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Resource Allocation for Sharing Cloudlet with MOPSO in wireless sensor network

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Abstract: *Connecting mobile devices with the cloud, suffers from high network latency and the huge transmission power consumption. Main obstacle for today's mobile devices is lack of resource, and requires increasing the processing power of device, increasing memory capacity, a need for greater durability of the battery etc. Cloudlets can provide available resources to nearby mobile devices with lower access overhead and energy consumption. To stimulate service provisioning by cloudlets and improve resource utilization, a feasible and efficient incentive mechanism is required to charge mobile users and reward cloudlets.*
This paper introduces multi-object Practical swam optimization (MOPSO) algorithm in order to optimize various single or combinations of objectives including localization time, messages sent during localization, and the power consumed.
Keywords - *Cloudlet, localization, MOPSO, power consumption, resource utilization.*

I. Introduction

The advancement of today's technologies has allowed the world to be connected together through networks. Both wired and wireless networks are heavily used by everyday computing allowing information share and remote computing across continents. However, these advances in technologies and the increase adoption of them are introducing many new challenges and opening new areas of research. WSNs are also facing great challenges on the network level and on the individual sensor node level that form the sensor network. One of the most important issues that need to be addressed on the sensor node level is the power consumption of sensor nodes. Power consumption is considered to be very important in WSNs due to the fact that sensor nodes have small and limited power supplies. Consequently, WSN applications, such as the localization procedures, need to be modified or the behavior of sensor nodes needs to be adjusted, in order to reduce excessive amount of power consumption. Different versions of CI algorithms are designed as global optimizers in WSNs, to concurrently minimize the required localization time and the maximum number of nodes fully localized while reducing the power consumption of nodes.
This paper proposes multi-object PSO (MOPSO) algorithm in order to optimize various single or combinations of objectives including localization time, messages sent during localization, and the power consumed.

II. Background

Auction is a popular trading form that can efficiently distribute resources of sellers to buyers in a market at competitive prices, an incentive-compatible auction mechanism (ICAM) for the resource trading between mobile devices as service users (buyers) and cloudlets as service providers (sellers). ICAM can effectively allocate cloudlets to satisfy the service demands of mobile devices and determine the pricing. Both theoretical analysis and numerical results show that ICAM guarantees desired properties with respect to individual rationality, budget balance, truthfulness (incentive compatibility) for both buyers and sellers, and computational efficiency [1].

To assist the matching between mobile users and cloudlets, a trusted third party is necessary to administer the trading between them, e.g., in the form of auction. In particular, a double auction fits well the bilateral nature of
this scenario. The trusted third party in a double auction is the *auctioneer* between mobile users (*buyers*) and cloudlets (*sellers*). The auctioneer needs to determine the matching of winning buyers and winning sellers, the price it charges the buyers and the price it rewards the sellers. A truthful incentive mechanism (TIM) is computationally efficient, individually rational and budget-balanced. To further improve the system efficiency, extend TIM to a more efficient design of auction (EDA), by involving randomness and bidding uncertainty. EDA maintains all desired properties of TIM except for slightly relaxed truthfulness. EDA guarantees trustfulness of sellers but it is not strongly truthful for buyers. Numerical results confirm the analysis and

