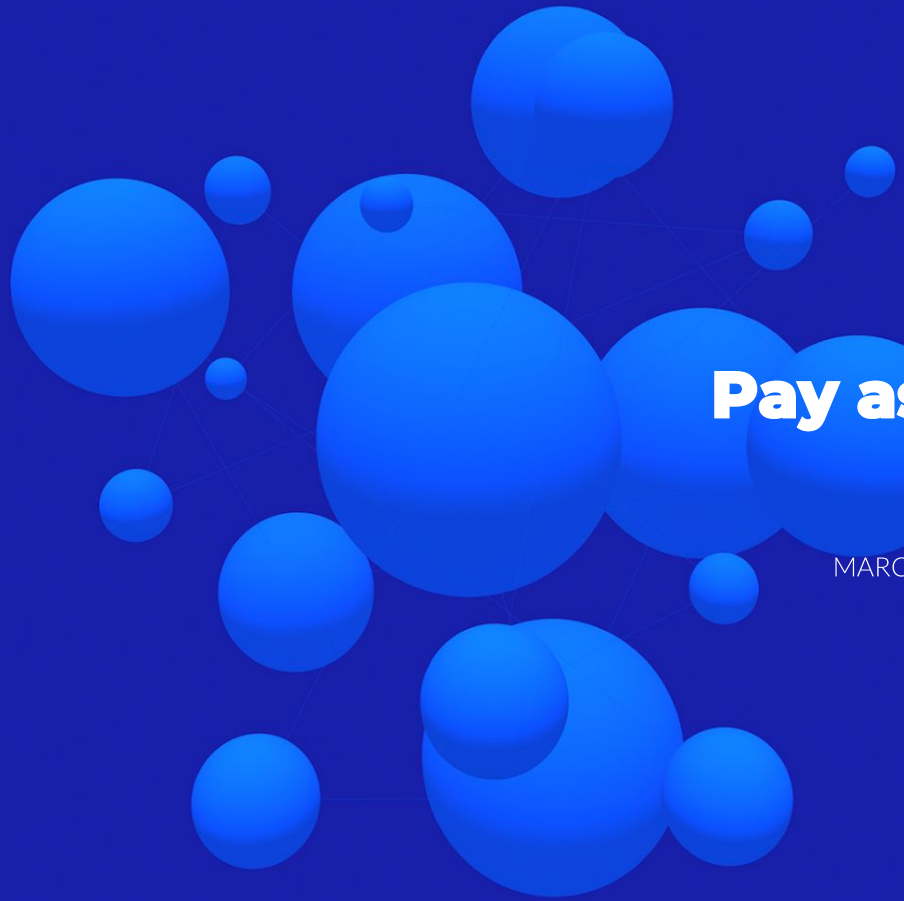
golem



EthCC

Pay as you use in Golem

MARCIN BENKE, R&D ADVISOR

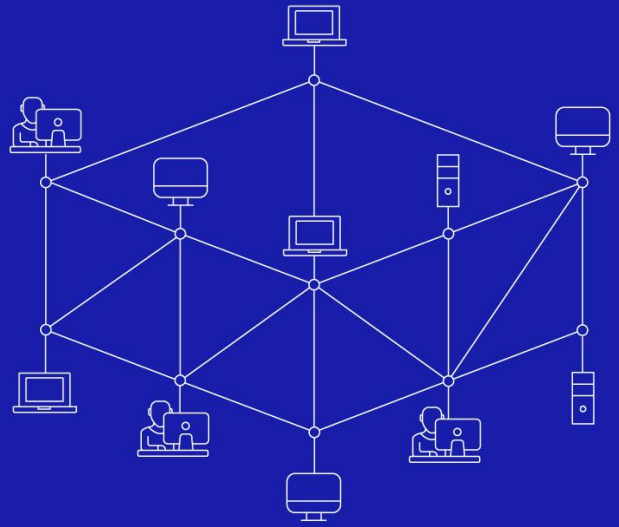
What is Golem

01

A network of computing resources that can either be used by a requestor or provided to other participants by a provider.

