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A NEW CLOUD ASSITED MOBILE HEALTH MONITORING SYSTEM

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ABSTRACT:

Cloud-assisted mobile health (mHealth) monitoring, which applies the prevailing mobile communications and cloud computing technologies to provide feedback decision support, has been considered as a revolutionary approach to improving the quality of healthcare service while lowering the healthcare cost. Unfortunately, it also poses a serious risk on both clients' privacy and intellectual property of monitoring service providers, which could deter the wide adoption of mHealth technology. This paper is to address this important problem and design a cloud assisted privacy preserving mobile health monitoring system to protect the privacy of the involved parties and their data. Moreover, the outsourcing decryption technique and a newly proposed key private proxy re-encryption are adapted to shift the computational complexity of the involved parties to the cloud without compromising clie.

Index Terms— Healthcare, key private proxy reencryption, mobile health (mHealth), outsourcing decryption, privacy

INTRODUCTION:

WIDE deployment of mobile devices, such as smart phones equipped with low cost sensors, has already shown great potential in improving the quality of healthcare services. Remote mobile health monitoring has already been recognized as not only a potential, but also a successful example routing has been proposed in recent years as an effective way to achieve certain routing properties, without going into the long and tedious process of standardization and global deployment of a new routing

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protocol. For example, in overlay routing was used to improve TCP performance over the Internet, where the main idea is to break the end-to-end feedback loop into smaller loops. This requires that nodes capable of performing TCP Piping would be present along the route at relatively small distances. Other examples for the use of overlay routing are projects like RON and Detour where overlay routing is used to improve reliability. Yet another example is the concept of the "Global-ISP" paradigm introduced in where an overlay node is used to reduce latency in BGP routing. In order to deploy overlay routing over the actual physical infrastructure, one needs to deploy and manage overlay nodes that will have the new extra functionality. This come swith a non negligible cost both in terms of capital and operating costs. Thus, it is important to study the benefit one gets from improving the routing metric against this cost.

Existing System:

Using overlay routing to improve network performance is motivated by many works that studied the inefficiency of varieties of networking architectures and applications. Analyzing a large set of data, Savage *et al.* [6] explore the question: How "good" is Internet routing from a user's perspective considering round-trip time, packet loss rate, and bandwidth? They showed that in 30%–80% of the cases, there is an alternate routing path with better quality compared to the default routing path. In [7] and later in [1], the authors show that TCP performance is strictly affected by the RTT. Thus, breaking a TCP connection into low-latency sub connections improves the overall connection performance. In [5], [8], and [9], the authors show that in many cases, routing paths in the Internet are inflated, and the actual length (in hops) of routing paths between clients is longer than the minimum hop distance between them

Proposed System:

In the authors study the relay placement problem, in which relay nodes should be placed in an intra domain network. An overlay path, in this case, is a path that consists of two shortest paths, one from the source to a relay node and the other from the relay node to the destination. The objective function in this work is to find, for each source destination pair, an overlay path that is maximally disjoint from the default shortest path.

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH IN COMPUTER SCIENCE AND ENGINEERING TECHNOLOGIES

ISSN : 2454-9924

This problem is motivated by the request to increase the robustness of the network in case of router failures. In the authors introduce a routing strategy, which replaces the shortest-path routing, that routes traffic to a destination via predetermined intermediate nodes in order to avoid network congestion under high traffic variability.Roy *et al.* were the first to actually study the cost associated with the deployment of overlay routing infrastructure. Considering two main cases, resilient routing, and TCP performance, they formulate the intermediate node placement as an optimization problem, where the objective is to place a given number intermediate nodes in order to optimize the overlay routing, and suggested several heuristic algorithms for each application. Following this line of work, we study this resource allocation problem in this paper as a general framework that is not tied to a specific application, but can be used by any overlay scheme. Moreover, unlike heuristic algorithms, the approximation placement algorithm presented in our work, capturing any overlay scheme, ensures that the deployment cost is bounded within the algorithm approximation ratio.

