SmartSlog knowledge patterns: initial experimental performance evaluation

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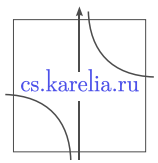

Smart Spaces and Smart-M3

- Publish-subscribe system
- Application consists of several KPs
- Smart Space consists of SIBs (which maintain space content in RDF triples)
- KPs communicate throw SSAP protocol

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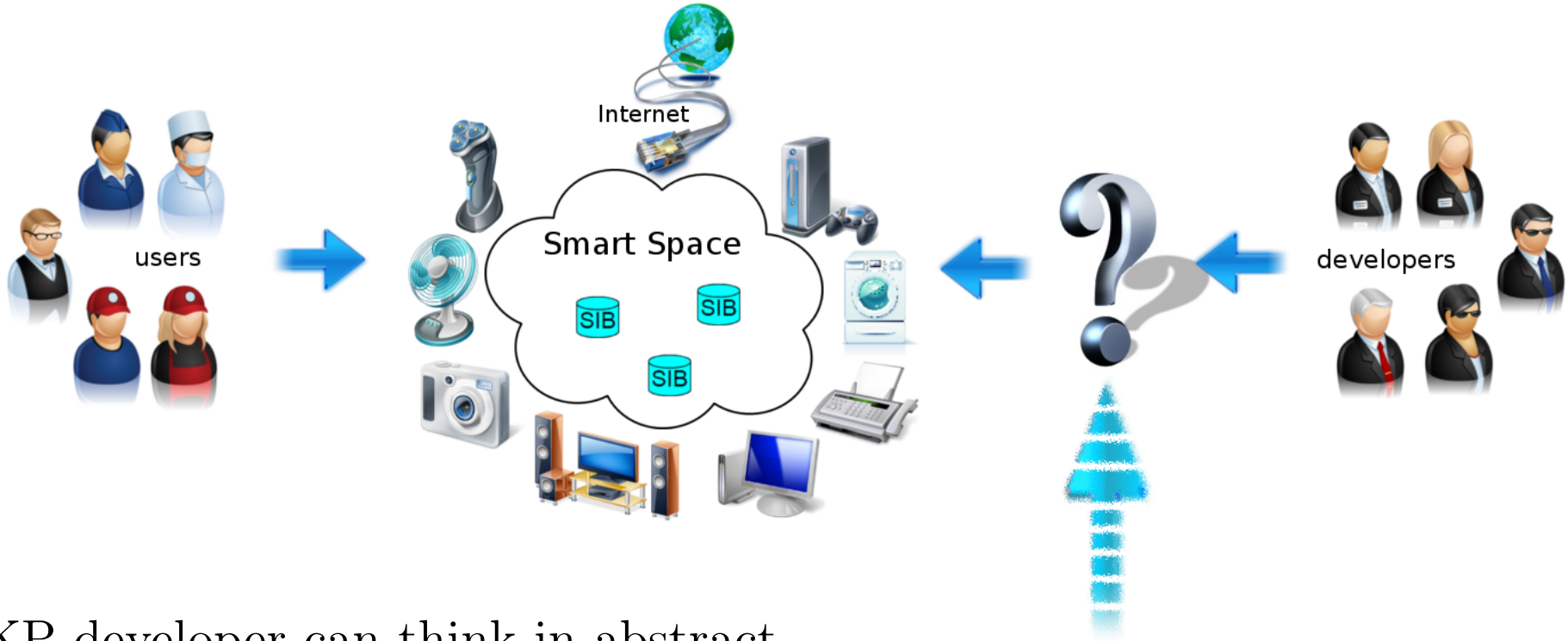
SmartSlog ADK



KP developer can think in abstract
ontology terms with SmartSlog ADK

- ADK stands for Application Development Kit
- Ontology descripes with OWL (mapped to code: ANSI C or C#)
- SmartSlog uses KPI_Low library as low-level interface