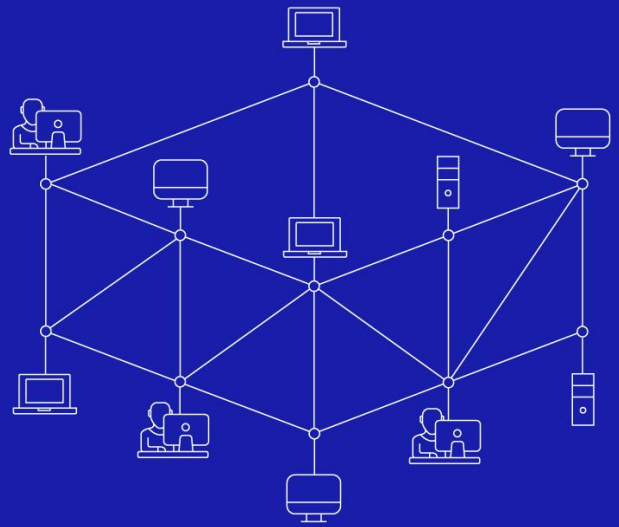
02

A decentralised marketplace based on Ethereum tokens



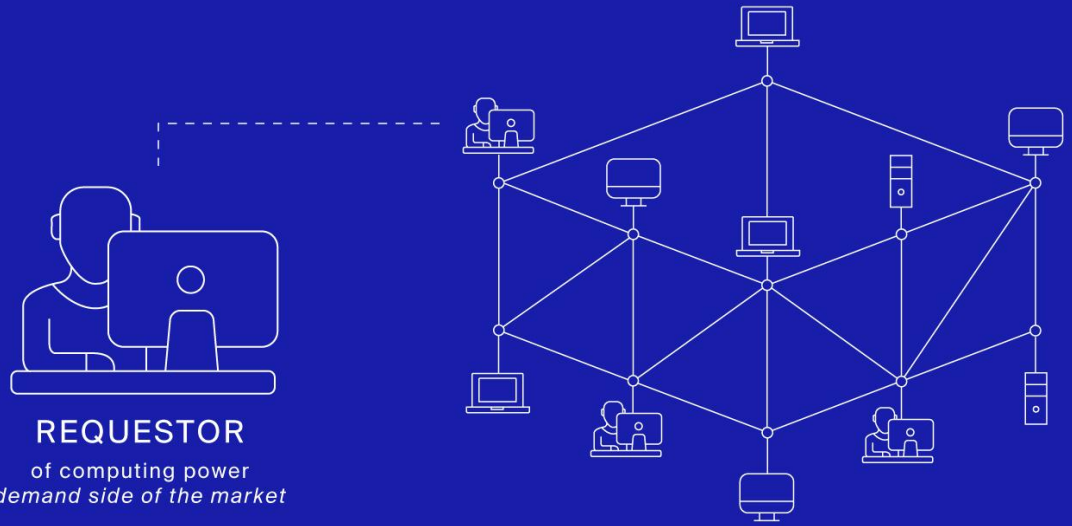
golem

NETWORK



golem

NETWORK



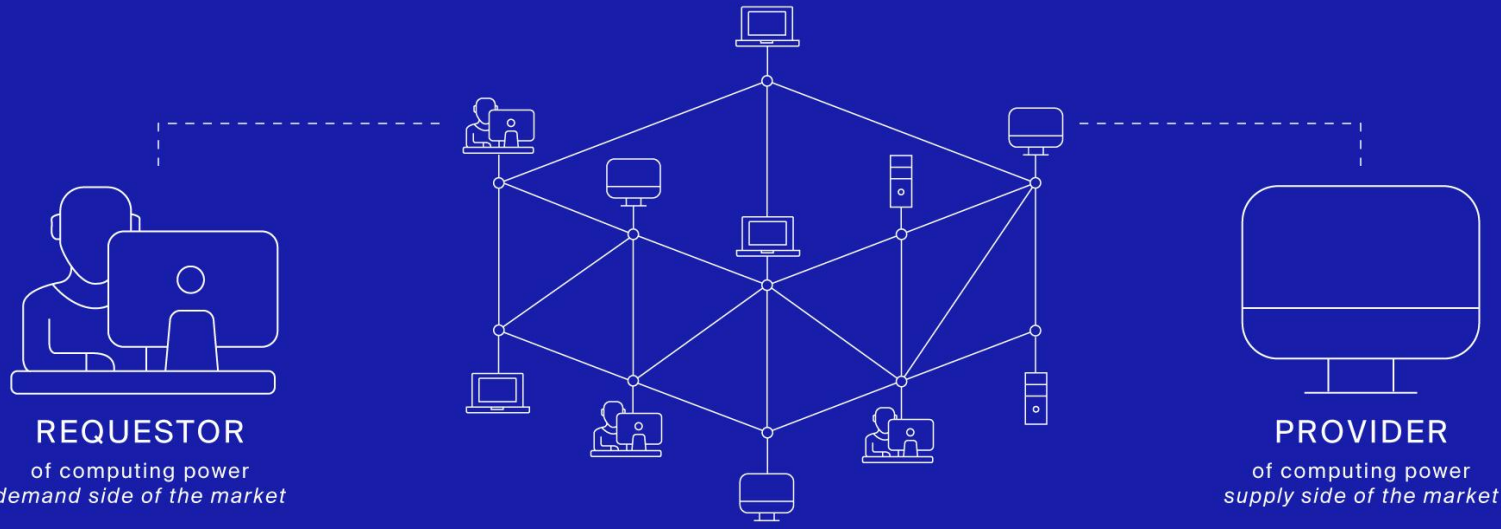
REQUESTOR

of computing power

demand side of the market

golem

NETWORK



REQUESTOR

of computing power
demand side of the market

golem
NETWORK

PROVIDER

of computing power
supply side of the market

golem

Pricing work

Fixed Price

safe for requestors, big risk for workers when job size unknown

Time & Materials

safe for workers, overcharge risk for requestors, especially for remote work

PRICING WORK

Time & Materials

01

Is FP really better for buyers than T&M?

