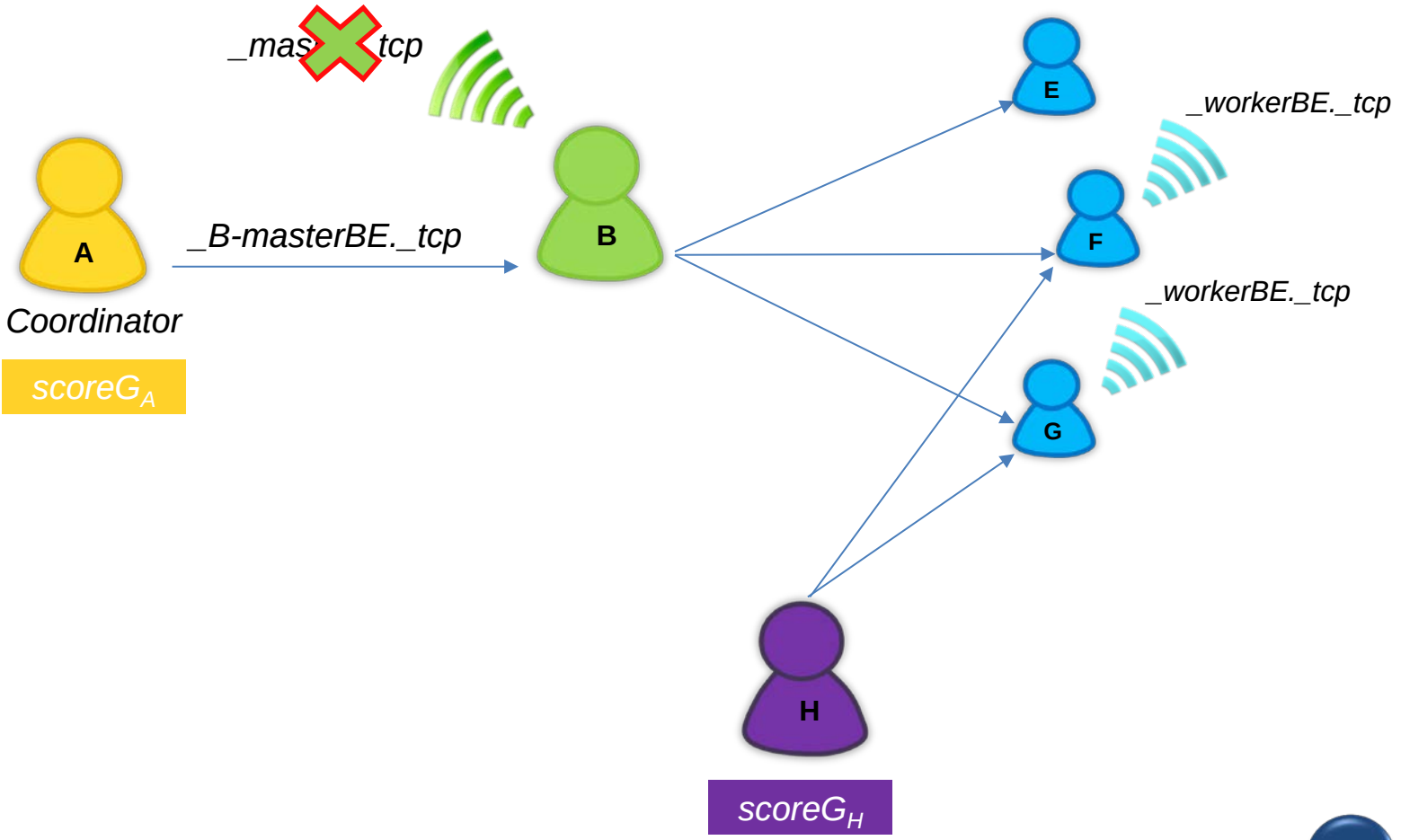
Implementations (5/8)



