Online ISSN : 0975-4172
Print ISSN : 0975-4350

Global Journal
of Computer Science and Technology: E

Network, Web & Security

Minimum Spanning Tree

Efficient Security Mechanisms

Highlights

Architecture for NoC

Energy Efficient Mapping

Discovering Thoughts, Inventing Future

VOLUME 13 ISSUE 14 VERSION 1.0

Global Journal of Computer Science and Technology: E
Network, Web & Security

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Volume 13 Issue 14 (Ver. 1.0)

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Contents of the Volume

Global Journal of Computer Science and Technology
Network, Web & Security
Volume 13 Issue 14 Version 1.0 Year 2013
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

Energy Efficient Mapping in 3D Mesh Communication Architecture for NoC

By Pranav Wadhwani, Naveen Choudhary & Dharm Singh
Maharana Pratap University of Agriculture and Technology, India

Abstract - By the end of this decade we will be entering into the era of thousand cores SoCs. 3D integration technologies have opened the door of new opportunities for NoC architecture design in SoCs providing higher efficiency compared to 2D integration by appropriately adjusting the increased path lengths of 2D NoC. The application to core mapping on NoC architecture can significantly affect the amount of system's dynamic communication energy consumption. The considerable amount of energy savings can be achieved by appropriately optimizing the application to core mapping in NoC architecture. This paper presents a Branch-and-Bound heuristic for smart application to core mapping in 3D Mesh NoC architecture. Experimental results show that proposed heuristic saves about 42%-55% and 19%-28% of dynamic communication energy consumption in comparison to random mapping in 3D NoC communication architecture and the energy aware-mapping in 2D NoC architecture of same size, respectively.

Keywords : branch and bound, energy-aware mapping, NoC, 3D mesh, ULC, ILC.

GJCST-E Classification : C.2.1

ENERGY EFFICIENT MAPPING IN 3D MESH COMMUNICATION ARCHITECTURE FOR NOC

Strictly as per the compliance and regulations of:

Energy Efficient Mapping in 3D Mesh Communication Architecture for NoC

Pranav Wadhwani [α], Naveen Choudhary [σ] & Dharm Singh [ρ]

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Keywords : branch and bound, energy-aware mapping, NoC, 3D mesh, ULC, ILC.

I. Introduction

The network on chip technology has brought an archetype shift from computation centric design architecture to communication centric design architecture. Using on-chip network has advantages of structure, performance, and modularity. The Next generation SoCs will contain a large number of on-chip cores and the main challenge to be solved will be the network on chip (NOC) bottleneck of these systems which restricts scalability. 3D integration technologies have opened the door of new opportunities for architecture design in SoCs. The fusion of two emerging archetypes, NoC & 3D IC, facilitates the design of novel structures with considerable performance improvements in quality metrics over traditional solutions (Rahmani, Latif, Liljeberg, Plosila & Tenhunen, 2010).

One of the important stages in design flow of NoC is application to core mapping. This stage significantly affects the dynamic communication energy consumption and quality metrics of the system. To this end, in this paper the mapping problem is formulated followed by illustration of the effect of various applications to cores mappings on the consumption of dynamic communication energy by a given system. The paper presents a Branch-and-Bound heuristic for smart application to core mapping in 3D NoC architecture to minimize the total dynamic communication energy consumption of the system. Several experiments are carried out on various random benchmarks to verify the efficiency of the algorithm.

In (Feero & Pande, 2009; Xu, Du, Zhao, Zhou, Zhang & Yang, 2009) demonstrated that besides the footprint reduction in a fabricated design, 3D network structures tends to lead better performance in terms of lower dissipation of energy, higher throughput, and smaller latency compared to traditional, 2D NoC architectures. In (Hu & Marculescu, 2005) the mapping problem for 2D regular Tile - based architectures is addressed.

II. Energy-aware Mapping Problem for 3D NoC

This paper uses the energy model presented in (Hu & Marculescu, 2005) by Hu et al. The chip under consideration is composed of LxMxN tiles which are interconnected according to the underlying 3D Mesh infrastructure. A tile in 3D NoC (Fig.1) is composed of IP Core, Virtual Channels (VCs) & seven communications links (East, West, North, South, Front, Rear and Core). For the 3D mesh NoC with XYZ routing, Eq.1 shows that the average dynamic energy consumed in sending a single bit of information from core i to core j is estimated by the Manhattan distance between these two cores.

$$E_{bit}^{c_i,c_j} = n_{hops} \times E_{Sbit} + (n_{hops} - 1) \times E_{Lbit} \qquad (1)$$

Where $E_{bit}^{ci,cj}$ corresponds to the dynamic energy consumed in transmitting single bit of information from core i to core j, E_{Sbit} the energy consumed by single bit of information transported through a switch, E_{Lbit} the energy utilized by single bit of information on the link between two switches & n_{hops} the number of hops single bit of information encounters when it is transported from source tile i to destination tile j (i.e. Core i to Core j).

a) *Formulation of Energy-aware mapping problem*

The problem is to find a mapping of applications to cores in 3D NoC architecture, such that the overall dynamic communication energy consumption is minimized.

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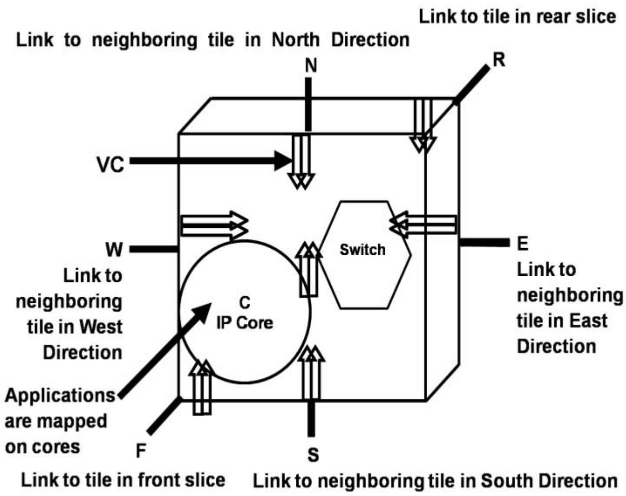

Figure 1 : A tile in 3D NoC

Communication Routing Graph, CRG, G = G(C, P) also referred as Interconnection Network graph, is a directed graph, where each vertex c_i corresponds to one core in the architecture, and each directed edge $p_{i,j}$ corresponds to the routing path between c_i and c_j which is determined using XYZ routing algorithm. $e(p_{i,j})$ corresponds to the average energy consumed (joule) in transporting a single bit of information from core c_i to c_j , i.e., $E_{bit}^{ci,cj}$. $l(p_{i,j})$ corresponds to the group of links that forms the routing path $p_{i,j}$.

Application Communication Graph, ACG, G = G(A, M) is a directed graph, where each vertex a_i corresponds to one application, and each directed edge $m_{i,j}$ corresponds to the communication from a_i to a_j. $V(m_{i,j})$ denotes the communication volume (bits) from a_i to a_j . $bw(m_{i,j})$ stands for the minimum bandwidth (bits/sec.) that the underlying communication architecture should provide.