02

Fair to both sides if they are honest

03

How to bid on tasks with unknown size?

04

Workers need to include risk premium in their price.

Time & Materials

01

Generally good choice if job size unknown

02

Fair to both sides if they are honest

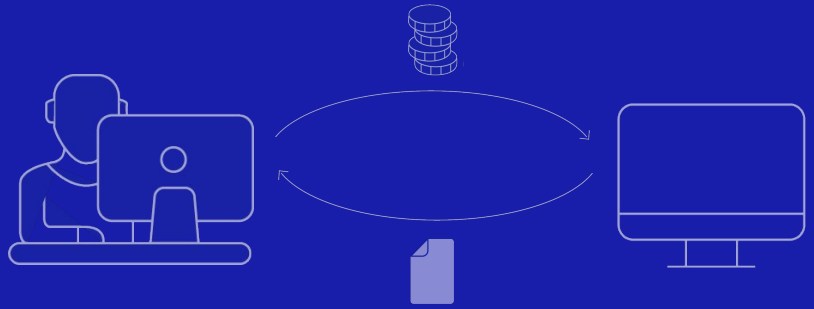
03

Risk of overcharge by dishonest workers

04

Requestor still has the option not to pay at all

Pay as You Use



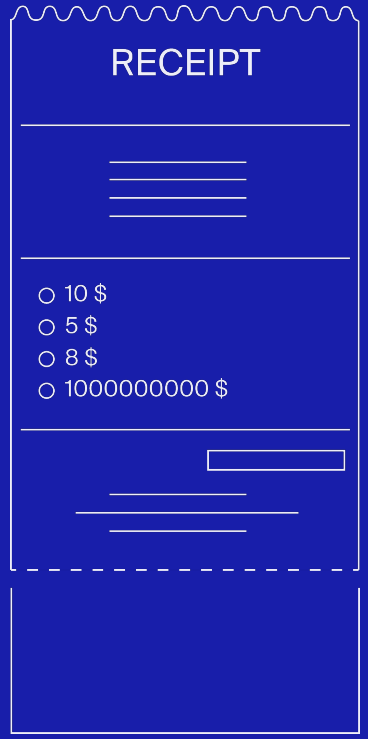
Existing model

- So far Golem used FP contracts
- General computations are hard to estimate

Pay as You Use

- A new T&M billing model for Golem
- Providers charge for resource usage (e.g. CPU time)
- Enables new use cases e.g. WASM computing