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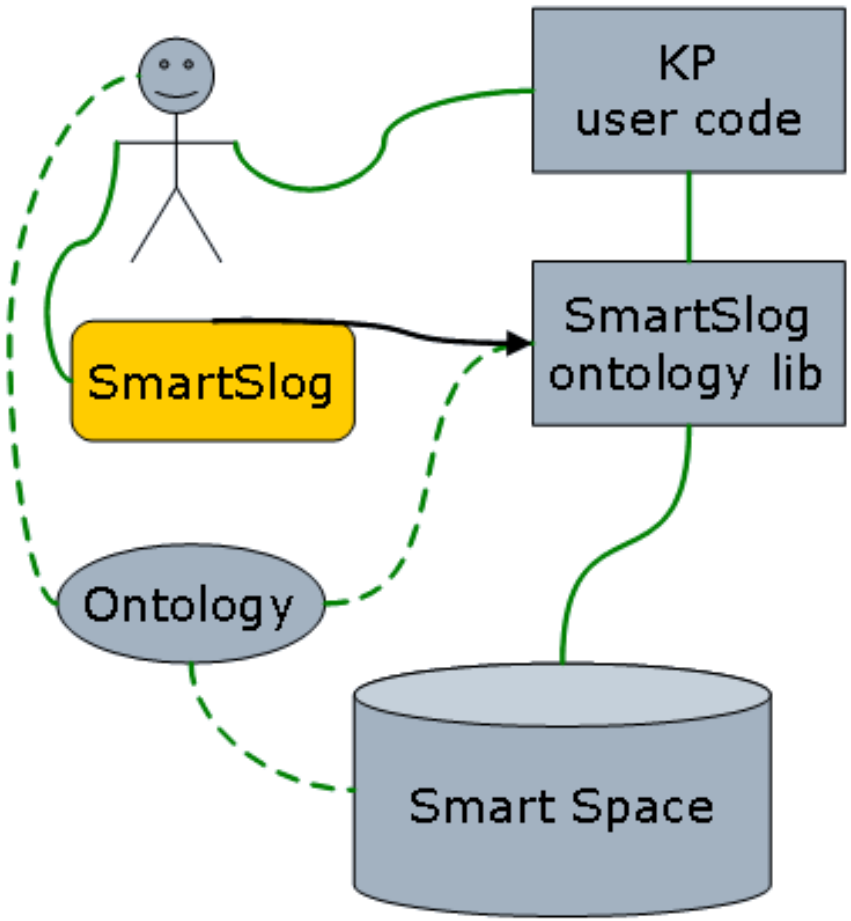
SmartSlog advantages

- Simplifying KP code
  using high-level OWL terms
  - SIB uses low-level RDF triples
  - KP uses high-level abstractions
- Speed development
  of huge amount of KPs
  - Multilingual support
  - Cross-platform code generation
- Target devices
  could be low-performance
  - Subset of ANSI C version
  - Modest code schemes
- Space search
  - Knowledge patterns...



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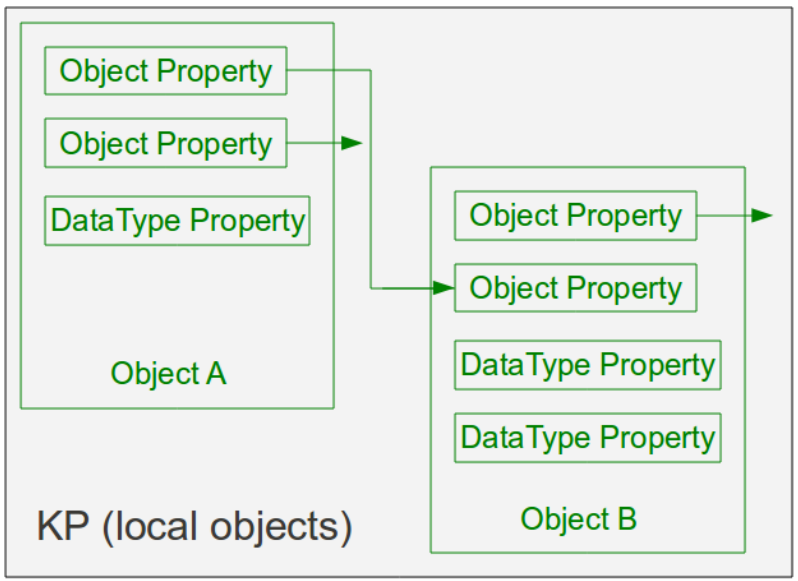
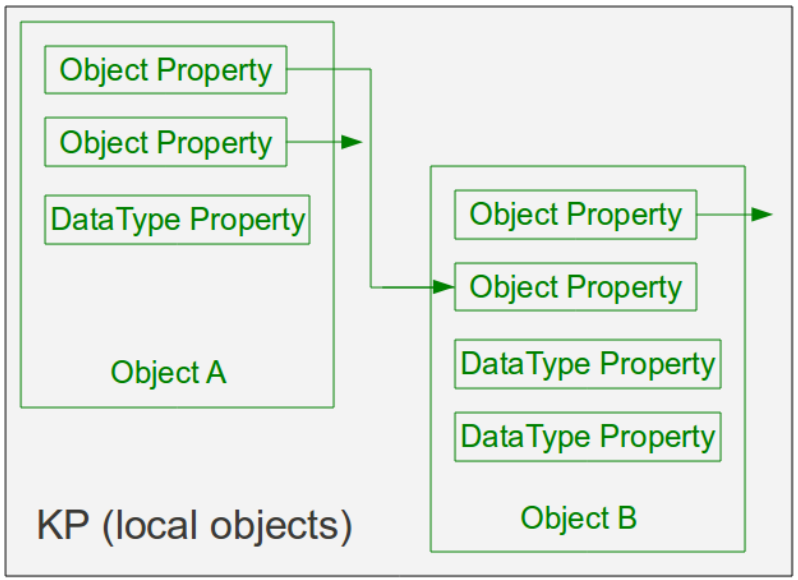
Knowledge Patterns: filtering

