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Modeling of collaboration archetypes in digital market places

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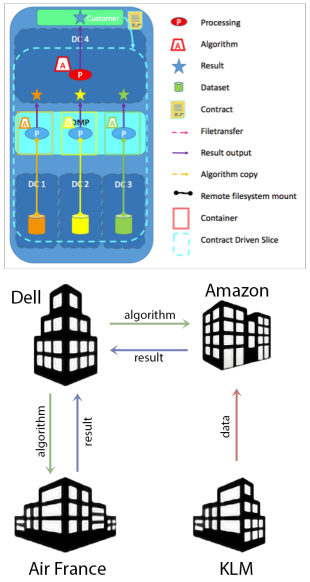
What are multi-party collaboration relationships?

- Determined by the *trust* among participating parties
- Provide information about the rules of how data and compute are shared and used
- Defined from both DMP and application perspective
  - *DMP archetype* collaboration model
    - *Project DL4LD* defined multiple collaboration archetypes
    - A DMP may support a subset of archetypes
  - *Application collaboration model*
    - The application/user collaboration request comes from indivic customer
    - *Hard and Soft Requests*
      - *Hard Request*: not negotiable and must be fulfilled
      - *Soft Request*: can be adjusted to better fit any existing DMP arch



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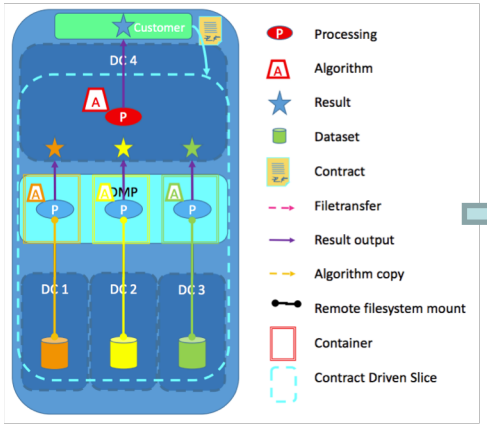
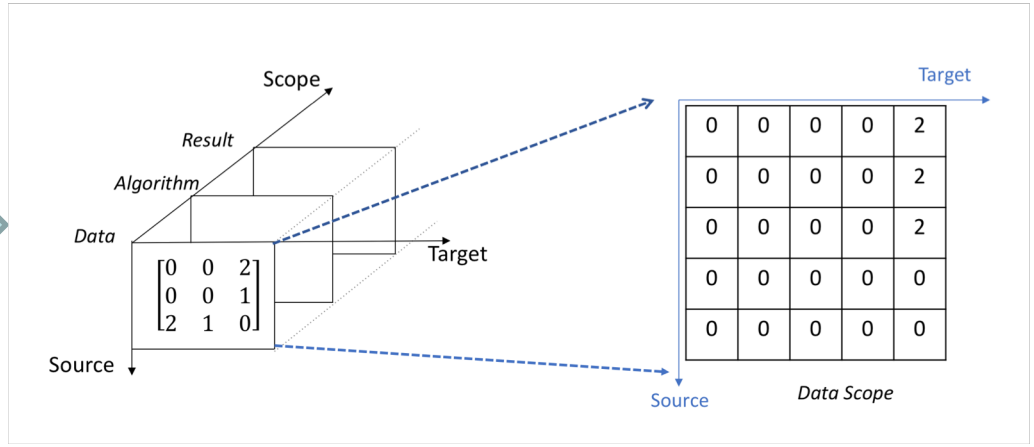
How to model multi-party collaboration relationships generically?

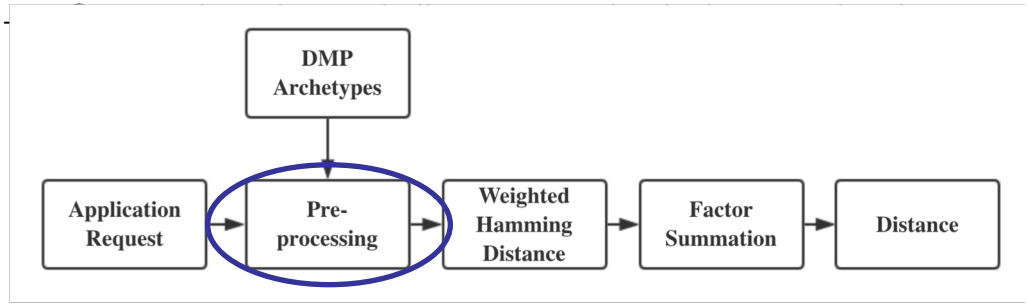




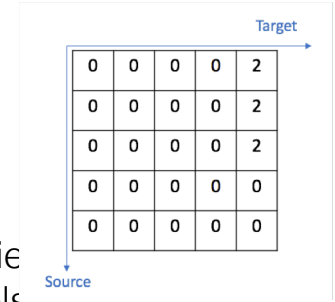
- Parties in the DMP may collaborate across a number of scopes: **data, algorithm ∫ result**
- In each scope, a number, which we call **collaboration level**, describes the concrete approach of asset sharing between any source and target
  - E.g. Filetransfer or Remote filesystem mount
- This model is generic, more scopes and collaboration level could be extended

How to match application requests to DMP archetypes?