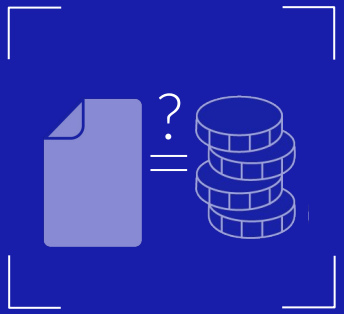
The main challenge of T&M



- What if a provider inflates resource usage?
- Budget limit provides partial protection
- Ensure sustainability of the economy in the long term
- Eliminate cheaters from the market
- Focus on long-term cost rather than single transactions
- How to detect & prevent fraud?

golem

Fraud detection & prevention



- Quest for information: what is the job worth?
- A priori information sources:
  - human input
  - algorithmic estimation
- A posteriori - comparisons
  - punishing worst workers
  - comparable tasks (task farming)
  - cross-checking (redundancy)

Comparing and choosing offers

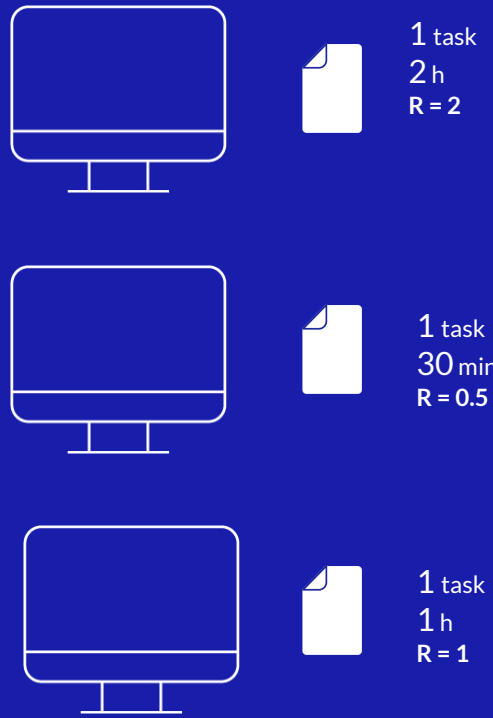
Providers offer prices per resource unit. To compare offers, requestors rate provider efficiency

Usage factor
R = resources needed to compute a reference task.

Offers compared according to
`R * price`

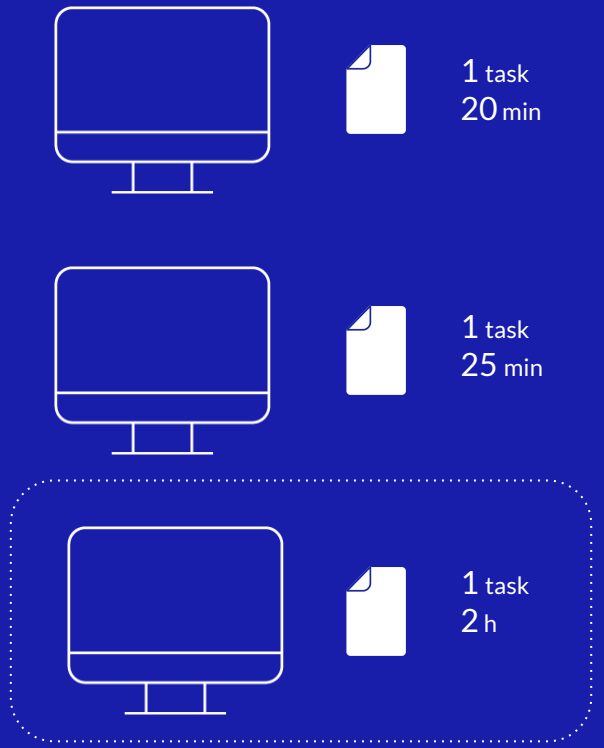
Comparable tasks

- Multiple jobs with the same complexity
- Great source of information
- Use cases: task farming (e.g. mathematical or molecular modelling)
- Adjust usage factors to the weighted geometric mean