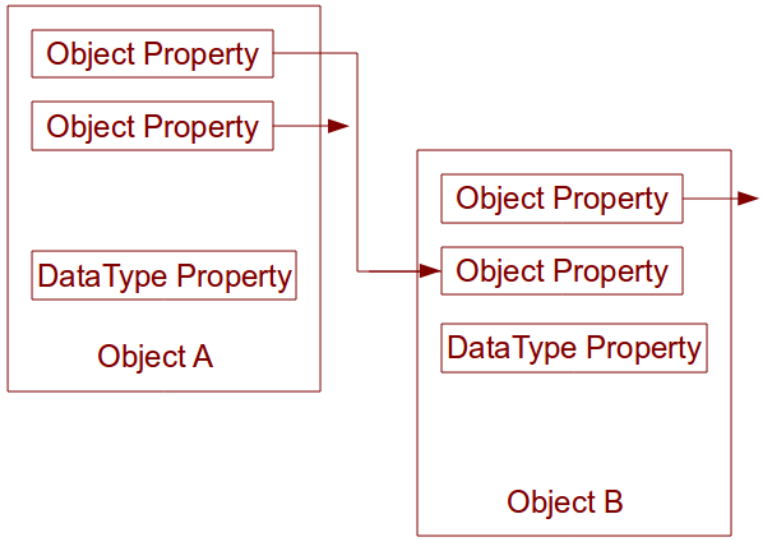
- KP storage – ”local space”
- Local objects are linked with Object Properties



Knowledge Patterns: filtering

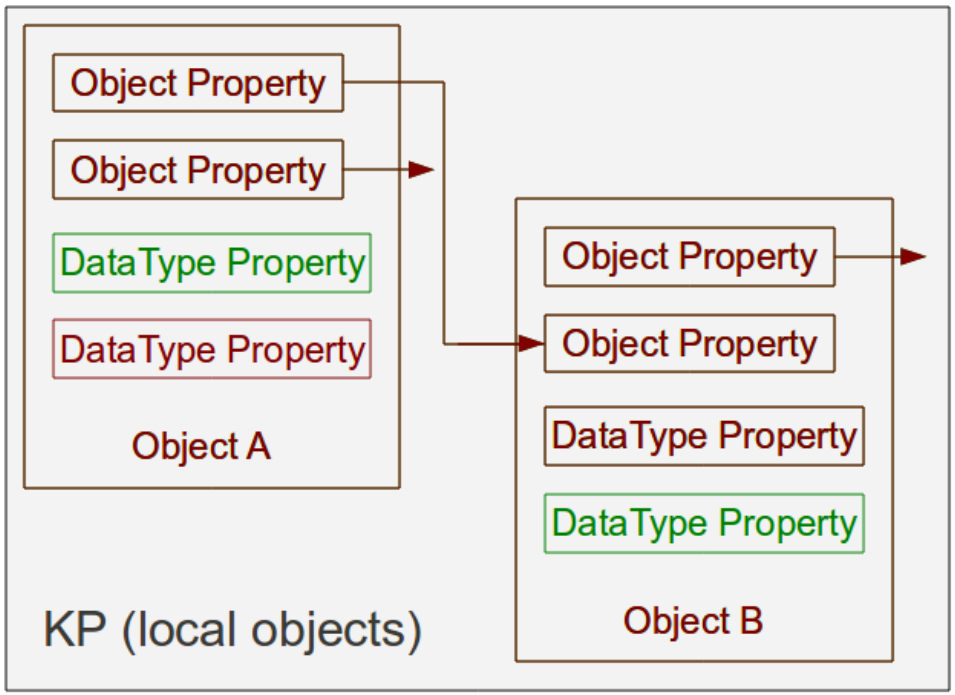
- Knowledge Patterns is an abstract object graph (K-graph)