demonstrate their desirable properties, especially the high system efficiency achieved by EDA. It is also shown that EDA is truthful in expectation for buyers [2].
A promising technology within the cellular standards is small cells (such as femtocells or picocells). The physical size and signal coverage of a small cell can be as small as a home Wi-Fi router. However, unlike Wi-Fi, small cells operate in licensed frequencies in conjunction with a pre-existing cellular operator's backend, relying on it for authentication, billing, roaming, and interoperating with the PSTN. The small footprint of a small cell compared to that of a macro cell (traditional cell tower) means that spatial reuse of spectrum can increase dramatically. Requiring only Ethernet connectivity and wall-socket power, and with SON (self-organizing network) support to adapt transmit power and channel selection, the deployment of a new small cell is dramatically cheaper and faster compared to provisioning a new macro cell. Even though the small cell will connect over IP to the cellular operator's backend, the standard allows it to access services on the local LAN directly. Hence, deploying a cloudlet in the small cell architecture is far easier than on the macro cell architecture [3].
Pocket cloudlets could drastically improve the mobile user experience in three major ways. First, since all or portions of the information resides on the phone, users can instantly get access to the information they are looking for, eliminating, when possible, the latency and power bottleneck introduced by the cellular radio. Furthermore, by serving user requests on the actual device, pocket cloudlets can mitigate pressure on cellular networks, which is expected to be a critical resource as mobile internet grows. Second, since most of the interactions between the user and the service take place on the mobile device, it is easier to personalize the service according to the behavior and usage patterns of individual users. Third, since the service resides on the phone, all the personalization information could also be stored on the phone and possibly protect the privacy of individual users [4].
The initial design of a distributed cloudlet-based system that integrates depth maps crowd sourced from mobile devices and head-mounted displays into a global 3D world model. To ensure fast enough processing of depth frames for real-time vision applications, the model is automatically split over multiple VMs when it becomes too large. By geographically distributing the VMs with sub-models across cloudlets, system provides the model as building block to low latency vision based applications without overwhelming the network [5].
This paper used MOPSO algorithm in cloudlet with WSNs to achieve better solutions of the localization problems. This Paper organized as follows **Section 1** Introduction. **Section 2** discusses Background. **Section 3** discusses previous work done. **Section 4** discusses existing methodology. **Section 5** discusses analysis and discussion. **Section 6** proposed method **Section 7** outcome possible result. Finally **section 8** concludes this review paper and **Section 9** related future works.

III. Previous Work Done

A-Long Jin et al. (2015) [1] proposed an incentive-compatible auction mechanism (ICAM) for the resource trading between mobile devices as service users (buyers) and cloudlets as service providers (sellers). ICAM can effectively allocate cloudlets to satisfy the service demands of mobile devices and determine the pricing. Both theoretical analysis and numerical results show that ICAM guarantees desired properties with respect to individual rationality, budget balance, truthfulness (incentive compatibility) for both buyers and sellers, and computational efficiency. ICAM guarantees truthfulness for both buyers and sellers since the utility cannot be improved by bidding or asking untruthfully. Thus, ICAM can be freed from the interference of untruthful participants (cloudlets and mobile users) that try to strategize over others. The mobile users are stimulated to request resources from the cloudlets instead of the centralized cloud. Some cloudlets may only provide storage service, while other cloudlets may provide computing and networking services. Thus, the mobile user needs to assign its service requests to the "compatible" cloudlets. With such a system model, it can be much more challenging to design an auction mechanism with the desirable properties.
A-Long Jin et al. (2015) [2] proposed two double auction mechanisms, truthful incentive mechanism (TIM) and efficient design of auction (EDA), which coordinate the resource trading between mobile devices as service users (buyers) and cloudlets as service providers (sellers). Both mechanisms are proved to be feasible, which ensures computational efficiency, individual rationality and budget balance. Furthermore, TIM guarantees truthfulness for both buyers and sellers. EDA achieves fairly high system efficiency but satisfies truthfulness in a weaker sense. EDA still maintains truthfulness for sellers, while preventing untruthful bidding of buyers with increased difficulty of computing an effective lie.
Steven Bohez et al. (2015) [3] presented the initial design of a distributed cloudlet-based system that integrates depth maps crowd- sourced from mobile devices and head-mounted displays into a global 3D world model. To ensure fast enough processing of depth frames for real-time vision applications, the model is automatically split over multiple VMs (virtual machines) when it becomes too large. By geographically distributing the VMs with sub-models across cloudlets, system provides the model as building block to low latency vision-based

applications with- out overwhelming the network. When depth map generated from stereoscopic cameras there are probability result in loss of accuracy.