The formulation of the problem of dynamic communication energy consumption minimization can be done as one to one mapping of applications to cores: Given a CRG and an ACG that satisfies condition in Eq.2:

$$\text{size(ACG)} \leq \text{size(CRG)} \tag{2}$$

Deriving a one to one mapping relation bmap() from ACG to CRG which reduces:

$$\text{minimize}\left\{\text{Energy} = \sum_{\forall m_{i,j}} V(m_{i,j}) \times e\left(p_{\text{bmap }(a_i),\text{bmap }(a_j)}\right)\right\} \tag{3}$$

Such that:

$$\forall \text{ link } l_k, \text{Bw}(l_k) \geq \sum_{\forall i,j,a_i,a_j \in M} \text{bw}(m_{i,j}) \times \text{is\_link}\left(l_k, p_{\text{bmap }(a_i),\text{bmap }(a_j)}\right) \tag{4}$$

Where $Bw(l_k)$ is the link l_k's bandwidth and is_link() returns true (i.e. 1) if l_k is one of the link in the group of links that form the routing path $p_{\text{bmap }(a_i),\text{bmap }(a_j)}$ otherwise it returns false (i.e. 0).

Eq. (4) assures that the traffic load on any link will not go beyond its allocated bandwidth.

b) Branch and Bound Heuristic for 3D Mesh NoC

The proposed branch-and bound heuristic moves through the search tree. This search tree corresponds to the solution space as shown below in Fig. 2 to find an optimal mapping which has the least communication cost.

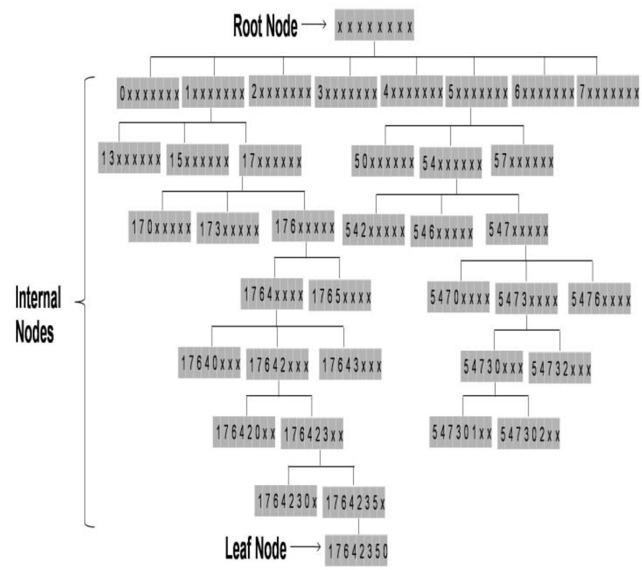

Figure 2 : Search tree example for mapping eight applications onto 2 ×2 × 2 NoC architecture

Every node except root node is assigned a label. For example, node 547xxxxx represents an internal node where Application number A_0, A_1 and A_2 of ACG are mapped on $Core_5$, $Core_4$ and $Core_7$ of CRG respectively, whereas application number A_3 to A_7 of ACG are still unmapped.

Communication Matrix: It is use to store the communication requirements of applications. Communication Matrix is derived as shown in Eq 5:

$$\text{CommMatrix}[i][j] = \sum_{\forall j \neq i} \{V(m_{i,j}) + V(m_{j,i})\} \tag{5}$$

For any node in the search tree, the energy consumed by communication among mapped applications represents the cost of that node. For example, the cost of node 546xxxxx can be computed as:

$V(m_{0,1}) \times e(p_{5,4}) + V(m_{1,0}) \times e(m_{4,5}) + V(m_{0,2}) \times e(m_{5,6}) + V(m_{2,0}) \times e(p_{6,5}) + V(m_{1,2}) \times e(p_{4,6}) + V(m_{2,1}) \times e(p_{6,4})$

The cost of child node is not lesser than cost of its parent node. In order to prune ineligible tree-branches, this property will be used later on in the heuristic. A node is referred as a legal node if the bandwidth requirement between the currently mapped applications is satisfied. This condition can be represented as shown in Eq 6:

$$Bw(l_k) \geq \sum_{\forall i,j,a_i,a_j \in M} bw(m_{i,j}) \times lis\_link(l_k, p_{bmap\ (a_i),bmap\ (a_j)}) \quad (6)$$

Here, M denotes the set of mapped applications.

A node is said to be illegal if it violates the condition represented in Eq 6. The child nodes of an illegal parent node are also illegal.

The upper limit cost (ULC) of a node denotes a cost that is no less than the minimum communication cost of its legal, descendant child nodes where all the applications have been mapped (i.e. leaf nodes). In order to compute as lowest ULC as possible for a node, a greedy approach for mapping the applications onto cores is adopted.

The lower limit cost (LLC) of a node denotes the best possible communication cost that its legal descendant child nodes where all the applications have been mapped (i.e. leaf nodes) can probably attain.

The Run time of proposed heuristic scales up with the system size. There exists a trade-off between the quality of solution and run time. The **quickening techniques** used in the proposed heuristic reduce the search time by detecting as many unpromising nodes as possible at earlier stages during the search process and then trim away such nodes. To this end, the applications are ranked on the basis of their communication requirement so that mapping of applications with higher communication requirement can be done at the earlier stages of mapping. A node preference queue is maintained to store the legal nodes that are eligible for further expansion. The node with the lowest cost has the utmost preference for branching. The length of node preference queue can affect the run time of proposed heuristic. When the queue length reaches a threshold value, selection of child nodes for insertion into queue is done on the basis of some stern criteria.

The heuristic iterates in-between the following two steps until it finds out an optimal solution.

i. *Branch*

New child nodes are generated in this step by selecting next unexpanded node from the node preference queue, and then mapping the next unmapped application with the utmost communication requirement to the set of cores that have not been occupied yet.

ii. *Bound*

Each child node that has been generated in the previous step is examined to see if it tends to yield the best leaf nodes later. The ULC and LLC of the node under inspection are computed and this node is pruned if either the communication cost among mapped applications on the occupied cores or LLC is higher than the lowest ULC that has been evaluated during the search.

The following method is used to minimize the computation time of ULC and LLC without compromising with the quality of these parameters.

ULC Computation

As stated above, the ULC of a node can be set equivalent to the communication cost of any legal descendant leaf node. A greedy mapping is used to find a legal descendant leaf node with the least communication cost. In the process of greedy mapping the next unmapped application a_k with the utmost communication requirement is chosen and its ideal position on CRG is calculated in terms of x, y and z coordinates using Eq. 7:

$$x = \frac{\sum_{\forall a_i \in M} (V(m_{k,i}) + V(m_{i,k})) \times a_i^x}{\sum_{\forall a_i \in M} (V(m_{k,i}) + V(m_{i,k}))}$$

$$y = \frac{\sum_{\forall a_i \in M} (V(m_{k,i}) + V(m_{i,k})) \times a_i^y}{\sum_{\forall a_i \in M} (V(m_{k,i}) + V(m_{i,k}))} \quad (7)$$

$$z = \frac{\sum_{\forall a_i \in M} (V(m_{k,i}) + V(m_{i,k})) \times a_i^z}{\sum_{\forall a_i \in M} (V(m_{k,i}) + V(m_{i,k}))}$$

Here, a_i^x, a_i^y and a_i^z represent the row number, column number and slice number of the core that a_i is mapped onto, respectively; the set of applications that have been mapped is represented by M. At each stage of mapping this set of mapped applications is updated. a_k is mapped to a core which is not occupied and whose topological position has the least Manhattan distance to *(xyz)*.