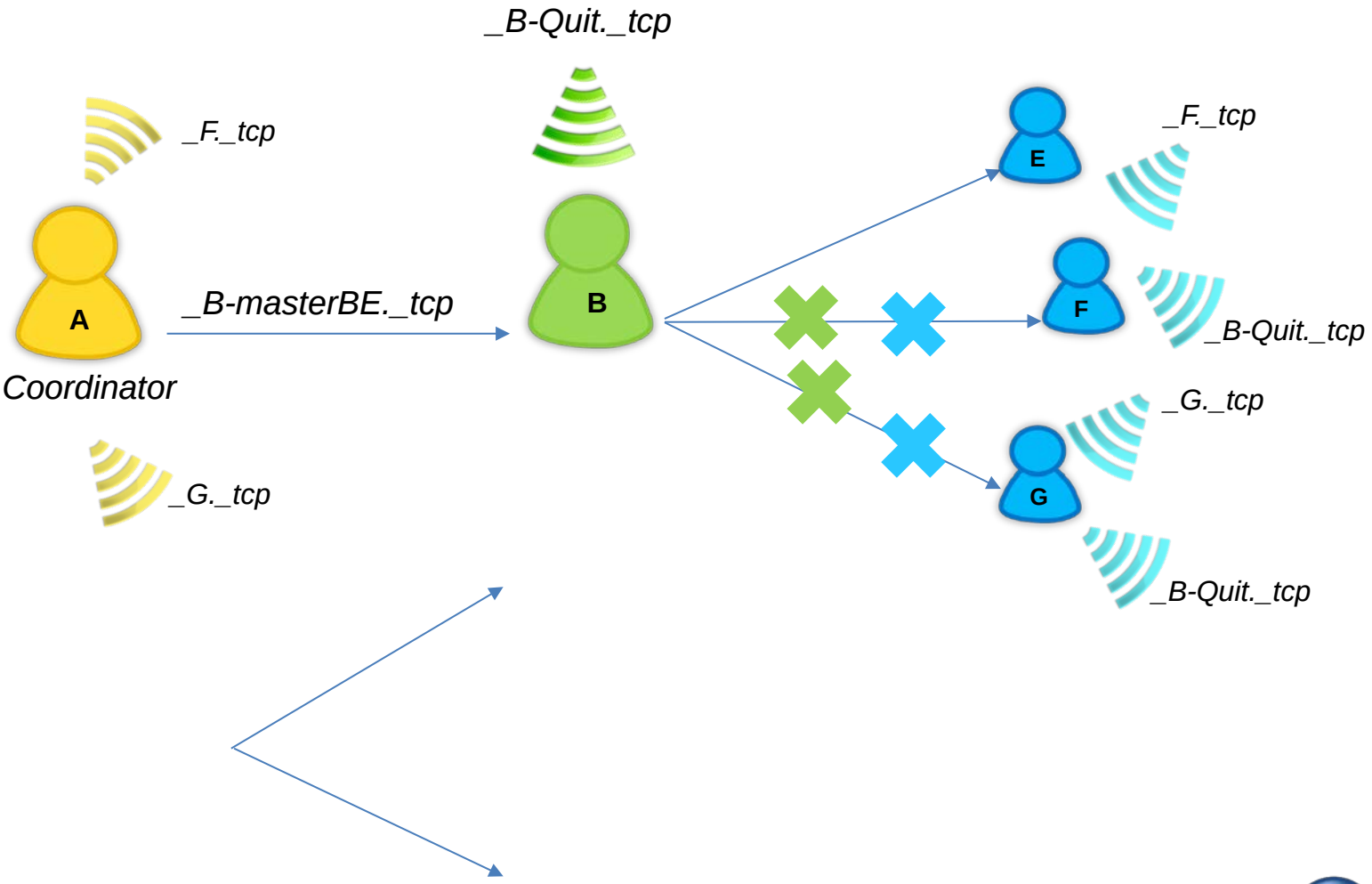
Implementations (6/8)

