

LEISURE Load-Balanced Network-wide Traffic Measurement and Monitor Placement[2015 LEISURE]

LEISURE FRAMEWORK

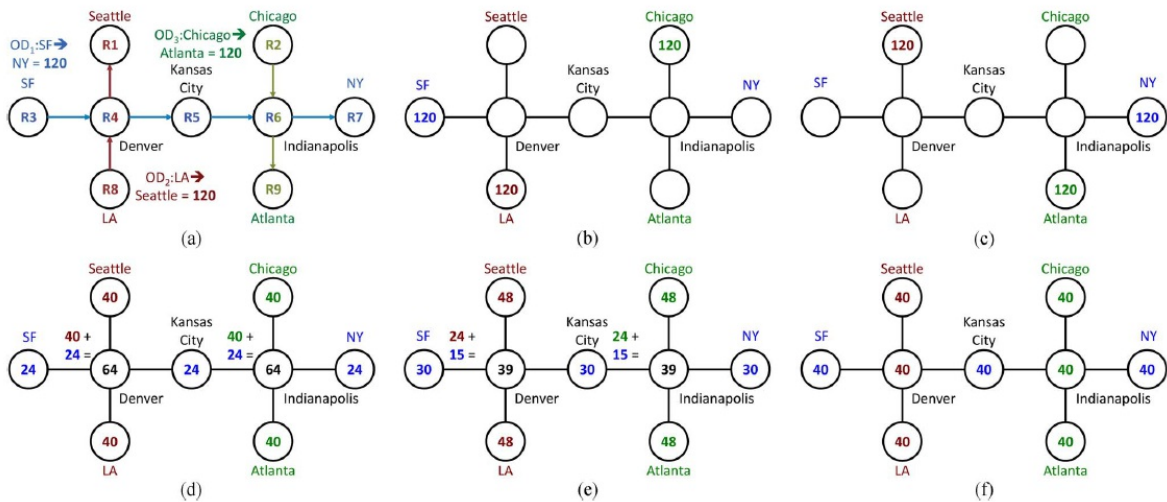
1. INTRODUCTION

Contribution

- 提出LEISURE, 公式化全网流量测量负载均衡优化问题, 启发式解决方案
 - 有限的测量点资源, 有限的测量点数量, 多路由路径
- 将LEISURE公式化为混合整数二次规划(MIQP)问题, 并通过解耦两个决策变量, 将其转化为标准混合整数线性规划问题
- 基于Abilence,GEANT网络拓扑于流量, 评估算法效果
 - 单点最大网络负载, 所有测量点的负载方差(测量任务均匀分布假设下)

2. MOTIVATING EXAMPLE

利用Example说明网络负载均衡问题



- 样例假设:
 - 3 OD-pairs(each with 120 units of traffic):
 - SF->NY | LA->Seattle | Chicago->Atlanta
- 解决方法:
 - i. 在入/出口路由器测量(图中b,c方法): 数量少, 但负载高, worst-case(peak 120 units)
 - ii. 将负载均分到沿路的测量点(图d方法): 数量多, 负载有多又少(出现在多个路径上的负载高)
 - iii. 引入负载均衡, 按比例计算(图e方法): 进一步减小负载
 - iv. 进一步优化, 全局负载均衡(图f方法): 数量与负载均有减小. 哪些节点参与哪些任务, 每个节点该负责任务的比例

3. LEISURE FRAMEWORK

问题公式化与解决方案

- 前置条件

- ISP通常根据 **源/目的对(OD-pairs)** 定义全网测量任务
- LEISURE
 - 测量任务定义，需要考虑流量需求、路由信息
 - 网络拓扑，流量需求，路由矩阵，测量消耗
 - 中心化的架构
 - 假设：
 - 每个路由器均具备测量功能
 - 每个OD-pair遵循最短路径算法(OSPF)
 - 每个测量点仅执行一种测量任务
- Basic Model
 - Network Topology: $G(V, E)$
 - Set of routers(monitors): V
 - Set of directed links: E
 - Router resource constraint(the number of flows that router v_i can measure in a given measurement interval): $C_{v_i} (i=1 \dots M)$
 - OD-pair: $OD_x, x \in V \times V-1$
 - set of all OD-pairs: $\Theta = V \times V-1$
 - traffic demand(IP flows) of OD-pair OD_x : $\phi_x, x \in \Theta$
 - routing strategy for every OD-pair OD_x : $P_x, x \in \Theta$
 - coverage fraction of IP flows of OD_x that is required to measure: a_x
 - total required measurement traffic: $\beta = \sum_{x \in \Theta} \phi_x \times a_x$
 - fraction of traffic demand of OD_x : d_i^x
 - the total traffic that router v_i measures for all OD-pairs: L_i
- Problem Formulation
 - min-VAR
 - min-MAX
 - min-VAR-given-MAX
- Optimal/Heuristic Solutions
 - 二次规划QP: for min-VAR
 - 线性规划LP: for min-MAX
 - LP first QP follow : for min-VAR-given-MAX