This step undergoes repetition until a single descendent leaf node is identified. If this leaf node is legal, then ULC of node under examination is set equivalent to its cost otherwise ULC is set to infinitely large and the node is trimmed away.

LLC Computation

The LLC is composed of 3 components, as shown in Eq. 8:

$$LLC = C_{mm} + C_{mu} + C_{uu} \quad (8)$$

C_{mm} is the cost of communication among mapped applications. C_{mm} can be calculated exactly as positions of the mapped applications are known. C_{mu} is the communication cost between mapped and unmapped applications. C_{mu} can be derived from Eq.9:

$$C_{mu} = \sum_{i=0}^{Nmap} \sum_{j=Nmap}^{Np} CommMatrix[i][j] \times LUC_i \quad (9)$$

$$LUC_i = \min_{\forall a_i \in M, c_k \in \breve{O}} e(p_{bmap\ (a_i),k}) \quad (10)$$

LUC is the lowest unit cost. N_{map} represents the total number of mapped applications; N_p represents the total number of applications which includes both mapped and unmapped applications. $\breve{o}$ represents the set of unoccupied cores.

The last Component is C_{uu} which represents the cost of communication among all unmapped applications. It can be derived as shown in Eq 11:

$$\mathrm{Cuu} = \mathrm{vol} \times \mathrm{LUUC} \tag{11}$$

$$\mathrm{vol} = \sum_{i=Nmap}^{Np} \sum_{j=Nmap+1}^{Np} \mathrm{CommMatrix[i][j]} \tag{12}$$

$$\mathrm{LUUC} = \min_{\forall Cm, Cn \in \breve{O}} e(p_{m,n}) \tag{13}$$

Here, *vol* represents the total communication volume among all he unmapped applications. *LUUC* is the lowest unmapped unit cost.

III. Experimental Results and Analysis

The performance of application to core mapping derived from proposed heuristic was evaluated on a NoC simulator NC-G-SIM. NC-G-SIM is a discrete event, cycle accurate simulator which supports Regular 3D, 2D and irregular topology framework with XYZ and distributed table based routing. In 3D ICs the length of heat conduction path and power density per unit area increases as more dies stack vertically (Bernstein, Andry, Cann, Emma, Greenberg, Haensch & Young, 2007; Ebrahimi, Daneshtalab, Liljeberg, Plosila & Tenhunen, 2011; Hassanpour, Khadem & Hessabi, 2013). Hence, the maximum number of slices in the 3D topologies is kept 4 in the experimental setup. ELbit is set to 0.0007 with the help of analytical energy model presented in (Choudhary, Gaur & Laxmi, 2011; Hu & Marculescu, 2003); ESbit is assumed to be 0.54 and 0.52 for 6 Ports and 4Ports router respectively based on estimation from Orion (Kahng, Li, Peh & Samadi, 2009) for 0.18μm technology. The packet size and flit-interval are set to 8 bytes and 2 clock cycles respectively. The number of cores used in the experiments ranges from 8 to 512. The heuristic is applied on five sets of 100 different topologies each to generate the energy aware mapping as well as random mapping of applications to cores in both 3D and 2D Mesh NoC architectures of same sizes and for same traffic scenarios. Thousand categories of benchmarks were randomly generated using TGFF (Dick, Rhodes & Wolf, 1998), with diverse bandwidth requirement of the IP Cores and randomly generated communication volumes according to the specified distribution. The average total energy consumption/flit reaching its corresponding destination is taken as performance metric. The simulation is run for 5000 clock cycles with applied packet injection interval.

As shown in Fig.3, the proposed heuristic saves about 42%-55% of dynamic communication energy consumption compared to random mapping because heuristic maps applications on the basis of traffic characteristics. Application ordering has been done so that applications with higher communication requirement will be mapped earlier to an unoccupied core which has the lowest cost to the occupied core.

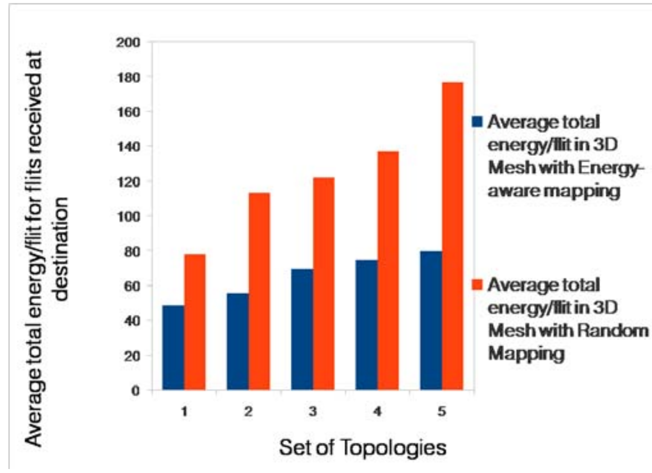

Figure 3 : Energy Consumption comparative result between optimized mapping and random mapping on same set of 3D Mesh topologies and same traffic scenarios

As shown in Fig.4. the proposed heuristic saves about 19%-28% of dynamic communication energy consumption in 3D Mesh architecture in comparison to energy aware mapping propsed in [4] for 2D Mesh architecture of same size. For a same source-destination pair, a data packet has to traverse less number of links to reach its destination which also includes less switch arbitration in 3D NoC in comparison to 2D NoC leading to decrease in the dynamic energy consumption in 3D Mesh architecture.

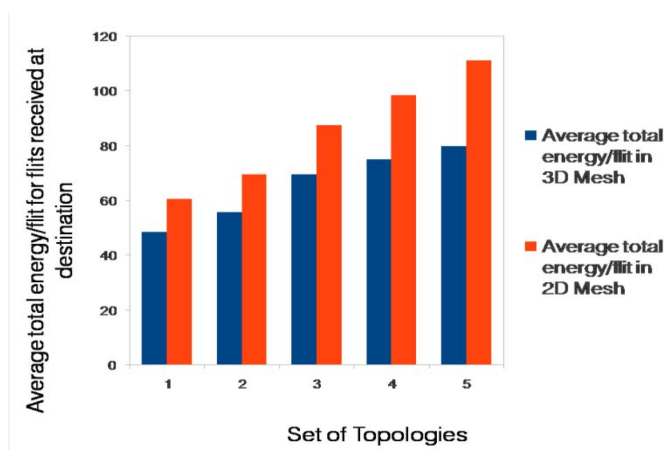

Figure 4 : Average total Energy/flit for the received flits at destinations after applying energy aware mapping in 3D Mesh and energy aware mapping in 2D mesh of same sizes

Global Journal of Computer Science and Technology (E) Volume XIII Issue XIV Version I Year 2013

IV. Conclusion

In this paper, the Branch and Bound algorithm for smart energy aware mapping of applications to cores in a 3D Mesh NoC architecture is proposed. The experimental results clearly show that application to core mapping significantly impacts the dynamic communication energy consumption of the system. The proposed heuristic is fast and results in significant energy savings. The proposed Branch and Bound heuristic can be extended to support application to core mapping in irregular NoCs where the application modules vary in shape and sizes and deadlock free routing is more challenging.