MODEL AND PROBLEM DEFINITION

Given a graph $G = (V, E)$ describing a network, let be the set of routing paths that is derived from the underlying routing scheme, and let be the set of routing paths that is derived from the overlaying routing scheme (we refer to each path in and in as the underlying and overlaying path sets, respectively). Note that both and can be defined explicitly as a set of paths, or implicitly, e.g., as the set of shortest paths with respect to a weight function over the edges. Given a pair of vertices , , denote by the set of overlay paths between and , namely , and , the endpoints of are and .

Definition 3.2: Given a graph $G = (V, E)$, a set of source–destination pairs $Q = \{(s_1, t_1), (s_2, t_2), \ldots, (s_n, t_n)\}$ (where $Q \subseteq V \times V$), a set of underlay paths P_u, and a set of overlay paths P_o, find a subset of vertices $U \subseteq V$ such that $\forall 1 \leq i \leq n$, U covers (s_i, t_i).

Definition 3.3: Given an instance of the *ORRA* problem, and a nonnegative weight function $W : V \rightarrow \mathbb{R}$ over the vertices, one needs to find a set $U_{opt} \subset V$ such that: 1) U_{opt} is feasible; and 2) the cost of U_{opt} is minimal among all feasible sets.

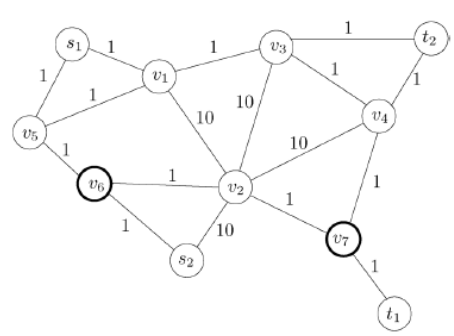

Fig. 1. Overlay routing example: Deploying relay server on v_6 and v_7 enables overlay routing.

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ISSN : 2454-9924

Definition 3.4: Given an instance of the *ORRA* problem, a weight function $W : V \to \mathbb{R}$ over the vertices, and a positive number k, test if there is a feasible solution U such that $W(U) \leq k$.

ON THE COMPLEXITY OF THE *ORRA* PROBLEM

In this section, we study the complexity of the *ORRA* problem. In particular, we show that the -*ORRA* problem is NP-hard, and it cannot be approximated within a factor of(where is the minimum between the number of pairs and the number of vertices), using an approximation preserving reduction from the Set Cover (SC) problem . We also present an -approximation algorithm where is the number of vertices required to separate each pair with respect to the set of overlay paths (a formal definition will be given later in this section).

While the reduction and the hardness result hold even for the simple case where all nodes have an equal cost (i.e., the cost associated with a relay node deployment on each node is equal), the approximation algorithm can be applied for an arbitrary weight function, capturing the fact that the cost of deploying a relay node may be different from one node to another.

Theorem 1:

1) The k-*ORRA* problem is NP-hard.
2) The *MIN-ORRA* problem cannot be approximated within a factor of $(1-\epsilon)\cdot\ln(n)$ for any $\epsilon > 0$ unless $NP \subseteq \text{DTIME}(n^{\log\log n})$.

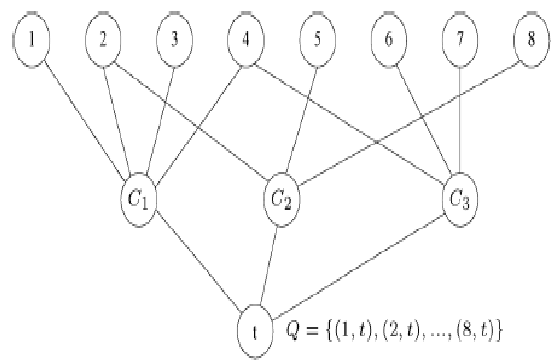

Fig. 2. Example: Set Cover—ORRA reduction.

Theorem 2: (Local Ratio): Given an instance of the *MIN-ORRA* problem and a feasible solution U. Let w_1 and w_2 be weight functions such that $w = w_1 + w_2$. If U is α-approximate with respect to w_1 and w_2, then U is also α-approximate with respect to w.