scoreTolerated = scoreG$_A$

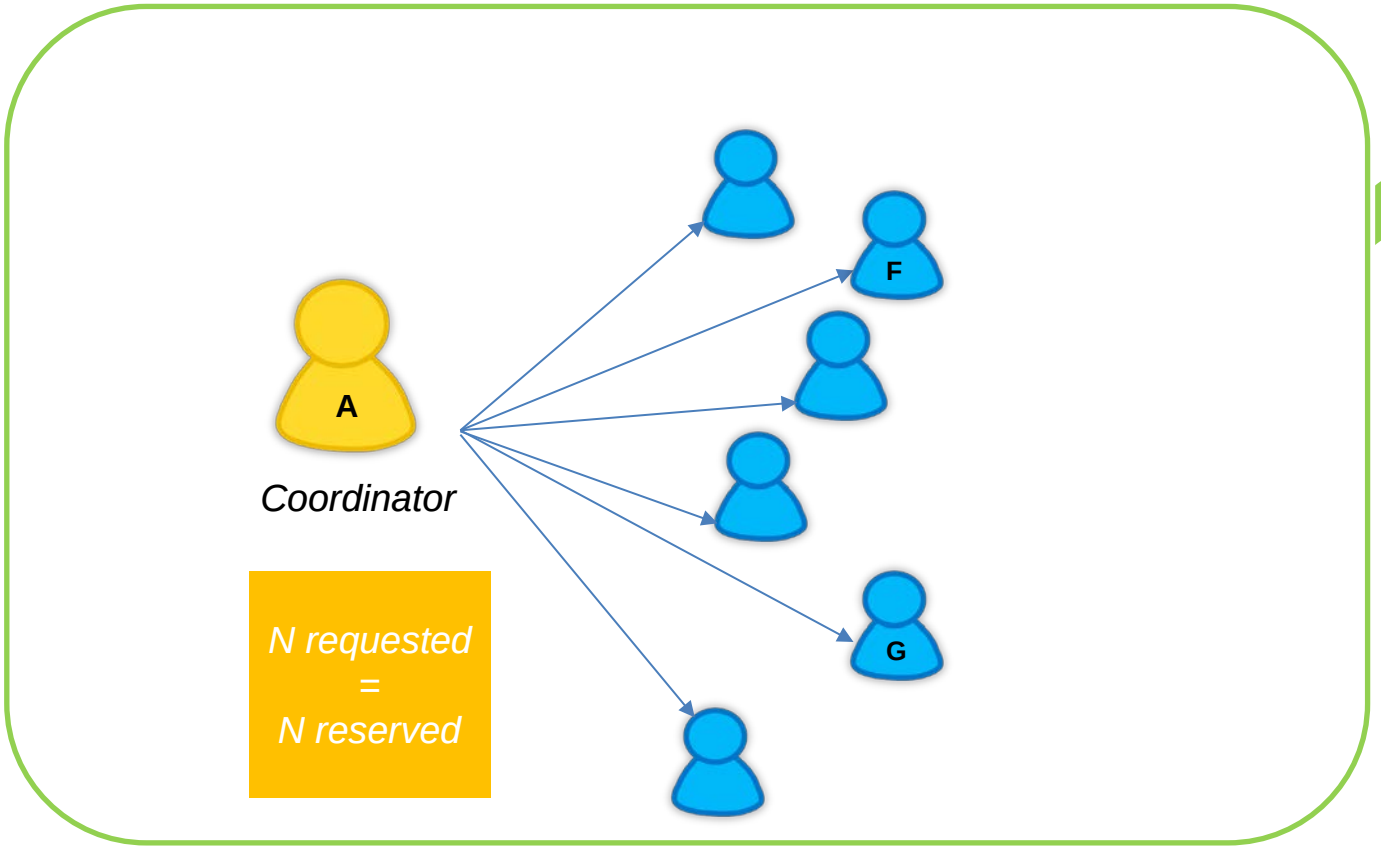
scoreTolerated % scoreG$_H$



Implementations (7/8)



Implementations (8/8)



Outline

- Introduction
- Problematic
- Existing approaches
- BonjourGrid
- Proposed approach
- Implementations
- Experimentations
- Conclusion and perspectives

Experimentations (1/6)

Scenario 1

Graphene-21

Arrival time = 0s
Reservation duration = 3600
Available Nbr= 47
Requested Nbr = 24
Reserved Nbr = 24

Graphene-22

Arrival time = 0s
Reservation duration = 3600
Available Nbr = 47
Requested Nbr = 23
Reserved Nbr = 23

Graphene-23

Arrival time = 60s
Reservation duration = 2500
Available Nbr = 0
Requested Nbr = 15
Reserved Nbr = 0

Resources reservation is random, it does not undergo any constraint of time or number.