V. Acknowledgment

The work is supported by Department of Science and Technology, jaipur, Rajasthan, India under the research project "Network-on-Chip simulation framework for regular, irregular and 3D-Mesh Interconnection Architecture".

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Global Journal of Computer Science and Technology
Network, Web & Security
Volume 13 Issue 14 Version 1.0 Year 2013
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

NC-G-SIM: A Parameterized Generic Simulator for 2D-Mesh, 3D-Mesh & Irregular On-chip Networks with Table-based Routing

By Kartika Vyas, Naveen Choudhary & Dharm Singh
Maharana Pratap University of Agriculture and Technology, India

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Keywords : NC-G-SIM, generic, simulator, 3D, 2D, irregular, distributed table-based routing, deadlock-free.

GJCST-E Classification : C.2.2

NC-G-SIMA PARAMETERIZED GENERIC SIMULATOR FOR 2D-MESH, 3D-MESH IRREGULAR ON-CHIP NETWORKS WITH TABLE-BASED ROUTING

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Keywords : NC-G-SIM, generic, simulator, 3D, 2D, irregular, distributed table-based routing, deadlock-free.

I. Introduction

With the accelerated growth in calibration and denseness of integrated circuits in recent years, data communication amid the internal on-chip processing cores has become a hitch for SoC performance (Dally & Towles, 2004). This has led to a new paradigm on-chip communication in Ultra Large Scale Integrated systems. Traditional bus structure could not conciliate such a tight and high call of time-to-market as substantial amount of labor has to be enmeshed for engrafting these non-scalable architectures in such large systems, amplifying power consumption and stretching disposition time (Dally & Towles, 2004). NoC here takes the charge and provides an elegant approach to manage interconnect complexity (Heo & Asanovic, 2005), facilitating integration of multi-cores by abstracting computation from communication (Benini & Micheli, 2002) achieving better scalability and more predictable performances (Atienza, Angiolini, Murali, Pullini, Benini & Micheli, 2008). Until now, most of the researches were on making effective and potent 2D NoC designs scrutinized against power, performance and reliability (Heo & Asanovic, 2005).

However, simply increasing the number of cores over a 2D plane is not efficient due to long inter-connects. Emergence of viable 3D integration technologies has created opportunities for chip architectures that were prohibitive due to several constraints with the firm reliance that many of these 3D implementations can outperform their 2D counterparts (Feero & Pande, 2009). Research has also gained momentum in the domain of irregular networks (Silla & Duato, 2000) with the increased demand of application-specific SoCs as it saves significant power and area overhead, for most SoCs the mapping of tasks to processors and hardware cores is done on basis of static (or semi-static) prior knowledge and hence, has well characterized communication traffic characteristics are at design time of the SoC. Therefore, it has become excessively necessary to provide the architecture, methodology and simulation platform, which remains sustainable over different technology generations (Dally & Towles, 2004). With this perspective, NC-G-SIM simulator is developed that caters all the popular requirements of NoCs.

The rest of the paper is systematized as follows. Section 2 highlights background information about a few interconnection network simulators and the motivation behind developing generic NC-G-SIM simulator. Section 3 presents the simulator architecture and functionality. Section 4 describes the statistics collection process and depicts experimental results. Finally, Section 5 concludes the paper and highlights some directions for possible future work.

II. Related Work

Varied NoC simulators have been instituted and research communities are currently operating on these. Noxim (Palesi et al.) is such a simulator that put up the experimentation with different traffic distributions using various routing algorithms, but it supports mesh topology only and also lacks the concept of virtual channels disabling physical channel's bandwidth sharing. Simulators gpNoCsim (Hossain, Ahmed, Al-Nayeem, Islam & Akbar, 2007) and BookSim (Jiang et al.) support evaluation of different existing 2D

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architectures but with confined traffic injection models. A simulator with similar features is NoC sim (Jones 2005), only support VC routers with synthetic traffics and do not report router power and energy. Ocin tsim (Prabhu, Grot, Gratz & Hu, 2009), GARNET (Agarwal, Krishna, Peh & Jha, 2009), SICOSYS (Puente, Gregorio & Beivide, 2002) and Darsim (Mieszko, Sup, Hyon, Pengju, Khan & Devadas, 2010) support only 2D NoCs and compute router power based on the ORION model (Glass & Ni, 1992). Nostrum-NNSE (Lu, Thid, Millberg, Nilsson & Jantsch, 2005) developed in SystemC, has packet switched simulation environment. It supports irregular topologies but has no tool to estimate communication energy requirement and power consumption. NIRGAM (Jain, Al-Hashimi, Gaur, Laxmi & Narayanan, 2007) provides extension flexibility and modularity. However, only supports Mesh and torus topologies with limited support to various routing methodologies. *IrNIRGAM* (Choudhary, Gaur & Laxmi, 2011) supports irregular topologies using deterministic as well as adaptive table-based routing to make routing deadlock free and performance oriented. Therefore, most of existing simulators are specific to 2D-NoC topology architecture and may not be able to provide flexibility and modularity for existing and novel architectures. The market is also flooded with numerous simulators that researchers have materialized themselves to simulate their distinct architectures which aren't applicable for other topologies. The fast pace of current trends of the market raises the need for a generic simulation tool to efficiently explore the wide design space (Dally & Towles, 2004) where design choices are primarily taken on the basis of simulation before resorting to implementation as this is more flexible and cheaper.

IrNIRGAM is therefore, selected and extended to develop NC-G-SIM, a discrete event-cycle accurate 3D NoC simulation framework aimed typically at the NoC research and development community wherein it provides them with convenient and efficacious mechanism to experiment with NoC design in terms of 2D, 3D, irregular topology, routing and applications, with the facility to easily plug-in their own routers and attaching to cores any user-specified application library and configuration of parameters as per the need. It thereby, proves to be a powerful and competent tool to model vivid and intricate systems having large number of cores (upto 500) providing accurate performance estimation.