Knowledge Patterns: filtering

- The result object would be placed to SIB



Knowledge Patterns: searching, K-graph

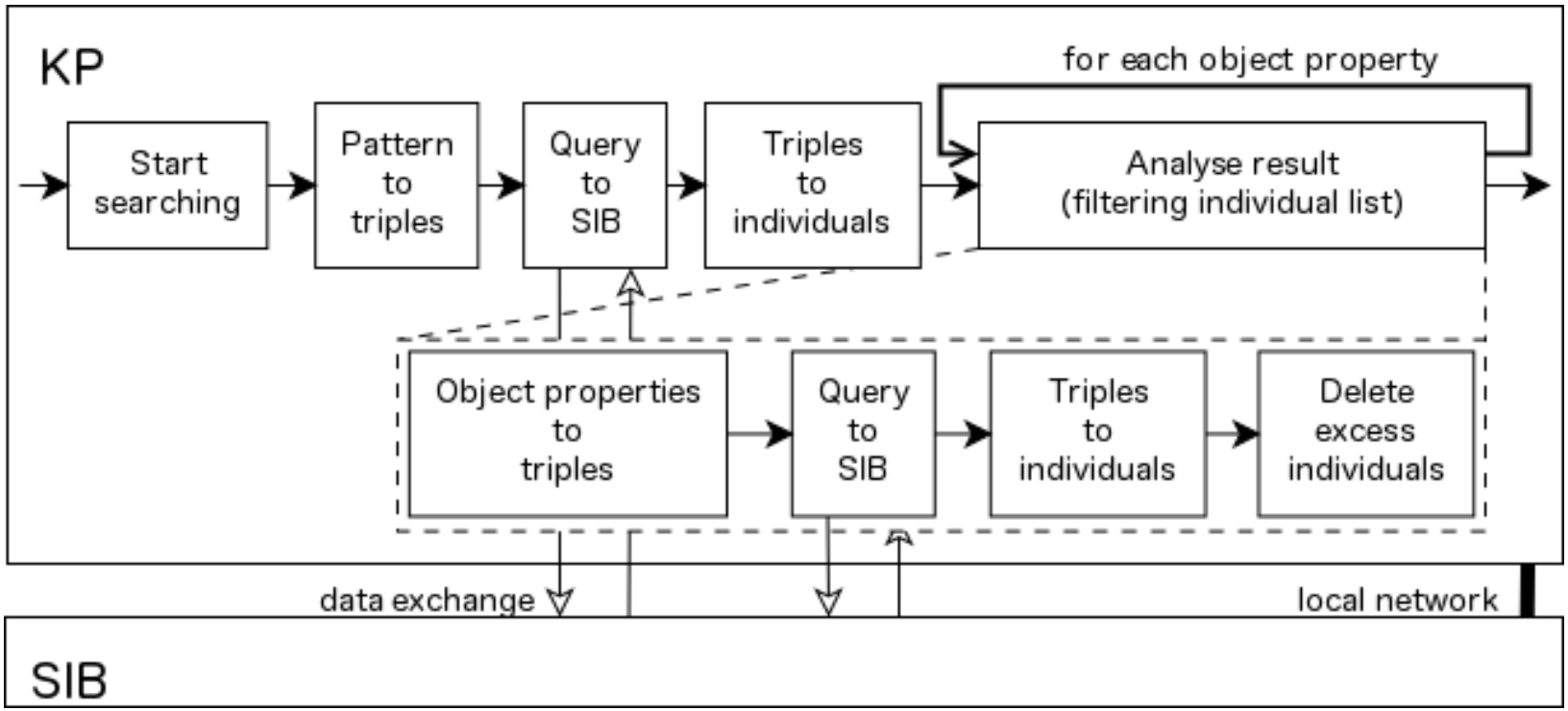
- The same pattern could be used for searching objects in the ”global” Smart Space
- Pattern would be mapped to RDF triples
- So Knowledge pattern would be used for searching triples