- Map any collaboration model as a point in discrete space – relative distance

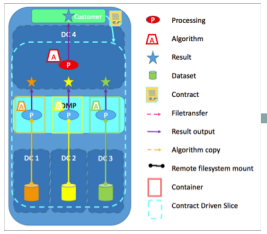


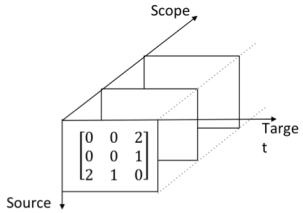
  - Pre-processing block for more commensurate comparison
    - Reduce the influence of how we assign those participating partie
    - Aim to find an optimum fitness between two collaboration models

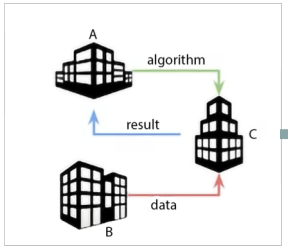


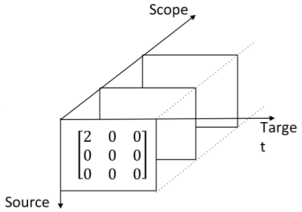
- The *closeness* of application request and the supported DMP archetypes can be identified

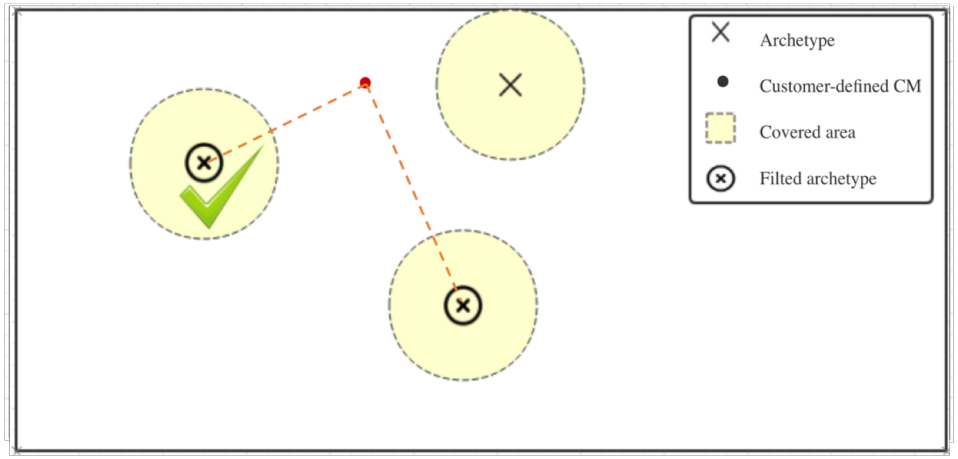
How to match application requests to DMP archetypes?





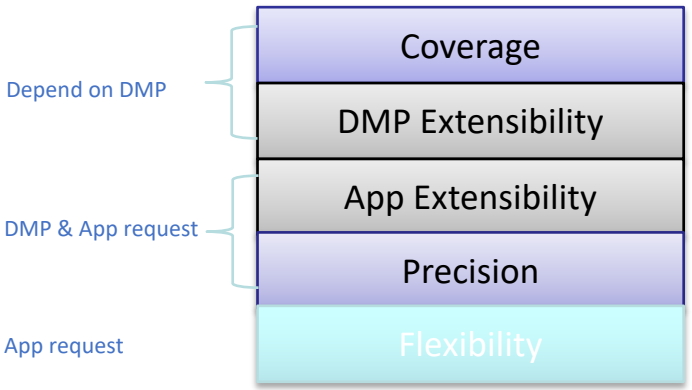






Evaluation metrics of a DMP

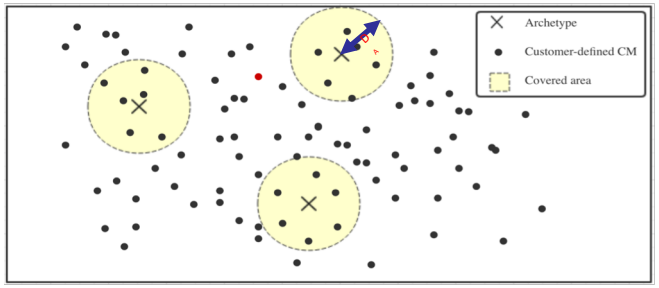
- Motivation:
  - Provide a-priori information for DMP providers and potential customers
  - Allow for an intelligent selection of DMPs
- Evaluation metrics



- how well the overall application requests can be satisfied by supported archetypes of a DMP
- richness a DMP can achieve by decomposing and composing current archetypes
- how elastic of an application request can achieve a perfect match with a given DMP
- how well the supported archetypes fits an application request
- how easily the application request from potential customer could be satisfied

Coverage

- A higher *coverage is* achieved by lowering customer satisfaction degree
  - Pre-define a tolerant distance D_A
  - Covered area of each archetype is modeled effectively as a sphere with radius D_A
  - Total covered area is of a DMP is the union of individual covered area
- Coverage of a DMP with under a fix D_A is calculated as



- An optimization algorithm for coverage calculation is designed for complexity reduction

How to use the proposed metrics for intelligent selection?