III. Simulator Description

a) NC-G-SIM Functionality

The flexibility of the structure of *IrNIRGAM* motivated to extend it in order to incorporate in it 3D NoC structure. NC-G-SIM simulator supports 2D regular Mesh and Torus topologies with a set of source, XY and odd-even routings. Irregular topology support and its features remain existent as they were in *IrNIRGAM.*

The 3D mesh NoC in NC-G-SIM follows the footsteps and uses both one of the well-known Dimension Order Routing (DOR) routing scheme i.e. XYZ algorithm as well as distributed table-based routing scheme. XYZ is a simple traditional scheme, easy to implement and free of deadlock and live lock. However, every time a packet is routed between a particular source-destination pair the same path is always followed which might lead to a scenario where a set of paths are heavily used while other paths remain idle, affecting overall system performance. But, use of distributed routing scheme overcomes this bottleneck, exploiting the fact that there might be multiple alternative paths to reach every node. Hence, look-up tables corresponding to each node is generated which cumulate this information, facilitating diverging traffic uniformly among the paths. Routing table files follow the format *[sourceID, destinationID, nexttileID, pathId]* each path is assigned a unique id '*pathID*' to make paths easily distinguishable. Each node decides next routing direction on basis of the entries in the node's corresponding table file. At each intermediate node, the same procedure is repeated till the packet reaches its destination. These tables are filled offline, based on the networks' localized knowledge, in accordance to either of miscellaneous deadlock free routing algorithms such as Left-Right (Schroeder et al. 1991), up*/down* (Schroeder et al. 1991) etc for irregular topologies and for 3D topology any of the minimal non-minimal, DOR or adaptive routing could be used meeting negligible chances of any deadlock formation.

Using tables we have also deployed a generic methodology based on *escape paths* by (Silla & Duato, 2000) in NC-G-SIM which enforces to follow deadlock free route only when the shortest paths are clocked up by high amount of traffic, thereby offering greater adaptivity, reduced latency and better overall throughput. It presumes that every physical channel should be split into two sets; original virtual channels and the new virtual channels representing minimal paths and escape-paths respectively. Packets following new channels are routed by the router to any channel without any circumscriptions giving first preference to new channels. Due to congestion, when no new channels are accessible then, the original routing function is followed and once a packet acquires an original channel it is not permitted to transit to a new channel anymore to avoid deadlock situation. Format of the tables based on *escape paths* methodology is similar to the above format except that instead of the '*pathID's* we have *'virtual_channel_no.'* that distinguishes between minimal paths and deadlock free paths, which is being followed by the packet.

The simulator facilitates the user to design one's own topology according to ones choice and research scenario. This is made possible by providing an overview of the topology layout by the user itself in a topology configuration file which is read in at the beginning of the simulation. This facility is provided for both irregular topologies, since there is no regularity or particular trend in the connections among the tiles, as well as for 3D topology. The topology is in a matrix format *[tileID, Neighbour_tileID*$_1$ *Neighbour_tileID*$_2$ *....... Neighbour_tileID*$_n$ *-1]* where *tileID* is current tile identifier followed by the *tileIDs* of its neighbouring nodes, list terminated by the delimiter "-1". With this, the topological arrangement becomes wieldy descriptive and alterable as and when desired. This not only simplifies the experimentations on the traditional NoC architectures but also encourages further extension of these architectures. Therefore, the simulator can be used for one and all purposes hence, proving to be totally generic in nature.

NC-G-SIM simulator can support 6 neighbours of any tile, with maximum number of tiles to be 500 for irregular and 3D topologies. Along with the topology file, another file of format *[tileID next_tileID link_length*$_{(in\ mm)}$*]* is provided which contains the length of the links in the topology in order to estimate the energy consumption.

Apart from these traffic characteristics are essentially required to run a simulation. Besides the well-known yet primitive CBR and Bursty traffic generator applications, NC-G-SIM additionally implements BWCBR traffic facility to generate concurrent traffic from a source node to different destinations by attaching multiple traffic generating processes thereby, making the simulation conditions more proximate to the actual scenarios where heavy traffic is exchanged between the nodes. Another important feature of this simulator is that it allows dynamic attachment of routing algorithms and application cores at the run time, letting re-modification of routing and traffic, saving the user from re-compilation of the code.

b) NC-G-SIM Architecture

A comprehensive architecture of NC-G-SIM simulator is shown in Fig.1. The additional customizable parameters are the size of the topologies, simulation and traffic generation cycle, buffer size, packet and flit sizes, packet interval, adjusted for the simulation engine Multiple numbers of virtual channels can be multiplexed per physical channel supporting fifo buffer for storing incoming traffic. It works at a default clock frequency of 1 GHz which can be altered. Wormhole switching mechanism is used, where packets are serialized into several flits therefore, smaller buffers can be utilized in contrast to the packet switching technique and thus, makes packet latency relatively insensitive to the path length.

When simulation ends, NC-G-SIM generates a log file that can be made detailed or concise by switching to different log levels. Apart from this the detailed results of the simulation can be read, checked and compared in terms of flit load, energy dissipation, throughput, latency and standard deviation from the result files generated on completion of the simulation. Using GnuPlot graphs can also be plotted of these output performance metrics.

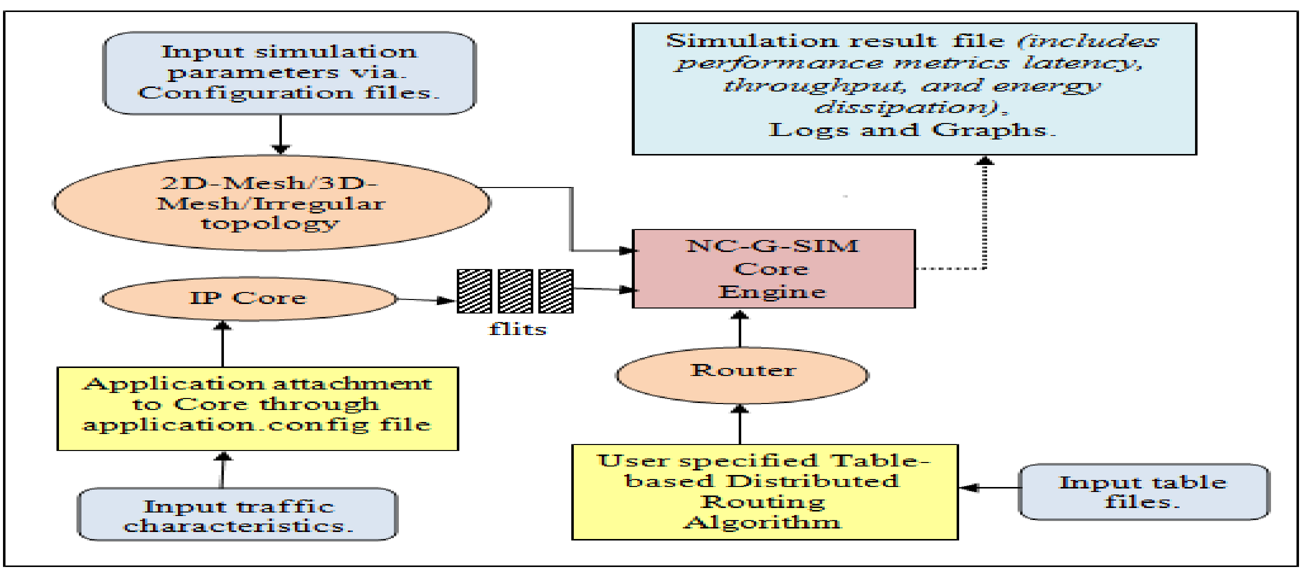

Figure 1 : NC-G-SIM Simulation Framework

Internal Architecture is implemented in the core where a module "NoC" models network of tiles and each tile is then prepared by the "NWTile" module. The preeminent components of each tile ("their module names") are as follows: Input Channel Controller[IC] ("InputChannel"), Controller: ("Controller"), Virtual Channel Allocator [VCA] ("VCAllocator"), Output Channel Controller [OC] ("OutputChannel") and ipcore