Experimentations (2/6)

Scenario 2

Coordinator	Arrival time	Reservation duration	initial score	Requested number	Available number	Sure number	Reserved number	Workers	Consumption valu	Final score	Withdrawn number	coordinator withdrawing
graphene-2	0	2000	0	12	45	6	12	graphene-11,112,114, 115,116,117,124,127, 128, 129, 131, 136	50	-600	0	Ø
graphene-20	120	1600	0	10	33	6	10	graphene-109,113,125, 132,137,142,143,144, 15,19	40	-400	0	Ø
graphene-21	240	1300	0	8	23	6	8	graphene-120,122,133, 134,135,140,141,18	30	-240	0	Ø
graphene-22	360	900	0	6	15	6	6	graphene-111,119,126, 13,138,139	20	-120	0	Ø
graphene-23	480	1400	0	9	9	6	9	graphene-110,118,12, 121,123,130,14,16,17	35	-315	0	Ø

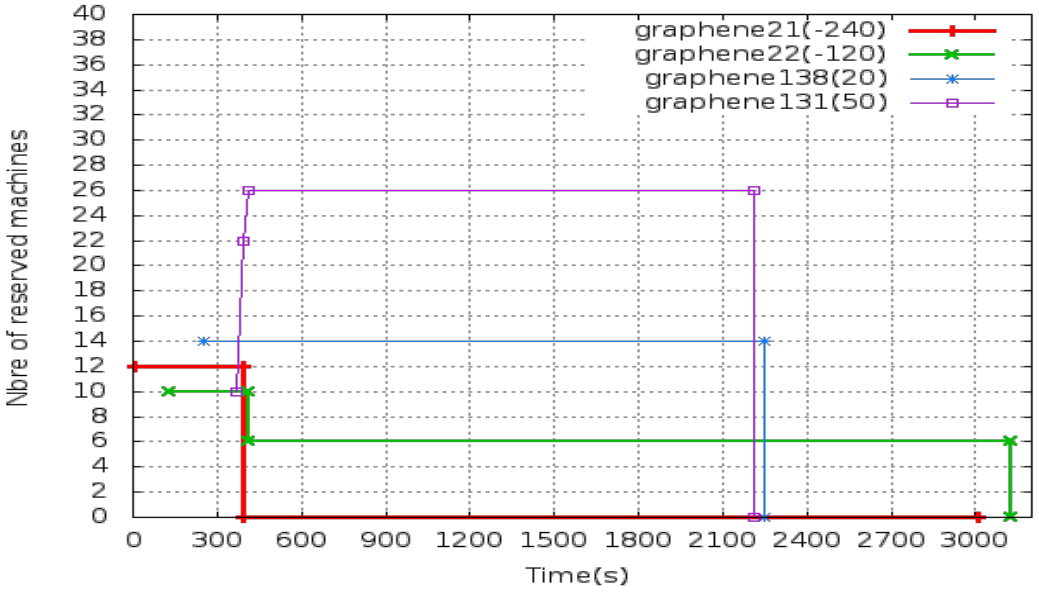
Experimentations (3/6)