	d_3^1	d_4^1	d_5^1	d_6^1	d_7^1	d_8^1	d_9^1	d_{10}^1	d_{11}^1	d_{12}^1	d_{13}^1	d_{14}^1	d_{15}^1	d_{16}^1	d_{17}^1	d_{18}^1	d_{19}^1	d_{20}^1	d_{21}^1	d_{22}^1	d_{23}^1	d_{24}^1	d_{25}^1	d_{26}^1	d_{27}^1	d_{28}^1	d_{29}^1	d_{30}^1	d_{31}^1	d_{32}^1	d_{33}^1	d_{34}^1	d_{35}^1	d_{36}^1	d_{37}^1	d_{38}^1	d_{39}^1	d_{40}^1	d_{41}^1	d_{42}^1	d_{43}^1	d_{44}^1	d_{45}^1	d_{46}^1	d_{47}^1	d_{48}^1	d_{49}^1	d_{50}^1	d_{51}^1	d_{52}^1	d_{53}^1	d_{54}^1	d_{55}^1	d_{56}^1	d_{57}^1	d_{58}^1	d_{59}^1	d_{60}^1	d_{61}^1	d_{62}^1	d_{63}^1	d_{64}^1	d_{65}^1	d_{66}^1	d_{67}^1	d_{68}^1	d_{69}^1	d_{70}^1	d_{71}^1	d_{72}^1	d_{73}^1	d_{74}^1	d_{75}^1	d_{76}^1	d_{77}^1	d_{78}^1	d_{79}^1	d_{80}^1	d_{81}^1	d_{82}^1	d_{83}^1	d_{84}^1	d_{85}^1	d_{86}^1	d_{87}^1	d_{88}^1	d_{89}^1	d_{90}^1	d_{91}^1	d_{92}^1	d_{93}^1	d_{94}^1	d_{95}^1	d_{96}^1	d_{97}^1	d_{98}^1	d_{99}^1	d_{100}^1	d_{101}^1	d_{102}^1	d_{103}^1	d_{104}^1	d_{105}^1	d_{106}^1	d_{107}^1	d_{108}^1	d_{109}^1	d_{110}^1	d_{111}^1	d_{112}^1	d_{113}^1	d_{114}^1	d_{115}^1	d_{116}^1	d_{117}^1	d_{118}^1	d_{119}^1	d_{120}^1	d_{121}^1	d_{122}^1	d_{123}^1	d_{124}^1	d_{125}^1	d_{126}^1	d_{127}^1	d_{128}^1	d_{129}^1	d_{130}^1	d_{131}^1	d_{132}^1	d_{133}^1	d_{134}^1	d_{135}^1	d_{136}^1	d_{137}^1	d_{138}^1	d_{139}^1	d_{140}^1	d_{141}^1	d_{142}^1	d_{143}^1	d_{144}^1	d_{145}^1	d_{146}^1	d_{147}^1	d_{148}^1	d_{149}^1	d_{150}^1	d_{151}^1	d_{152}^1	d_{153}^1	d_{154}^1	d_{155}^1	d_{156}^1	d_{157}^1	d_{158}^1	d_{159}^1	d_{160}^1	d_{161}^1	d_{162}^1	d_{163}^1	d_{164}^1	d_{165}^1	d_{166}^1	d_{167}^1	d_{168}^1	d_{169}^1	d_{170}^1	d_{171}^1	d_{172}^1	d_{173}^1	d_{174}^1	d_{175}^1	d_{176}^1	d_{177}^1	d_{178}^1	d_{179}^1	d_{180}^1	d_{181}^1	d_{182}^1	d_{183}^1	d_{184}^1	d_{185}^1	d_{186}^1	d_{187}^1	d_{188}^1	d_{189}^1	d_{190}^1	d_{191}^1	d_{192}^1	d_{193}^1	d_{194}^1	d_{195}^1	d_{196}^1	d_{197}^1	d_{198}^1	d_{199}^1	d_{200}^1	d_{201}^1	d_{202}^1	d_{203}^1	d_{204}^1	d_{205}^1	d_{206}^1	d_{207}^1	d_{208}^1	d_{209}^1	d_{210}^1	d_{211}^1	d_{212}^1	d_{213}^1	d_{214}^1	d_{215}^1	d_{216}^1	d_{217}^1	d_{218}^1	d_{219}^1	d_{220}^1	d_{221}^1	d_{222}^1	d_{223}^1	d_{224}^1	d_{225}^1	d_{226}^1	d_{227}^1	d_{228}^1	d_{229}^1	d_{230}^1	d_{231}^1	d_{232}^1	d_{233}^1	d_{234}^1	d_{235}^1	d_{236}^1	d_{237}^1	d_{238}^1	d_{239}^1	d_{240}^1	d_{241}^1	d_{242}^1	d_{243}^1	d_{244}^1	d_{245}^1	d_{246}^1	d_{247}^1	d_{248}^1	d_{249}^1	d_{250}^1	d_{251}^1	d_{252}^1	d_{253}^1	d_{254}^1	d_{255}^1	d_{256}^1	d_{257}^1	d_{258}^1	d_{259}^1	d_{260}^1	d_{261}^1	d_{262}^1	d_{263}^1	d_{264}^1	d_{265}^1	d_{266}^1	