(“ipcore”). The number of IC and OC in each tile is equal to the number of its neighbor plus one for ipcore. IC manages the arrival and storage of the flits whereas OC manages the transfer of the flits to the next neighbor node. Controller handles the routing requests from all ICs as it implements the router and VCA serves virtual channel allocation requests from all ICs. Ipcore in each tile consists of an IP element to which an application or traffic generator can be attached if needed.

IV. Experimental Results

NC-G-SIM simulator was tested to generate the various performance parameters. Flit interval rate is taken as 2 clock cycles which means that time taken for one flit injection at each core and its transmission into the network approximately takes 2 clock cycles. The evaluation is performed under medium congestion with varied traffic load ranges from 10 to 100 percent for a set of random sources and destinations decided randomly. These source-destination pairs are kept alike for fair comparison between 3D and 2D topologies in each run of simulation. For traffic generation BWCBR generator was chosen to send out traffic to multiple cores concurrently. For performance comparison, a period of 5000 simulation clock cycles was kept in NC-G-SIM with correlated packet injection interval to scrutinize network performance.

For the test cases of NoC, the energy required during communication is evaluated as per energy model proposed in (Hu 2005). The average energy consumption by router in transmitting a bit is calculated using analytical model such as Orion (Glass & Ni, 1992) and the dynamic bit energy consumption for inter-node links (El_{bit}) is calculated using equation (Hu 2005).

$$El_{bit} = (1/2) \times \alpha \times C_{phy} \times (V_{DD})^2 \quad (1)$$

Where α denotes average transition probability for a specific bit between two subsequent segments in the transit course. The value of α is assumed 0.5 for purely random data stream. C_{phy} is the physical capacitance of inter-node wire taken under consideration for any liable technology and V_{DD} is the supply voltage.

Within the vast range of supportable number of tiles 100 topologies were selected that posses same number of cores in both 2D and 3D for better comparison and for each topology 10 different test cases were prepared and executed. Having been experimented on illimitable number of topology sets, the average of obtained results is represented to show the fulfillment of our objectives.

Fig.2. proves three dimensional topologies exhibit better performance when experimented with constant average throughput. The average flit latency gets reduced by 8% to 21.8% as the architecture of 3D is more compact compared to 2D, therefore needs less number of hops to traverse from the source node to the destination node, thereby taking lesser time to reach its desired node. The average total energy per flit, consumed in the whole simulation scenario for each test case also proves the above stated fact of 3D architectures. The average energy dissipation for the received flits at destination in 3D has showed tremendous improvement, as we have got 21% to 36.8% lesser consumption of energy in 3D topologies as compared to 2D topologies. The reason behind this is since the whole bigger topology in 3D is sliced into layers so it has shorter routes to traverse, this in return utilises lesser number of routes and much less switch arbitration saving the energy and the time too.

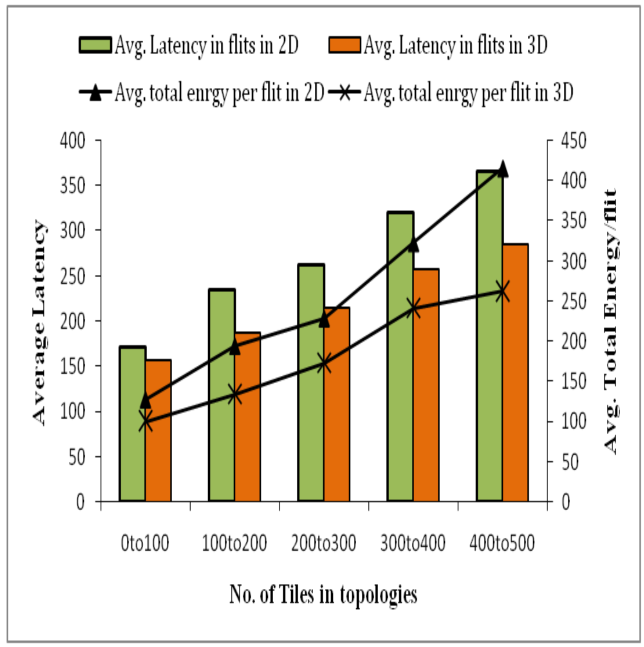

Figure 2 : Comparison of performance characteristics for both two dimensional and three-dimensional topologies, with topologies grouped in the range of hundreds

For testing the efficacy of irregular arrangement, a set of application specific irregular topologies were explored using table-based scheme supporting Left-Right routing. Our results in Fig.3. demonstrate that latency and energy dissipation of irregular NoC was lowered by approximately 23% and 7.6% respectively, in comparison to 3D NoCs. Irregular NoCs have achieved these results as they are more design specific according to the application requirements of the system. So, their property of being more system-oriented and targeted towards the fulfillment of precise system needs make them a suitable choice to those systems that require specific designs with maximum performance yield and in leser time-to-market constraint as well as cost trade-offs. Using irregular interconnection systems will also prove beneficial if they are tried to be fused with the three-dimensional interconnection feature of the upcoming network-on chips.

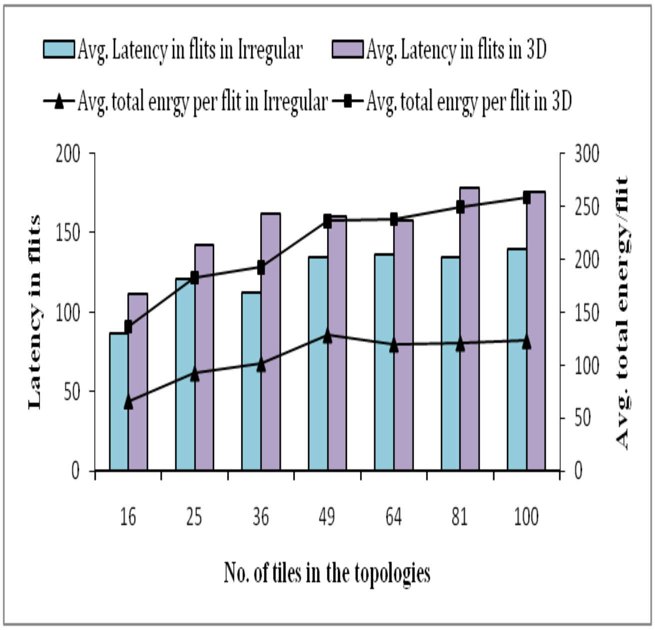

Figure 3 : Performance comparison between irregular and three-dimensional topologies in terms of latency and average energy consumed per flit

V. Conclusion and Future Extensions

In this paper, we presented a robust and generic simulation framework NC-G-SIM to study the performance of all the NoC domains 2D, 3D and irregular. System C is preferred as simulator design because it is meant for higher layer of NoC abstraction which leads to better understanding about the design enabling better system tradeoffs. NC-G-SIM features the use of distributed table-based routing in 3D & irregular interconnection networks with the potentiality of evaluating accurately and smartly the effectuation of multitudinous core designs, allowing the experimenter to migrate from one design archetype to some other effortlessly. For the future work we plan to support a wider range of NoC topologies, routing schemes and switching mechanisms. Fault tolerant feature is also seen as an upcoming prominent area of interest. Also, heterogeneous on-chip communication requirements will be soon addressed to make the simulator more advantageous for the researchers of NoC.