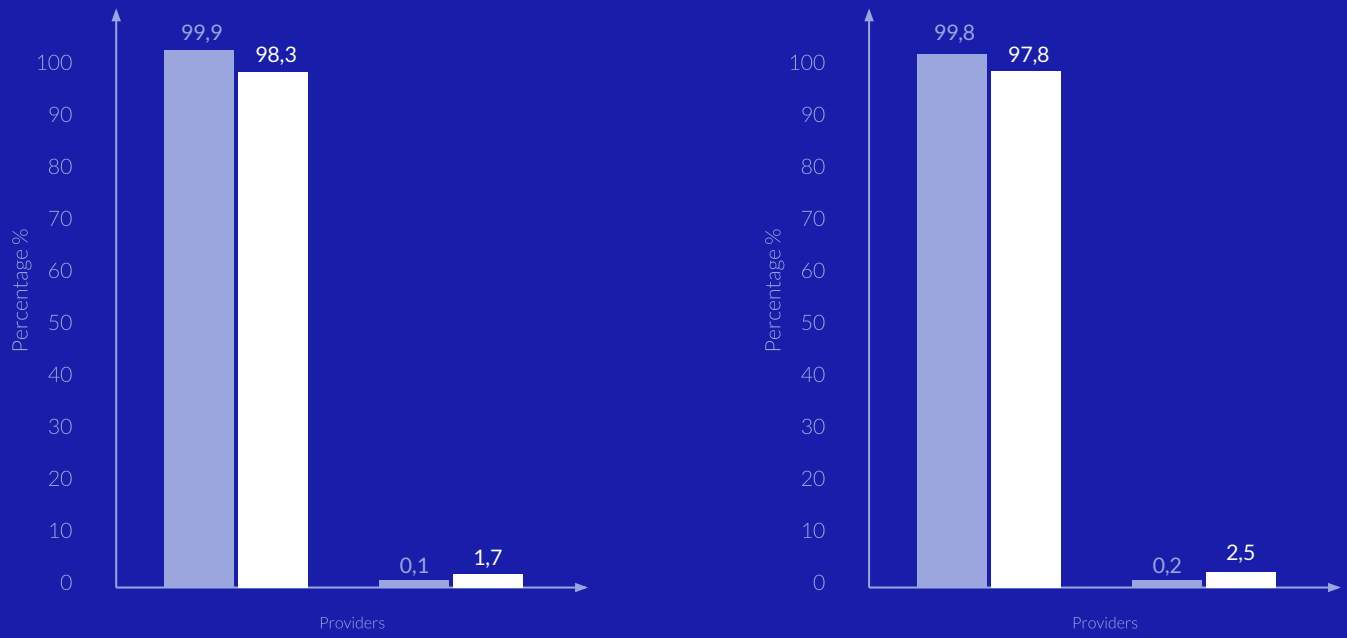


Cross-checking (redundancy)

- The same task executed by 2 or more providers
- Context: result validation by cross-checking (redundancy)
- Honest providers should report similar effective usage
- Otherwise penalize provider with excessive usage



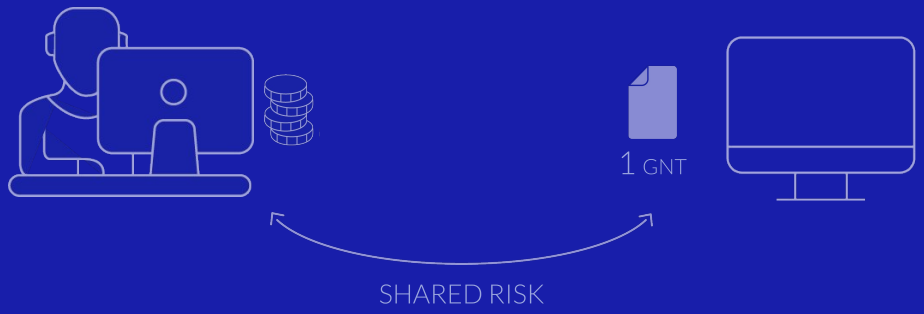
Simulations



10 honest vs 2 dishonest

10 honest vs 3 dishonest

Coming Next: Game-theoretic approaches



01 Provider submits the price and hash of the results

02 Requestor decides if it wants the results for this price

03 Requestor still needs to decide whether the price is fair

Conclusions and future work

01

We want Golem to be a good fit for general computation not only technically, but also economically