CASE STUDY AND EXPERIMENTAL RESULTS

BGP Routing Scheme

BGP is a policy-based interdomain routing protocol that is used to determine the routing paths between autonomous systems in the Internet. In practice, each AS is an independent business entity, and the BGP routing policy reflects the commercial relationships between connected ASs.

customer–provider

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relationship between ASs means that one AS (the customer) pays another AS (the provider) for Internet connectivity, a *peer–peer* relationship between ASs means that they have mutual agreement to serve their customers while a *sibling–sibling* relationship means that they have mutual transit agreement (i.e., serving both their customers and providers). These business relationships between

ASs induce a BGP export policy in which an AS usually does not export its providers and peers routes to other providers and peers . In [21] and [22], the authors showed that this route export policy indicates that routing paths do not contain so called *valleys* nor *steps*. In other words, after traversing a *provider–customer* or a *peer–peer* link, a path cannot traverse a *customer–provider* or a *peer-peer* link This routing policy may cause, among other things, that data packets will not be routed along the shortest path.

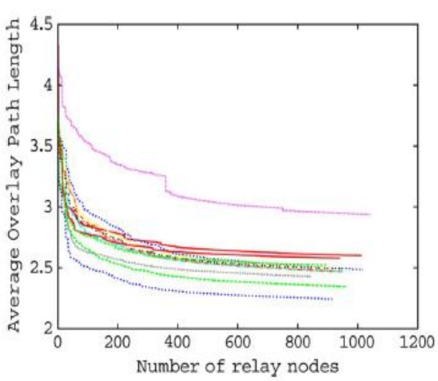

Fig. 5. Average path length versus number of relay nodes, BGP scenario. Each line represents a single BGP source.

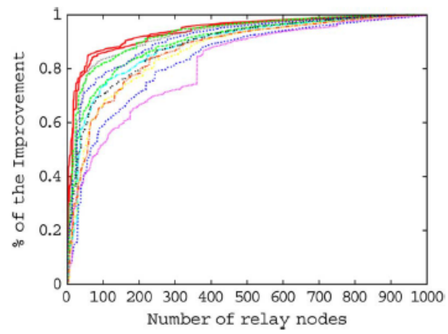

Fig. 6. Percent of the improvement versus number of relay nodes, BGP scenario. Each line represents a single BGP source.

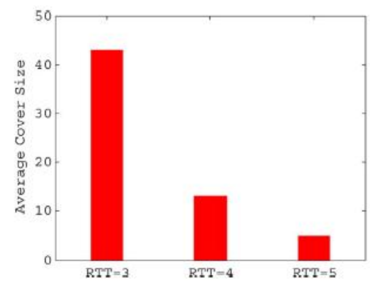

Fig. 8. Algorithm coverage for different RTT values.

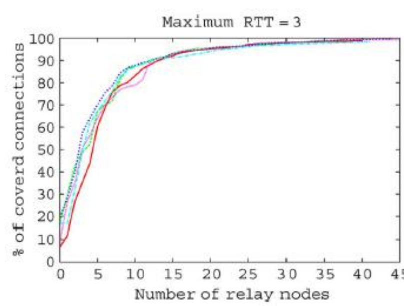

Fig. 9. Covered connections versus number of relay nodes, $RTT_{max} = 3$.

Since the performance of the algorithm is tightly coupled with the size of the *Overlay Vertex Cut*, increasing the value of the maximum RTT increases the average cut size. While the average cut size for is two, indicating that the approximation ratio in the case is bounded by two, it is increased to 2.2.

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ISSN : 2454-9924

CONCLUSION:

While using overlay routing to improve network performance was studied in the past by many works both practical and theoretical, very few of them consider the cost associated with the deployment of overlay infrastructure. In this paper, we addressed this fundamental problem developing an approximation algorithm to the problem. Rather than considering a customized algorithm for a specific application or scenario, we suggested a general framework that fits a large set of overlay applications. Considering three different practical scenarios, we evaluated the performance of the algorithm, showing that in practice the algorithm provides close ptimal results. Many issues are left for further research. One interesting direction is an analytical study of the vertex cut used in the algorithm. It would be interesting to find properties of the underlay and overlay routing that assure a bound on the size of the cut. It would be also interesting to study the performance of our framework for other routing scenarios and to study issues related to actual implementation of the scheme.

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