VI. Acknowledgments

This work is supported by Department of Science and Technology, Jaipur, Rajasthan, India under the research project “Network-on Chip simulation framework for regular, irregular and 3D-Mesh Interconnection Architecture”.

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Global Journal of Computer Science and Technology
Network, Web & Security
Volume 13 Issue 14 Version 1.0 Year 2013
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

A Novel Analysis of Clustering for Minimum Spanning Tree using Divide & Conquer Technique

By Velicheti Bharath & Ch. Praveen
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Abstract - Because of their capability to distinguish groups with sporadic limits, least spanning tree-based grouping calculations have been generally utilized within practice. Be that as it may, in such bunching calculations, the quest for closest neighbour in the development of least spanning trees is the primary wellspring of processing and the standard results take O(N 2) time. In this paper, we exhibit a quick least spanning tree-motivated grouping calculation, which, by utilizing a proficient execution of the cut and the cycle property of the least spanning trees, can have much preferable execution than O(N ^{2}).

Keywords : *clustering, spanning tree, conquer, grouping.*

GJCST-E Classification : *C.2.4*

A NOVEL ANALYSIS OF CLUSTERING FOR MINIMUM SPANNING TREE USING DIVIDE CONQUER TECHNIQUE

Strictly as per the compliance and regulations of:

A Novel Analysis of Clustering for Minimum Spanning Tree using Divide & Conquer Technique

Velicheti Bharath [α] & Ch. Praveen [σ]

Abstract - Because of their capability to distinguish groups with sporadic limits, least spanning tree-based grouping calculations have been generally utilized within practice. Be that as it may, in such bunching calculations, the quest for closest neighbour in the development of least spanning trees is the primary wellspring of processing and the standard results take O(N ^{2}) time. In this paper, we exhibit a quick least spanning tree-motivated grouping calculation, which, by utilizing a proficient execution of the cut and the cycle property of the least spanning trees, can have much preferable execution than O(N ^{2}).

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I. Introduction

In this paper, we propose another MST roused grouping approach that is both computationally effective and able with the state of the workmanship MST based bunching methods. Essentially, our MST enlivened bunching strategy tries to distinguish the moderately little number of conflicting edges and evacuate them to shape bunches after the complete MST is developed. To be as general as could be allowed, our calculation has no particular prerequisites on the dimensionality of the information sets and the arrangement of the separation measure, however euclidean separation is utilized as the edge weight as a part of our tests.

Given a set of information focuses and a separation measure, grouping is the procedure of dividing the information set into subsets, called groups, with the intention that the information in every subset offers a few lands in like manner. More often than not, the normal lands are quantitatively assessed by a few measures of the optimality, for example least intracluster separation or greatest intercluster separation, and so on. Grouping, as a significant apparatus to investigate the concealed structures of up to date substantial databases, has been broadly mulled over and numerous calculations have been proposed in the written works. As a result of the enormous mixed bag of the issues and information circulations, distinctive systems, for example various levelled, partitional, and thickness and model based methodologies, have been created also no systems are totally attractive for all the cases. Case in point, some traditional calculations depend on either the thought of assembling the information focuses around a few "focuses" then again the thought of differentiating the information focuses utilizing some customary geometric bends, for example hyper planes. Thus, they ordinarily don't work well when the borders of the bunches are eccentric. Sufficient experimental confirmations have demonstrated that a minimum spanning tree representation is truly invariant to the definite geometric updates in bunches' verges. Thusly, the state of a group has small sway on the execution of least spreading over tree (MST) based bunching calculations, which permits us to defeat a number of the issues confronted by the traditional bunching calculations. The MST system is a graphical examination of a subjective set of information focuses. In such a diagram, two focuses or vertices could be joined either by an immediate edge, or by an arrangement of edges called a way. The length of a way is the number of edges on it. The level of connection of a vertex is the amount of edges that connection to this vertex.

A circle in a chart is a shut way. An associated chart has one or more ways between each pair of focuses. A tree is an associated chart with no shut circles. A traversing tree is a tree that holds each focus in the information set. Assuming that a quality is allotted to every edge in the tree, the tree is known as a weighted tree. Case in point, the weight for every edge might be the separation between its two end focuses. The weight of a tree is the aggregate total of the edge weights in the tree. The base traversing trees are the traversing trees that have the insignificant sum weight. Two lands used to recognize edges provably in a MST are the cut property and the cycle property. The cut property states that the edge with the most diminutive weight intersection any two parts of the vertex set should fit in with the MST. The cycle property states that the edge with the biggest weight in any cycle in a chart can't be in the MST. Therefore, when the weight connected with every edge means a separation between the two close focuses, any edge in the base spreading over tree will be the briefest separation between the two subtrees

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that are joined by that edge. Subsequently, evacuating the longest edge will hypothetically bring about a two bunch gathering. Uprooting the following longest edge will bring about a three bunch gathering, et cetera. This relates to picking the breaks where the greatest weights happen in the sorted edges.

II. Existing System

In universal MST issues, a set of n vertices and a set of m edges in a joined diagram are given. A "non specific" least spreading over tree calculation develops the tree by including one edge at once. Two ubiquitous approaches to execute the nonexclusive calculation are the Kruskal's calculation and the Tidy's calculation. In the Kruskal's calculation, all the edges are sorted into a non decreasing request by their weights, and the development of a MST begins with n trees, i.e., each vertex being its own tree. At that point for every edge to be included such a non decreasing request, check if its two closes indicates have a place the same tree. In the event that they do (i.e., a cycle will be made), such an edge ought to be disposed of. In the Prim's calculation, the development of a MST begins with some root hub t and the tree T avariciously develops from t outward. At every venture, around all the edges between the hubs in the tree T and those not in the tree yet, the hub and the edge connected with the littlest weight to the tree T are included. Contrary to the "bland" least crossing tree calculations, "Reverse Delete" calculation begins with the full chart and erases edges in place of non increasing weights in light of the cycle property with the assumption that completing so does not detach the diagram. The expense of developing a MST utilizing these established MST calculations is O(m log n). More productive calculations make a guarantee to close to straight time unpredictability under diverse suspicions. In a MST based grouping calculation, the inputs are a set of N information focuses and a separation measure characterized upon them. Since each pair of focuses in the focus set is partnered with an edge, there are such edges. The time unpredictability of the Kruskal's calculation, the Prim's calculation, also the "Reverse Delete" algorithm adapted for this case is $O(N^2)$.