d_{267}^1	d_{268}^1	d_{269}^1	d_{270}^1	d_{271}^1	d_{272}^1	d_{273}^1	d_{274}^1	d_{275}^1	d_{276}^1	d_{277}^1	d_{278}^1	d_{279}^1	d_{280}^1	d_{281}^1	d_{282}^1	d_{283}^1	d_{284}^1	d_{285}^1	d_{286}^1	d_{287}^1	d_{288}^1	d_{289}^1	d_{290}^1	d_{291}^1	d_{292}^1	d_{293}^1	d_{294}^1	d_{295}^1	d_{296}^1	d_{297}^1	d_{298}^1	d_{299}^1	d_{300}^1	d_{301}^1	d_{302}^1	d_{303}^1	d_{304}^1	d_{305}^1	d_{306}^1	d_{307}^1	d_{308}^1	d_{309}^1	d_{310}^1	d_{311}^1	d_{312}^1	d_{313}^1	d_{314}^1	d_{315}^1	d_{316}^1	d_{317}^1	d_{318}^1	d_{319}^1	d_{320}^1	d_{321}^1	d_{322}^1	d_{323}^1	d_{324}^1	d_{325}^1	d_{326}^1	d_{327}^1	d_{328}^1	d_{329}^1	d_{330}^1	d_{331}^1	d_{332}^1	d_{333}^1	d_{334}^1	d_{335}^1	d_{336}^1	d_{337}^1	d_{338}^1	d_{339}^1	d_{340}^1	d_{341}^1	d_{342}^1	d_{343}^1	d_{344}^1	d_{345}^1	d_{346}^1	d_{347}^1	d_{348}^1	d_{349}^1	d_{350}^1	d_{351}^1	d_{352}^1	d_{353}^1	d_{354}^1	d_{355}^1	d_{356}^1	d_{357}^1	d_{358}^1	d_{359}^1	d_{360}^1	d_{361}^1	d_{362}^1	d_{363}^1	d_{364}^1	d_{365}^1	d_{366}^1	d_{367}^1	d_{368}^1	d_{369}^1	d_{370}^1	d_{371}^1	d_{372}^1	d_{373}^1	d_{374}^1	d_{375}^1	d_{376}^1	d_{377}^1	d_{378}^1	d_{379}^1	d_{380}^1	d_{381}^1	d_{382}^1	d_{383}^1	d_{384}^1	d_{385}^1	d_{386}^1	d_{387}^1	d_{388}^1	d_{389}^1	d_{390}^1	d_{391}^1	d_{392}^1	d_{393}^1	d_{394}^1	d_{395}^1	d_{396}^1	d_{397}^1	d_{398}^1	d_{399}^1	d_{400}^1	d_{401}^1	d_{402}^1	d_{403}^1	d_{404}^1	d_{405}^1	d_{406}^1	d_{407}^1	d_{408}^1	d_{409}^1	d_{410}^1	d_{411}^1	d_{412}^1	d_{413}^1	d_{414}^1	d_{415}^1	d_{416}^1	d_{417}^1	d_{418}^1	d_{419}^1	d_{420}^1	d_{421}^1	d_{422}^1	d_{423}^1	d_{424}^1	d_{425}^1	d_{426}^1	d_{427}^1	d_{428}^1	d_{429}^1	d_{430}^1	d_{431}^1	d_{432}^1	d_{433}^1	d_{434}^1	d_{435}^1	d_{436}^1	d_{437}^1	d_{438}^1	d_{439}^1	d_{440}^1	d_{441}^1	d_{442}^1	d_{443}^1	d_{444}^1	d_{445}^1	d_{446}^1	d_{447}^1	d_{448}^1	d_{449}^1	d_{450}^1	d_{451}^1	d_{452}^1	d_{453}^1	d_{454}^1	d_{455}^1	d_{456}^1	d_{457}^1	d_{458}^1	d_{459}^1	d_{460}^1	d_{461}^1	d_{462}^1	d_{463}^1	d_{464}^1	d_{465}^1	d_{466}^1	d_{467}^1	d_{468}^1	d_{469}^1	d_{470}^1	d_{471}^1	d_{472}^1	d_{473}^1	d_{474}^1	d_{475}^1	d_{476}^1	d_{477}^1	d_{478}^1	d_{479}^1	d_{480}^1	d_{481}^1	d_{482}^1	d_{483}^1	d_{484}^1	d_{485}^1	d_{486}^1	d_{487}^1	d_{488}^1	d_{489}^1	d_{490}^1	d_{491}^1	d_{492}^1	d_{493}^1	d_{494}^1	d_{495}^1	d_{496}^1	d_{497}^1	d_{498}^1	d_{499}^1	d_{500}^1	d_{501}^1	d_{502}^1	d_{503}^1	d_{504}^1	d_{505}^1	d_{506}^1	d_{507}^1	d_{508}^1	d_{509}^1	d_{510}^1	d_{511}^1	d_{512}^1	d_{513}^1	d_{514}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