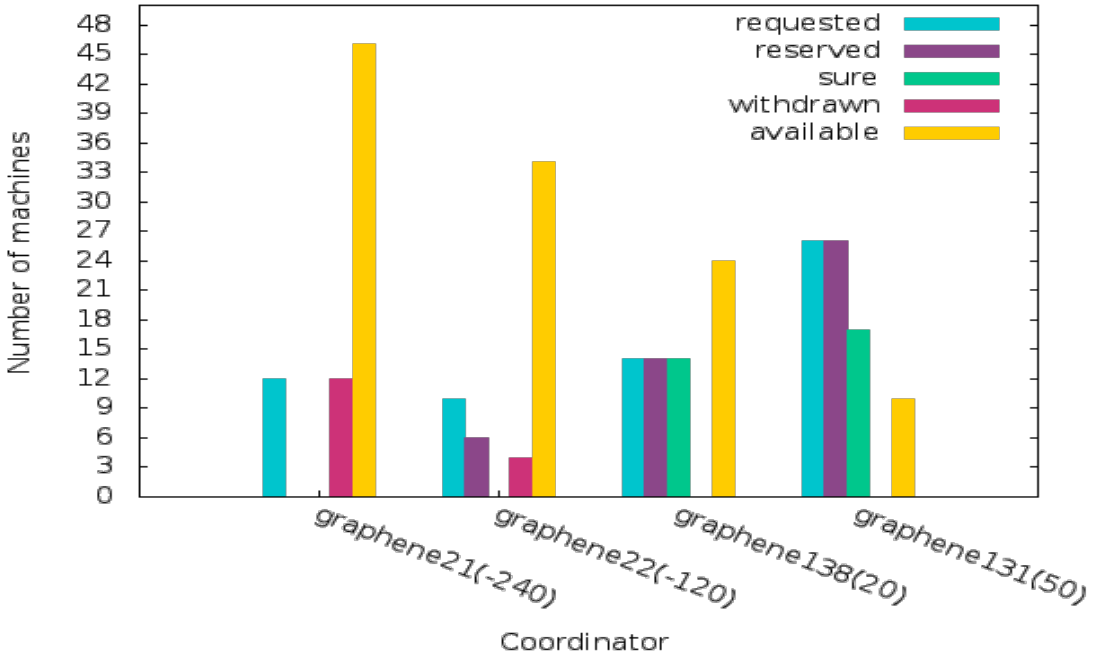
Scenario 2

Worker	Initial score	Attachment Duration	Coordinators	Provision value	Final score
graphene-109	0	1600	graphene-20	40	40
graphene-11	0	2000	graphene-2	50	50
graphene-110	0	1400	graphene-23	35	35
graphene-111	0	900	graphene-22	20	20
graphene-112	0	2000	graphene-2	50	50
graphene-113	0	1600	graphene-20	40	40
graphene-114	0	2000	graphene-2	50	50
graphene-115	0	2000	graphene-2	50	50
graphene-116	0	2000	graphene-2	50	50
graphene-117	0	2000	graphene-2	50	50
graphene-118	0	1400	graphene-23	35	35
graphene-119	0	900	graphene-22	20	20
graphene-12	0	1400	graphene-23	35	35
graphene-120	0	1300	graphene-21	30	30
graphene-121	0	1400	graphene-23	35	35
graphene-122	0	1300	graphene-21	30	30
graphene-123	0	1400	graphene-23	35	35
graphene-124	0	2000	graphene-2	50	50
graphene-125	0	1600	graphene-20	40	40
graphene-126	0	900	graphene-22	20	20
graphene-127	0	2000	graphene-2	50	50
graphene-128	0	2000	graphene-2	50	50
graphene-129	0	2000	graphene-2	50	50
graphene-13	0	900	graphene-22	20	20
graphene-130	0	1400	graphene-23	35	35
graphene-131	0	2000	graphene-2	50	50
graphene-132	0	1600	graphene-20	40	40
graphene-133	0	1300	graphene-21	30	30
graphene-134	0	1300	graphene-21	30	30
graphene-135	0	1300	graphene-21	30	30
graphene-136	0	2000	graphene-2	50	50
graphene-137	0	1600	graphene-20	40	40
graphene-138	0	900	graphene-22	20	20
graphene-139	0	900	graphene-22	20	20
graphene-14	0	1400	graphene-23	35	35
graphene-140	0	1600	graphene-21	30	30
graphene-141	0	1600	graphene-21	30	30
graphene-142	0	2000	graphene-20	40	40
graphene-143	0	2000	graphene-20	40	40
graphene-144	0	2000	graphene-20	40	40
graphene-15	0	2000	graphene-20	40	40
graphene-16	0	1400	graphene-23	35	35
graphene-17	0	1400	graphene-23	35	35
graphene-18	0	1300	graphene-21	30	30
graphene-19	0	1600	graphene-20	40	40

Experimentations (4/6)