- Normally there are multiple DMP candidate and each DMP may support different sets of archetypes
- Evaluation metrics could be computed for each DMP with a specific application request
- An optimal DMP could be recommended to a potential customer for a given application

Algorithm 2 Metrics validation with a specific collaboration request

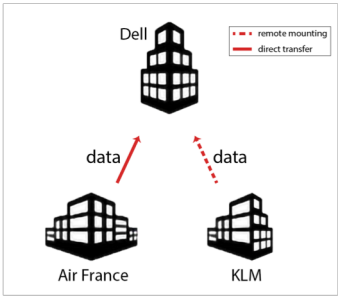
```
Input collaboration request → cr
Sort DMP candidates on coverage in descending order → DMP_rank
for dmp_i ∈ DMP_rank do
    if precision(dmp_i, cr) = 1 then
        dmp_i → dmp_opt
        go to output
    end if
end for
if flexibility(cr) > 0 then
    if ∃E_A ≥ 0 then
        Select dmp_i with maximum E_A
        dmp_i → dmp_opt
        go to output
    end if
end if
Extend DMP_rank by primitive composition → DMP_e
for dmp_i ∈ DMP_e do
    if precision(dmp_i, cr) = 1 then
        dmp_i → dmp_opt
        go to output
    end if
end for
output:
Return dmp_opt
```

Firstly, select the DMP candidate containing an exactly matched archetype

Then, select the DMP candidate containing an exactly matched archetype with minimum modification of soft requirements in the application request

Lastly, select the DMP candidate containing an exactly matched archetype by composing and decomposing current archetypes

Intelligent selection of DMPs



Hard Request: Air France and KLM trusts Dell in data scope

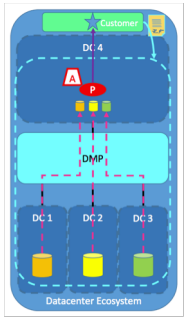
Soft Request: Air France prefer direct data transfer and KLM prefers direct mounting

DMP	Supported Archetype Trust Models
DMP_1	{1, 2, 3, 4, 7}
DMP_2	{1, 2, 3, 5, 7}
DMP_3	{1, 2, 3, 5, 6}
DMP_4	{1, 3, 4, 5, 7}
DMP_5	{2, 3, 4, 6, 7}

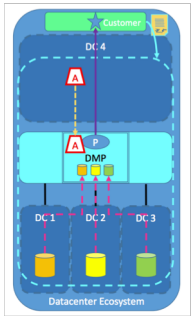
	DMP_1	DMP_2	DMP_3	DMP_4	DMP_5
Coverage (1e−12)	4.29	4.28	4.26	3.69	3.65
Precision	0.83	0.83	0.83	0.83	-0.67
Flexibility	0.06	0.06	0.06	0.06	0.06
Application extensibility	0.5	0.5	0.5	0.5	$-\infty$

Archetype I in DMP_1 is the best matched candidate for the app request

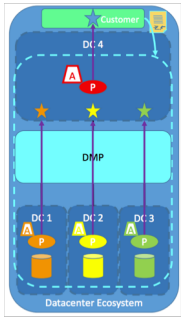
DMP archetypes in DL4LD



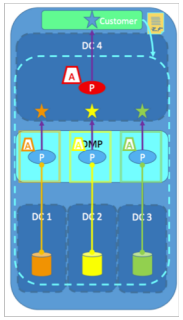
Archetype I



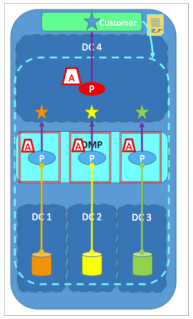
Archetype II



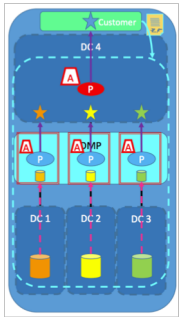
Archetype III



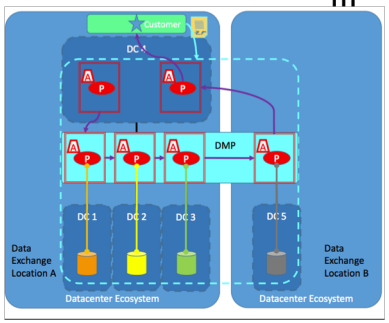
Archetype IV



Archetype V



Archetype VI



Archetype VII