Sharad Agarwai et al. (2014) [4] described why deployed macro cell base stations are unsuitable for cloudlet deployment. In contrast, also described why a small cell architecture is amenable for cloudlet deployments. And argue that the continuous vision workloads of the future require low latency and high throughput, near 30 Mbps, between a mobile device and a powered cloudlet. In unlicensed frequencies and uncoordinated deployments, Wi-Fi continues to be a viable technology for achieving this performance via deploying cloudlets at the access point. In licensed frequencies and coordinated deployments, argue that the existing LTE macro cellular network is not sufficient, but LTE small cells are.

Emmanouil Koukoumidis et al. (2011) [5] proposed pocket cloudlets, an effective architecture that leverages abundant non-volatile memory (NVM) in mobile devices to significantly improve user experience, both in terms of latency and battery life, by avoiding expensive radio wakeups and transmissions to access cloud services. Also explored other services that could benefit from a pocket cloudlet architecture and provided recommendations on how to build a system that supports multiple pocket cloudlets.

IV. Existing methodology

In ICAM, the auctioneer first identifies the winning candidates. Then, each winning seller candidate is assigned to one winning buyer candidate. Also, the clearing price charged to each buyer candidate and the clearing payments rewarded to the seller candidate are determined accordingly. More importantly, ICAM can keep potentially multiple sellers for a single buyer until a new last stage. In the end, the new stage of winner elimination can guarantee that a winning buyer is assigned to only one winning seller [1].

Truthful incentive mechanism (TIM) used to coordinate the resource auction between mobile devices as service users (buyers) and cloudlets as service providers (sellers). TIM improved the system efficiency over truthful auction scheme for cooperative communication (TASC). The properties of TIM are also analyzed in terms of computational efficiency, individual rationality, budget balance and truthfulness. Efficient design of auction (EDA) slightly relaxes the truthfulness constraint and ensures truthfulness in a weak sense [2].

Two algorithms are predominantly used in depth map registration. The Iterative Closest Point (ICP) algorithm iteratively minimizes a cost function based on the Euclidean distance between corresponding points in the input and target point cloud. ICP is typically used to match two point clouds that are highly similar, a canonical example are two depth maps consecutively captured. The (3D) Normal Distribution Transform (NDT) on the other hand uses a probabilistic approach by dividing a point cloud in different cells and assigns to each cell a normal distribution locally modeling the probability of measuring a point presence. NDT maximizes the sum of probabilities that the aligned points of the second point cloud can score on this density [3].

In small cell architecture the small cells are being deployed in a variety of situations –"femto" sized ones are installed in homes by users in coordination with the cellular operator, while "pico" sized ones are deployed in public spaces such as malls. Small cells operate in licensed frequencies, only equipment associated with that licensee can operate in a given location. Small cells can use LIPA (Local IP Access) to access services and computation local to the subnet in which they are deployed (such as in a home, coffee shop, or enterprise). Any traffic from the mobile device to local IP addresses is not tunneled to the core network but instead exits locally at the small cell's Ethernet interface. Cloudlets can be deployed on the local LAN that the small cell is connected to and can provide an application experience that relies on high data rate processing. This mode of operation does not require any architectural change or hardware change to existing equipment [4].

In the pocket Cloudlet architecture first, the amount of data to be stored locally on the device needs to be determined for each cloud service. Second, a mechanism to manage the locally stored cloud data is required as this data might change over time (e.g., web content changes over time). Third, a storage architecture for efficiently storing and accessing this large amount of data is needed. Mobile users need to be able to quickly search and access data across services while still having enough space to store their personal data. And The Pocket Search cloudlet can be used to store web search results, local businesses as well as mobile advertisements. PocketSearch consists of two discrete but strongly interrelated components; the community and the personalization components. The community part of the cache is responsible for storing the small set of queries and search results that are popular across all mobile users. This information is automatically extracted from the search logs and is updated overnight every time the mobile device is recharging, making sure that the latest popular information is available on the mobile device. The community part serves as a warm start for the cache and enables Pocket Search to instantly provide search results without requiring any previous knowledge of the user [5].