02

We propose a simple, yet efficient Pay as You Use solution

03

We plan to introduce it on mainnet along with WASM use-case

04

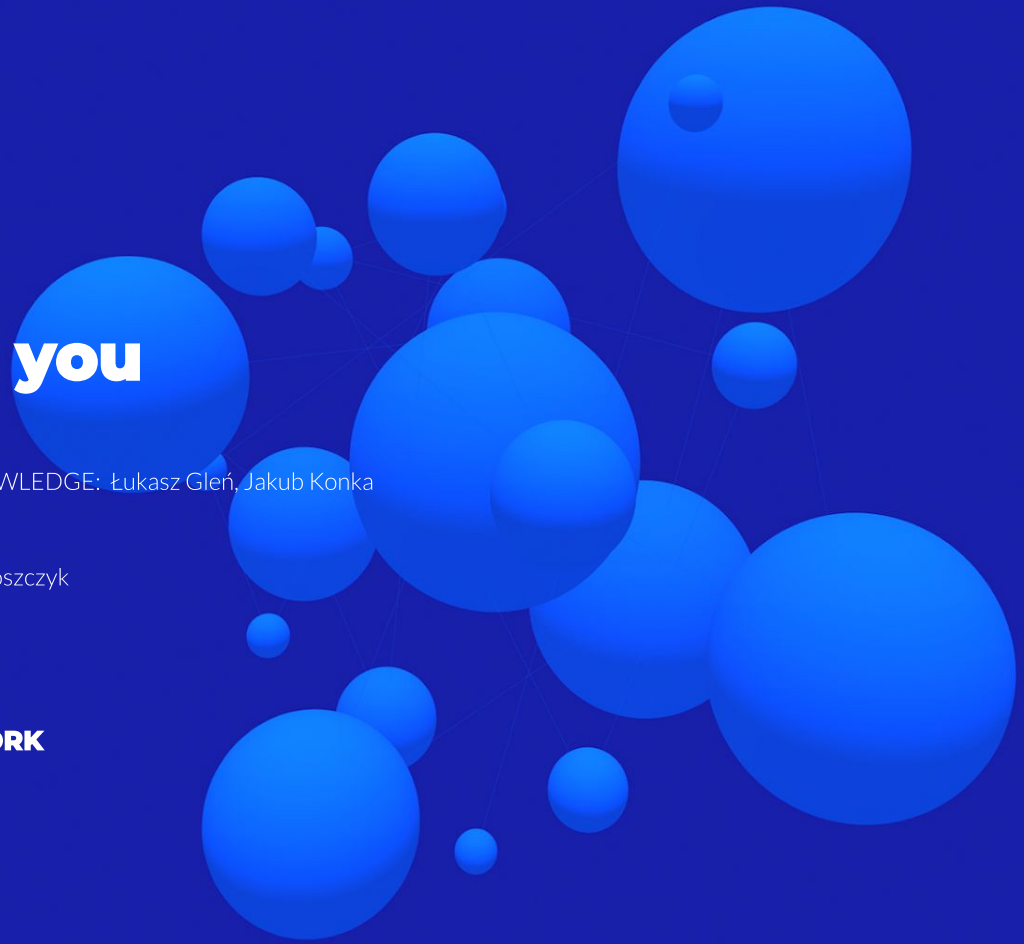
We keep improving our solution

Thank you

SUBSTANTIAL KNOWLEDGE: Łukasz Gleń, Jakub Konka

DESIGN: Natalia Mroszczyk

GOLEM.NETWORK



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Usage Factor adjustment

Providers with nominal usage factors R_1,...,R_n report usages u_1...u_n. Let

$$R = G(R_1, \ldots, R_n)$$

$$u = G(u_1, \ldots, u_n)$$

be their geometric averages.

Nominal and actual factors relative to the mean

$$\upsilon_i = u_i / u$$

$$\rho_i = R_i / R$$

Should be equal if R and u are accurate

Usage Factor adjustment

We move the R-factors of the providers towards the actual usage

$$R'_i = R_i \left(\frac{\upsilon_i}{\rho_i} \right)^q$$

Updated relative usage factors are the weighted geometric mean

$$\rho'_i = R'_i / R = \upsilon_i^q \rho_i^{1-q}$$