

Optimization/simulation-based risk mitigation in resilient green communication networks

Code for optimization procedures

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To reproduce the steps of the algorithm presented in the paper, save attached files to a common directory and provide required tools.

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SOFTWARE REQUIREMENTS

- CPLEX (including OPL Interpreter): <http://www-01.ibm.com/software/commerce/optimization/cplex-optimizer/>

DP.MOD

This CPLEX script presents the optimization problem of optimal assignment of optical flows if energy profiles in links are concave. The recovery option used by all the demands is based on dedicated path protection 1:1 DP. The energy profiles are approximated with linear segments.

```

1 // *****/
2 // OPL 12.6.0.0 Model
3 // Author: Piotr Cholda, AGH University of Science and Technology
4 // piotr.cholda@agh.edu.pl
5 // Creation Date: 2 June 2015
6 // *****/
7
8 float BigM = 100000;
9
10 {string} Nodes = ...;
11
12 tuple arc
13 {
14     string source;
15     string destination;
16 }
17
18 {arc} Arcs with source in Nodes, destination in Nodes = ...;
19
20 tuple demand
21 {
22     string source;
23     string destination;
24 }
25
26 {demand} Demands with source in Nodes, destination in Nodes = ...;
27
28 float Volume[Demands] = ...;
29
30 int Path = ...;
31
32 range Paths = 1..Path;
33
34 int delta[Arcs][Demands][Paths] = ...;
35
36 int beta[Arcs][Demands][Paths] = ...; // beta[e][d][p] = 1 if demand d uses in its backup ↙
37     ↘path p link e
38
39 dvar boolean flow[Demands][Paths]; //single flow
40
41 dvar float+ flow_summarized[Arcs];
42
43 int Number_seg = ...;
44
45 range Segments = 1..Number_seg;
46
47 float Coeff_a[Segments] = ...;
48
49 float Coeff_b[Segments] = ...;
50
51 dvar float+ y[Arcs][Segments];
52
53 dvar boolean u[Arcs][Segments];
54
55 dvar float+ cost_link[Arcs];
56
57 minimize sum(a in Arcs) cost_link[a];
58
59 subject to{
60     forall(d in Demands)
61         sum(p in Paths) flow[d][p] == 1;
62
63     forall(a in Arcs)

```

```
64     sum(d in Demands, p in Paths) (delta[a][d][p]+beta[a][d][p])*flow[d][p]*Volume[d] == ↵
        ↵flow_summarized[a];
65
66 forall(a in Arcs)
67     flow_summarized[a] == sum(k in Segments) y[a][k];
68
69 forall(a in Arcs,k in Segments)
70     y[a][k] <= BigM*u[a][k];
71
72 forall(a in Arcs,k in Segments)
73     u[a][k] <= BigM*y[a][k];
74
75 forall(a in Arcs)
76     sum(k in Segments) u[a][k] == 1;
77
78 forall(a in Arcs)
79     cost_link[a] == sum(k in Segments) (Coeff_a[k]*y[a][k] + Coeff_b[k]*u[a][k]);
80
81 }
```