Scenario 3

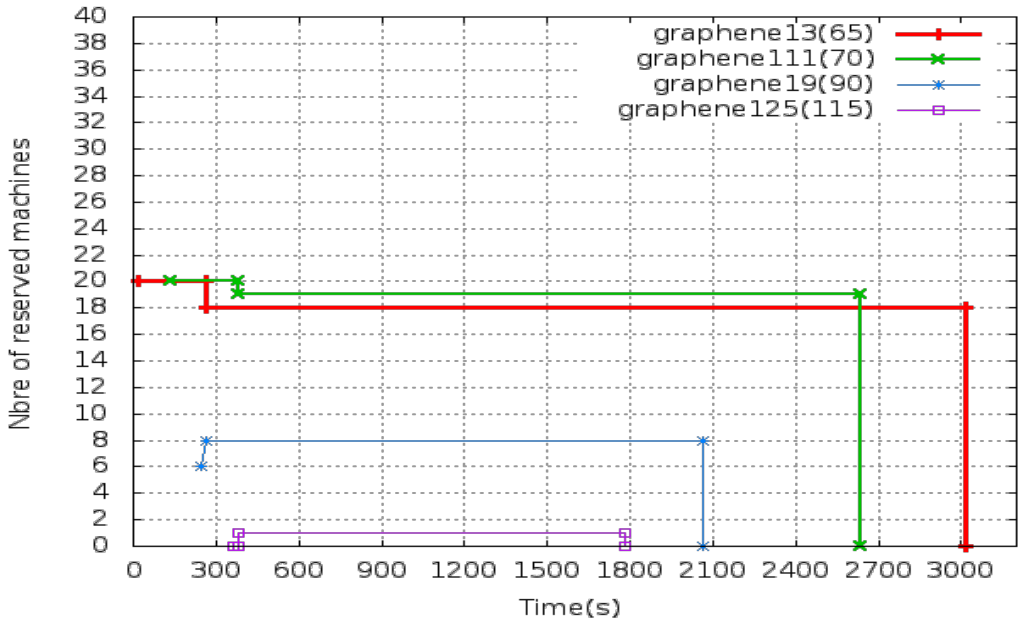


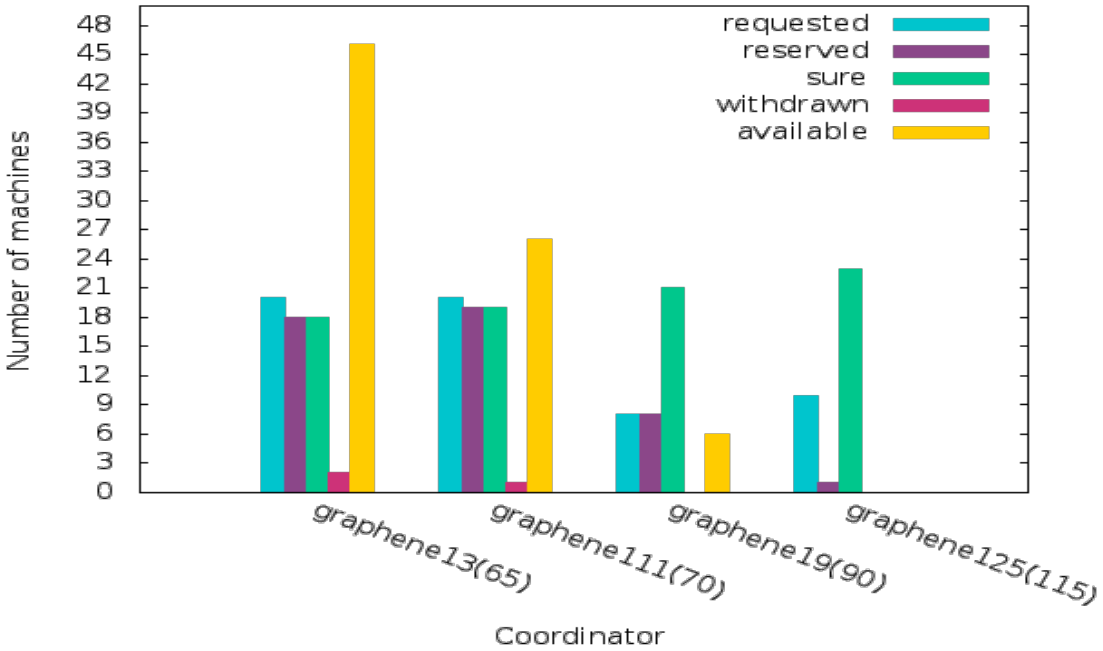


The score is the only factor determining the number of machines that a node can keep.

Experimentations (5/6)