V. Analysis and discussions

A double auction mechanism ICAM coordinates the resource trading between mobile devices as service users (buyers) and cloudlets as service providers (sellers). ICAM can effectively allocate the cloudlets' resources among mobile users to satisfy their service demands, while maintaining the desirable properties, including computational efficiency, individual rationality, budget balance, and truthfulness for both buyers and sellers. Some cloudlets may only provide storage service, while other cloudlets may provide computing and networking services. Thus, the mobile user needs to assign its service requests to the "compatible" cloudlets. With such a system model, it can be much more challenging to design an auction mechanism with the desirable properties. Another two double auction mechanisms, TIM and EDA coordinate the resource trading between mobile devices as service users (buyers) and cloudlets as service providers (sellers). Both mechanisms are proved to be feasible, which ensures computational efficiency, individual rationality and budget balance. Furthermore, TIM guarantees truthfulness for both buyers and sellers. EDA achieves fairly high system efficiency but satisfies truthfulness in a weaker sense. EDA still maintains truthfulness for sellers, while preventing untruthful bidding of buyers with increased difficulty of computing an effective lie. In a distributed cloudlet-based system ensure fast enough processing of depth frames for real-time vision applications, the model is automatically split over multiple VMs (virtual machines) when it becomes too large. Small cell architecture is amenable for cloudlet deployments. But it operates in licensed frequencies and only equipment associated with that licensee can operate in a given location. Pocket cloudlets Utilizes both individual user and community access models to maximize its hit rate, and subsequently reduce overall service latency and energy Consumption. The amount of data required by these services is expected to be large and should always be available on the device even after a power down.

Architecture	Advantages	Disadvantages
Incentive-compatible auction mechanism (ICAM)	ICAM guarantees desired properties with respect to individual rationality, budget balance, truthfulness (incentive compatibility) for both buyers and sellers, and computational efficiency. The mobile users are stimulated to request resources from the cloudlets instead of the centralized cloud.	With such a system model, it can be much more challenging to design an auction mechanism with the desirable properties.
Truthful incentive mechanism (TIM) and Efficient design of auction (EDA).	Both mechanisms are proved to be feasible, which ensures computational efficiency, individual rationality and budget balance.	Preventing untruthful bidding of buyers with increased difficulty of computing an effective lie.
A distributed cloudlet-based system	Low latency vision-based applications without overwhelming the network. Find the appropriate VM across all nearby cloudlets.	When depth map generated from stereoscopic cameras there are probability result in loss of accuracy.
A small cell architecture	Small cell architecture is amenable for cloudlet deployments.	Small cells operate in licensed frequencies, only equipment associated with that licensee can operate in a given location.
Pocket cloudlets	Utilizes both individual user and community access models to maximize its hit rate, and subsequently reduce overall service latency and energy Consumption.	The amount of data required by these services is expected to be large and should always be available on the device even after a power down.

TABLE1: Comparative analysis of various resources allocation methods in cloudlet.

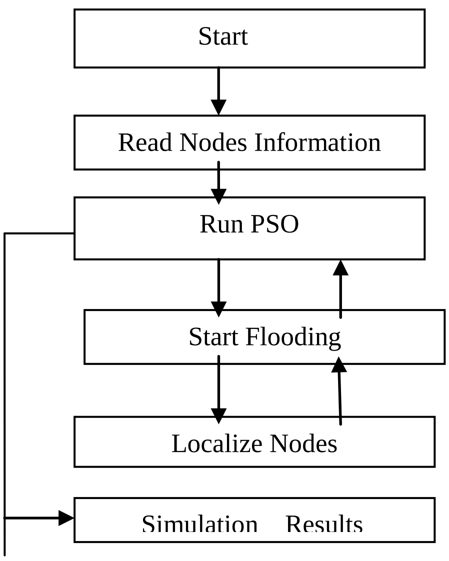
VI. Proposed Methodology

Optimization algorithm is truly complex procedures that consider many elements when optimizing a specific problem. Cloud computing and wireless sensor networks are full of optimization problem that need to be solved. In cloudlet PSO is used in order to optimize various single or combinations of objectives including localization time, messages sent during localization, and the power consumed. In order to make the methods as protocol