Summary:

- Filtering is used for transferring/delivering necessary parts of objects to/from the smart space
- Searching is used to deliver (search) new objects, existing in SS

Patterns search: the most complex operation

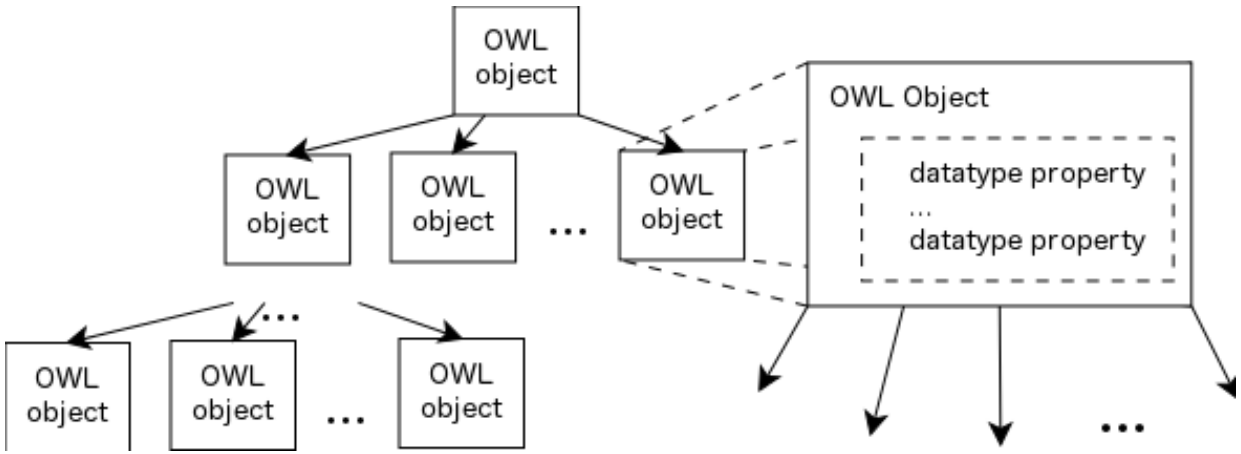
Here is a scheme how pattern based search works...



K-graph: worst-case model

Size parameters for K-graph:

1. s_{wg} – number of datatype properties that every object has (graph weight)
2. s_{wd} – number of object properties that every object has (graph width)
3. s_{hg} – longest path from a fixed node to other nodes (graph height)



Performance KP

We developed special KP for our experiment scenario:

- Generates ontology with defined parameters
- Sends ontology
- Generates pattern with defined parameters
- Time measuring

Parameters of experiments

Lets consider RDF-triples store:

N – the number of triples stored in the smart space

N_{ind} – individuals

It requires:

- N_{rdf} RDF triples with facts about individual
- N_{ont} RDF-scheme triples with high-level ontology declarations (constant)

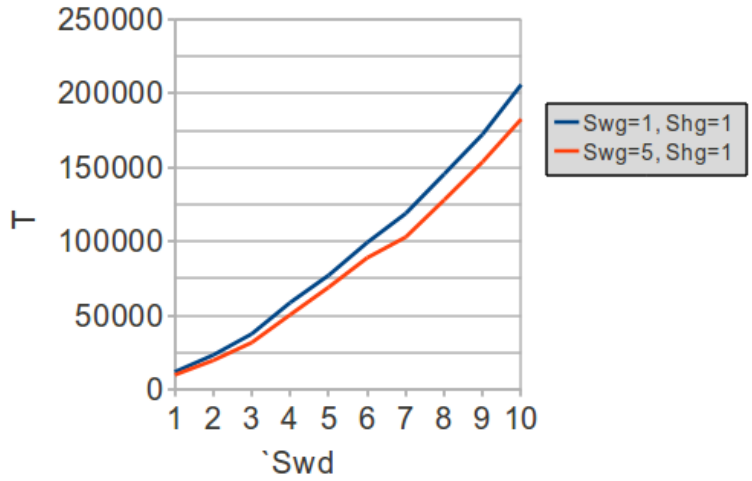
$$N = N_{\text{ont}} + N_{\text{ind}} N_{\text{rdf}}$$

