Blockchain-based Fully Distributed Cloud Computing
The Promise of Ethereum

- **Dapps**: Distributed Applications running on the Blockchain

Blockchain offer limited computing resources: storage is expensive, slow EVM, high tx latency etc.

How to satisfy compute/data-intensive DApps?
iEx.ec Objective

• Provides Blockchain-based Distributed Applications access to the off-chain computing resources they need:
  – Computing resources (CPU, GPU, storage)
  – Data access (remote storage)
  – Applications (compute and/or data-intensive)
  – Services (deployed as containers)
Global Market for Computing Resources

Low cost, Secure, on Demand and Fully Distributed Cloud
Towards Distributed Cloud Computing

- Benefits of Decentralizing Data-Centers.
  - Better energy efficiency
  - Data closer to the user

- Example of next-gen Data-centers
  a) Rutgers
  b) Stimergy
  c) Qarnot

- Fog/Edge Computing
  5G network -- In-network storage and processing
Origin of the Technology: Desktop Grid Computing

Using Idle PCs on the Internet to Execute Parallel Applications:

- Mature technology
- Advanced features: security, virtualization, QoS
- Many applications: Finance, Bio-medical, Chemistry, High Energy Physics etc...
- European Desktop Grid Infrastructure
  - http://desktopgridfederation.org

Book on Desktop Grid Computing
Ed. C. Cérin & G. Fedak, CRC/Chapman and all
Building Distributed Cloud Since 1999

- 2000
  - Parallel computing
  - N-faults resilience
  - MPICH-V

- 2001
  - Bag-of-Task Application
  - Multi-users & multi-applications

- 2003
  - Large Scale Data Management
  - BitDew

- 2008
  - Grid & Cloud
  - Highly secure
  - Virtualization
  - Hybrid public/private Infrastructure

- 2010
  - QoS for Best-effort infrastructure
  - SpeQuloS

- 2012
  - Big Data
  - 1st Implementation of MapReduce for Internet Computing

XtremWeb
- 1st Internet P2P Global Computing Platform
- Bag-of-Task Application
- Multi-users & multi-applications

XtremWeb-HEP
- Grid & Cloud
- Highly secure
- Virtualization
- Hybrid public/private Infrastructure

MapReduce
- Big Data
- 1st Implementation of MapReduce for Internet Computing

Tens of users/applications: Finance, HEP, biomedical research…

>1M€ EU FP7, ANR funding, ≈100 papers published
iEx.ec Experiments

- Applications (non-blockchain based)
  - E-Fast

- Ethereum Blockchain

- Resource Management Middleware (XtremWeb-HEP, BitDew)

- Distributed Cloud: Grid5K, Stimergy
Resource Management on the Blockchain

- Matchmaking
- Task/Computing resources
- Market Management Framework
- Verified File transfer
- Resource Ontology
- Result certification
- Resource Provisioning
- Multi-Criteria Scheduling
- Resource Publication
E-FAST : E-Services Framework for Knowledge-based Decision Support in Finance

Service Oriented Platform:
Integrated, advanced tools to analyze financial market data, high-level services that automatically react to market changes and propose investment alternatives

Data and Computing-Intensive Methods:
Text-mining, Neural Networks and Genetic Algorithms, enhanced by applying relevant findings from the efficient-market theory study.
Selling E-FAST using iEx.ec

Customers access E-FAST services which uses iEx.ec for their execution:
Only pay for resources when a service has been sold to a customer
Testbed

Grid5000
French Infrastructure dedicated for research in distributed systems:
• 9 sites, 1000 nodes, 8000 cores
• GPU, Xeon Phi, SSD
• 10Gb network
• Fully reconfigurable (bare metal access)
Stimergy: install 10 to 100kW server rooms in buildings and coupling them with their heating system to valorise the heat generated by computers while getting rid of air conditioners.

Using Stimergy servers as iEx.ec computing resources.
iEx.ec Architecture (Envisioned)

- Blockchain-based Distributed Applications (Dapps)
- Ethereum Blockchain
- iEx.ec Sidechain (Proof-of-Contribtion)
- Resource Management (XtremWeb-HEP, BitDew, Gollem, ...)

Sidechain for Cloud
- consensus for off-chain resource utilisation (Proof-of-Contribtion)
- transient information
- specific workload
- partial consensus
Conclusion

iEx.ec: Greener & Smarter Cloud Computing
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