independent as possible and allow the methods to be used with any localization protocol, the methods will only optimized the Transmit mode of transceivers in order to minimize the average output power levels used by all nodes. The power consumption is calculated from the modified transmission range of each node. The transmission ranges are adjusted by MOPSO algorithms in order to achieve better solutions of the localization problems. a PSO method capable of handling MOPs in order to find the tradeoff between the contradicted objectives and to have a set of optimal solutions instead of having only a single objective solution where the main target is to maximize the number of localized nodes without over consuming power or taking more time to localize the nodes.
Algorithm shows the pseudo-code of MOPSO in cloudlet. The algorithm starts by initializing the swarm, in Line 2, where the positions and velocities matrices are initialized and the fitness values are calculated for all particles.

```
1: procedure MOPOSO (nodesList)
2: initialize swarm;
3: initialize leaders archive;
4: measure crowding distances;
5: for i ← 0 → number iterations do
6: for j ← 0 → number Particles do
7: procedure calculate New Velocities
8: choose andom leader as global best;
9: update velocities;
10: end procedure
11: calculate new positions;
\12: run MOPSO mutation;
13: evaluate the solution;
14: update particle memory;
15: update leaders archive;
16: measure crowding distances;
17: end for
18: end for
19: end procedure
```

Algorithm 1: MOPSO in cloudlet
Following figure shows the flow chart of the simulation procedure. In Step-2, Java code reads the positions of each node from a saved topology file. In Step-3 MOPSO algorithm is used. Step-4 and Step-5 is part of the fitness function where each particle's solution is examined by flooding the network and using a Trilateration-based localization (TBL) localization method.



Flowchart 1: Multi-object PSO in cloudlet

6.1 WSN Localization

A typical WSN consists of N sensor nodes scattered among a field of M×M meters. Each node has a transmission range of R and may or may not be equipped with various sensors such as temperature or humidity sensors, or radios such as GPS. Each node also holds a state of being localized, i.e. aware of its own position in the global or local positioning system, or unlocalized, i.e. not aware of its own position in space. Each node in the WSN can eventually be localized with the help of three already localized neighbor nodes that a node can communicate with over 1-hop connections .Two nodes are said to have a 1-hop connection if the distance between them is less than or equal to the transmission range, R. The localization procedure is the step that precedes actual network transmissions which, in the long run, will help in data forwarding and routing procedures between nodes in the network.

VII. Outcomes and Possible Result

Algorithm MOPSO in WSNs cloudlet used to find out a set of optimal solutions instead of having only a single objective solution where the main target is to maximize the number of localized nodes without over-consuming power or taking more time to localize the nodes.

VIII. Conclusion

The study resource allocation in cloud computing discusses the most relevant cloud computing and cloudlets techniques developed in recent years with their challenges. In cloudlet PSO is used in order to optimize various single or combinations of objectives including localization time, messages sent during localization, and the power consumed. MOPSO does not have a single global best solution, that all particles learn from when they update their velocities in each iteration. Instead, MOPSO will have an archive of particles called leaders, where each leader is a potential solution of the problem. So instead of having only one global best solution the MOPSO will keep track of different solutions and use them randomly to lead other particles to update their velocities in each iteration. So MOPSO algorithm is used to achieve better solutions of the localization problems.

IX. Future Scope

The study resource allocation in cloud computing discusses the most relevant cloud computing and cloudlets techniques developed in recent years with their challenges. In cloudlet PSO is used in order to optimize various single or combinations of objectives including localization time, messages sent during localization, and the power consumed. MOPSO does not have a single global best solution, that all particles learn from when they update their velocities in each iteration. Instead, MOPSO will have an archive of particles called leaders, where each leader is a potential solution of the problem. So instead of having only one global best solution the MOPSO will keep track of different solutions and use them randomly to lead other particles to update their velocities in each iteration. So MOPSO algorithm is used to achieve better solutions of the localization problems.

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