Scenario 4

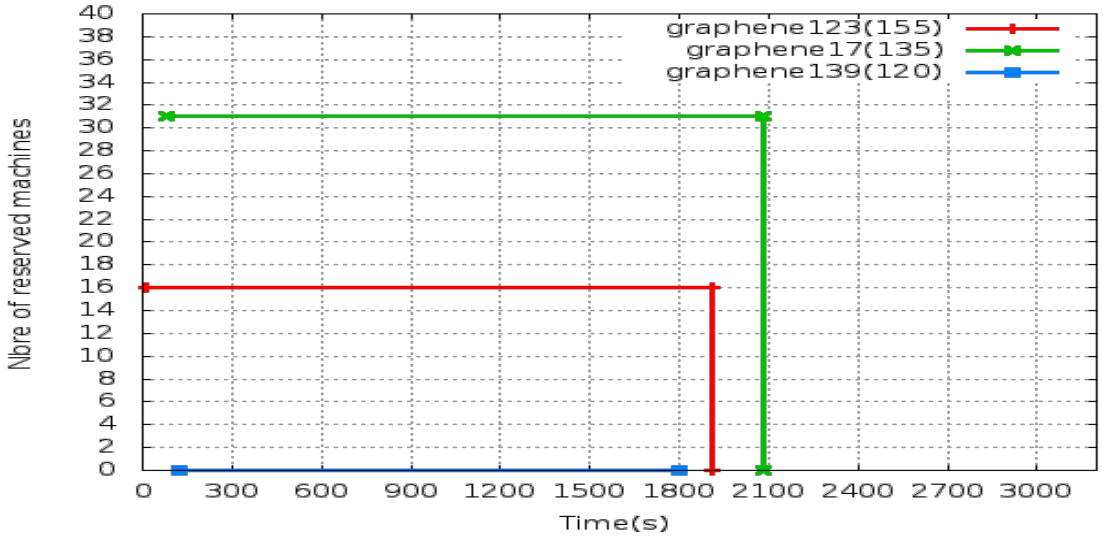


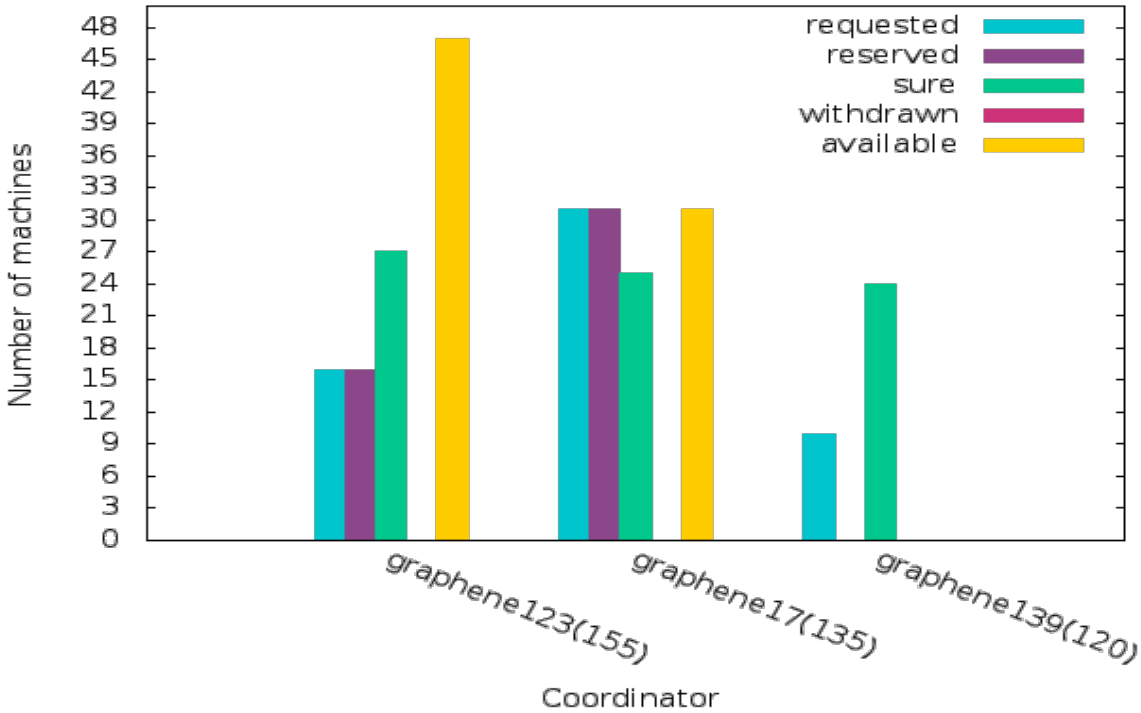


Even the arrival of a node that has the highest score and demands a number of machines greater than the available one, it can not remove the other sure machines.

Experimentations (6/6)

Scenario 5





If a node has a higher score, it is always safe and terminates its execution without any disturbance coming from less deserving nodes.

Outline

- Introduction
- Problematic
- Existing approaches
- BonjourGrid
- Proposed approach
- Implementations
- Experimentations
- Conclusion and perspectives

Conclusion and perspectives

Conclusion

- Study of selfishness problem and incentive approaches dealing with it.
- Proposal of a decentralized approach for resources reservation in BonjourGrid based on the score metric.
- Evaluation of the proposed solution through experiments showing that the resources reservation is more codified.

Perspectives

- Evolution of the formula of score calculation.
- Realization of more advanced experiments.
- Integration of the security aspect.

Thank you