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## ROUTING OF NAMED DATA OBJECT WITH SEMANTIC PART OF NAME IN INFORMATION-CENTRIC NETWORKING

According to previous research it was proposed the three-dimension address for NDO (Name data objects) [1–3]. As follows, the three tables design. The first table matches semantic addresses to publisher ID address. The second table matches publisher ID address to geographical address. The third table matches semantic address to geographical address.

Let's walk through the process of adding, removing and matching an entry to the routing table on an NDO request.

If a subscriber sends Interest Request Message (IRM) and it reaches the router, the router will search its tables for an entry match. There are three cases:

Case 1: If there is no positive match between IRM and any addressing table in the router, the router will broadcast IRM to the network from all its interfaces in a spanning tree technique to avoid loops. When IRM reaches the match in any router caching the content or even in the original publisher cache, the latest will send a reply message to all requested interfaces, which sent IRM to it containing the data with the three publisher addressing dimensions. The reply message CRM (Content Reply Message) will allow updating all the routing tables across the requested paths towards the subscriber who sent the IRM for the first time. Thus, when there are no previous records in the tables, it will be created with a default TTL (Time To Live);

Case 2: If positive naming matches occurs between IRM and routing table and the router already caches the content, TTL will be updated (increased) in the routing table more specifically TTL, which represents time to live in the cache, will be calculated based on the number of subscribers interested in the address and the number of usages of this address. Then the reply message ARM (Address Reply Message) will be sent to the subscriber with the three addresses dimensions without the content to allow the subscriber to choose;

Case 3: If positive naming matches occurs between IRM and routing table but the content is not cached locally in the router, the router will forward the message toward the nearest publisher which could be a relay cache or the original publisher directly from the interface connected towards them since their ID or IP are recorded in the table. The latest will send the reply message (ARM) with its three addressing dimensions. This case applies when the subscriber making a video call or asks for a video from certain publisher as you tube.

After many requests, the TTL will reach a threshold defined by the administrator (threshold TTLth) allowing to caching the data and as TTL increases data caching time will increase. In all cases, the interfaces in the tables will be learnt from the interface that passed the reply message

Now let's review the process of removing records from the routing table. TTL will decay automatically with a ratio γ defined by the administrator. If TTL reaches the minimum threshold i.e., (TTL =) which means there no interests from subscriber exists for a long time, then the record will be removed from the table and from the cache, if it exists which will allow the table to be always dynamic and up to date. Considering the case of subscriber message coming from interface matches the advertised naming of the publisher, the router will automatically increase the TTL of this interface if the match of the data already increases. However, if it was not existed, the source interface of the subscriber message will be added to the publisher record in the routing table and then increase TTL.

Another important process is merging. Merging is the process to generalize the addresses in the routing table in order to reduce its size. In semantic address, the specific relations will be merged into the general relations. In publisher ID address, the table will keep the most general publisher ID depending on the number of requests. In geographical address, the merge will take place on the network. If we have any super network and the subnetwork on the same interface, super network will be considered and the sub network will be discarded.

Matching is the process of comparing the addresses of the IRM to the addresses existed in the routing tables and find the best match based on the longest prefix match. Matching occurs on three levels based on the IRM address content: semantic matching, geographical matching, and publisher ID matching.

Semantic matching: each semantic address is composed of a set of ORO chains. When an IRM holding a semantic address is requested, the router will search for the ORO chains of this semantic address in the geo-semantic and semantic-ID routing tables respecting the logical relations (or/XOR/and/in/super) determined by the user. Knowing that in semantic matching the router choose from its tables only ORO chains from the same information source (Publisher ID, Geographical IP). In a brief, the semantic matching is the matching of the semantic address by matching all chains for the same source.

Geographical matching: when an IRM holding a geographical address is requested, the router will search for the longest prefix match in the geo-semantic and geo-ID tables to route IRM to the requested information source. If the requested IP is not found in the last router, because the mobility of the user, this router will multicast the prefix to all the nearest neighbor subnets with fixing the suffix which is based on EUI64 address assignment (for more details about how to reach a mobile user see mobility section).

Publisher ID matching: when an IRM holding a Publisher ID is requested, the router will search for this publisher in the semantic-ID and geo-ID tables. When the router finds a positive match respecting logical relations, it will route the IRM toward the source of information using the geographical address.

We addressed the problem of Routing in the field of Information-Centric Networking (ICN) where a new semantic-based scheme is proposed to solve the obstacles facing IP networks.

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## УГРОЗЫ И ПРОЕКТИРОВАНИЕ БЕЗОПАСНОСТИ ИНФОРМАЦИОННО-ОРИЕНТИРОВАННЫХ СЕТЕЙ

Информационно-ориентированная сеть (*ICN – Information Centric Network*) – это новая сетевая парадигма, которая заменяет широко используемую, ориентированную на хост, в сетях связи (например Интернет, мобильные специальные сети) с информационно-ориентированной парадигмой, которая определяет приоритет доставки именованного контента, не обращая внимания на происхождение контента.

Парадигма *ICN* по своей сути поддерживает несколько функций безопасности и конфиденциальности, которые все еще недостаточно доступны в парадигме, ориентированной на хост.

Однако, *ICN* имеет несколько нерешенных проблем, связанных с безопасностью и конфиденциальностью, как старых, так и новых. На данный момент любой контент ориентирован на запросы пользователя, а, значит, должен обладать такими свойствами как: отказоустойчивость, быстрый доступ к контенту, высокая скорость доставки, а также безопасность конечного пользователя и контента потребляемого им. Использование архитектуры *ICN* сокращает время простоя системы из-за сбоев сервера, например, такие сбои были у пользователей *Netflix*, *Pinterest* и *Instagram* в США (22 октября 2012 г.). Таким образом, учитывая высокую скорость развития данного направления должны решаться важные задачи, связанные с безопасностью: обеспечение приватности и контроль доступа.

Учитывая то, что именованный контент может храниться где угодно в сети; каждый информационный объект должен быть уни-