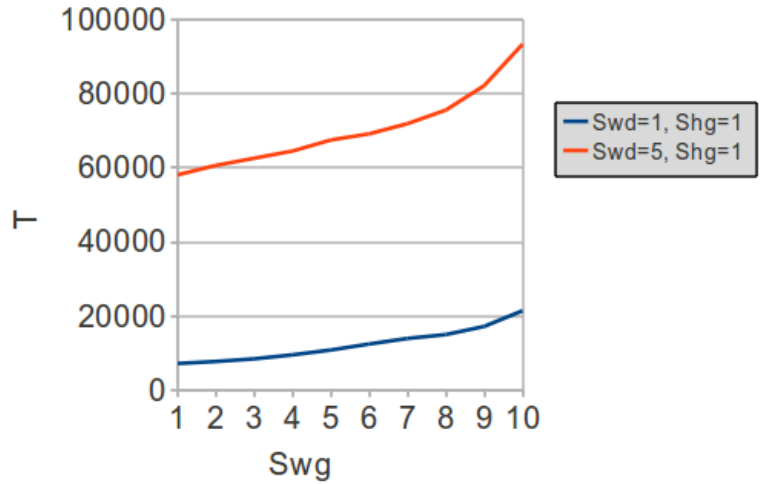
$$N_{\text{rdf}} = 1 + s_{\text{wg}} + s_{\text{wd}}$$

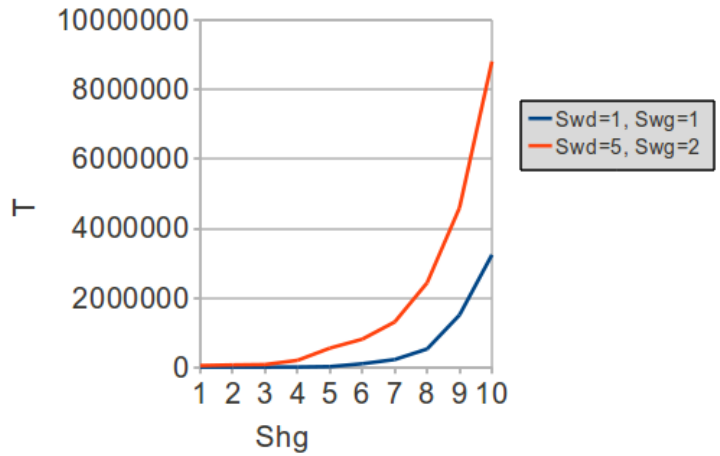
$$N_{\text{ind}} = (s_{\text{wd}}^{s_{\text{hg}}} - 1)/(s_{\text{wd}} - 1)$$

Experiments

We vary s_{wg}, s_{wd} from 1 to 10 and s_{hg} from 1 to 5







Evaluation model

We measure the time

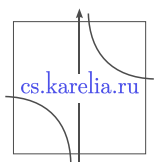
$$T(s_{\mathrm{wg}}, s_{\mathrm{hg}}, s_{\mathrm{wd}}) = b_0 \exp\left(b_1 s_{\mathrm{wg}} + b_2 s_{\mathrm{hg}} + b_3 s_{\mathrm{wd}}\right).$$

Applying multiple non-linear regression analysis

$b_0 \approx 11.582$, $b_1 \approx 0.034$, $b_2 \approx 5.538$, $b_3 \approx 0.388$

Performance-impact proportion

$$s_{\mathrm{hg}} : s_{\mathrm{wd}} : s_{\mathrm{wg}} \approx 1 : 10 : 10^2.$$



Conclusion and Plan

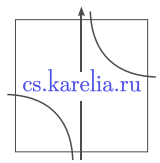
Early measurements showed the basic trends

Complexity grows with size of Knowledge Patterns

Helps developer to decide the size limit of Knowledge Patterns

We plan...

- to continue this research applying other benchmarks and models
  - Measurments on every step
  - Reduce connections impact
- further focus on typical scenarios of real-life Smart-M3 applications
  - Patterns based algorithms
  - Subscriptions measurments



References

- SmartSlog developers wiki:
  http://oss.fruct.org/wiki/SmartSlog/
- Open source code:
  http://sourceforge.net/projects/smartslog/

Thank you!