III. Proposed & Analysis of MST-Based Clustering Algorithm

With a MST being developed, the following step is to characterize an edge conflict measure to segment the tree into bunches. As numerous other grouping calculations, the number of bunches is either given as a data parameter or figured out by the calculations themselves. Under the perfect condition, that is, the bunches are generally differentiated and there exist no outliers, the conflicting edges are simply the longest edges. Nonetheless, in true undertakings, outliers frequently exist, which make the longest edges a problematic evidence of bunch partitions. In these cases, all the edges that fulfil the conflict measure are evacuated and the information focuses in the littlest groups are viewed as outliers. Subsequently, the meaning of the conflicting edges and the improvement of the ending condition are two major issues that must be tended to in all MST-based grouping algorithms, indeed, when the amount of bunches is given as an information parameter. Because of the imperceptibility of the MST representation of an information set of dimensionalities past 3, numerous conflict measures have been prescribed in the expositive expression.

Despite the fact that MST based grouping calculations have been generally concentrated on, in this segment, we depict another partition and prevail over plan to expedite proficient MST based bunching in advanced extensive databases. Fundamentally, it accompanies the thought of the Reverse Delete calculation. When progressing, we give a formal evidence of its effectiveness.

Theorem 1

Given a connected, edge-weighted graph, the “Reverse Delete” algorithm produces an MST.

Proof

First and foremost, we indicate that the calculation processes a crossing tree. This is on the grounds that the diagram is given associated at the starting and, when erasing edges in the non expanding request, just the most exorbitant edge in any cycle is erased, which does wipe out the cycles however not detach the chart, bringing about a joined chart holding no cycle at the finish. To show that the got crossing tree is a MST, think about any edge evacuated by the calculation. It might be watched that it should lie on some cycle (overall uprooting it might detach the diagram) and it must be the most exorbitant one on it (generally holding it might defile the cycle property). Thus, the "Reverse Delete" calculation processes a MST.

For our MST-propelled grouping issue, it is clear that n=n and m=n (N-1)/2, and the standard result has O (N^2logn) time multifaceted nature. Be that as it may, m=o (N^2) is not dependably fundamental. The outline of a more effective plan is propelled by the accompanying perceptions. First and foremost, the MST-based bunching calculations might be more productive if the longest edges of a MST could be distinguished rapidly soon after the majority of the shorter ones are discovered. This is since, for some MST based grouping issues, provided that we can uncover the longest edges in the MST quite rapidly, there is no compelling reason to process the definite separation qualities connected with the shorter ones.

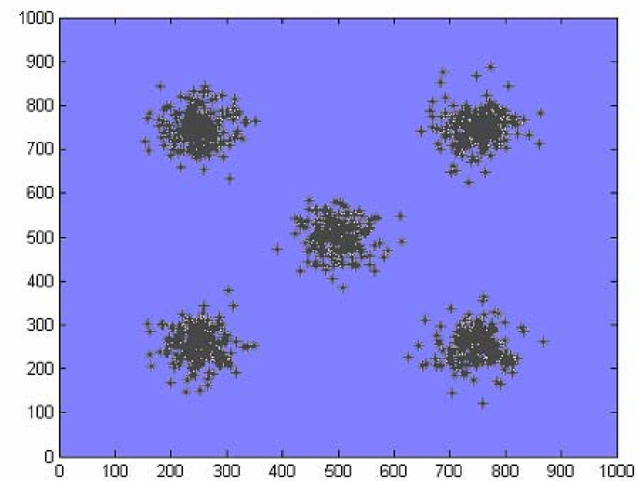

Figure 1 : A two-dimensional five-cluster data set

Second, for other MST-based grouping calculations, if the longest edges might be discovered rapidly the Prim's calculation could be all the more proficiently connected to every singular size diminished group. This partition and overcome methodology will permit us to spare the amount of separation reckonings tremendously.

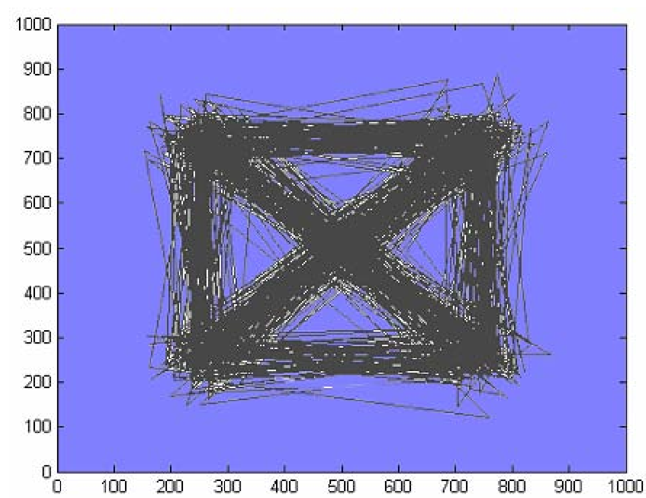

Figure 2 : Spanning tree after the sequential initialization

a) Proposed Idea

Given a set of s dimensional information, i.e., every information thing is a focus in the s dimensional space, there exists a separation between each pair of the information things. To register all the pair wise separations, the time unpredictability, where N is the amount of information things in the set. Assume at the starting, every information thing is introduced to have a separation with alternate information item in the set. Case in point, since the information things are dependably saved successively, every information thing might be appointed the separation between itself and its prompt antecedent called a forward instated tree or successor called a regressive introduced tree. These starting separations, whatever they are, give an upper destined for the separation of every information thing to its neighbour in the MST. In the execution, the information structure comprises of two clusters, a separation cluster and a file show. The separation exhibit is utilized to record the separation of every information indicate some other information focus in the successively saved information set. The file cluster records the record of the information thing at the flip side of the separation in the separation cluster.

In the usage, the information structure comprises of two clusters:

i. Distance cluster
ii. Index cluster.

i. *Distance Array*

The separation cluster is utilized to record the separation of every information indicate some other information focus in the successively saved information set.

ii. *Index Array*

The record cluster records the file of the information thing at the flip side of the separation in the separation cluster.

Consistent with the working guideline of the MST based bunching calculations, a database might be part into parcels by recognizing and evacuating the longest conflicting edges in the tree. In view of this finding, after the successive introduction, we can do a pursuit in the separation cluster (i.e., the present crossing tree) for the edge that has the biggest separation quality, which we call the potential longest edge hopeful. At that point the following step is to check whether there exists an alternate edge with a littler weight intersection the two allotments joined right away by this potential longest edge hopeful. Assuming that the result shows that this potential longest edge hopeful is the edge with the littlest weight intersection the two allotments, we uncover the longest edge in the present crossing tree (ST) that concurs with the longest edge in the comparing MST. Any other way, we record the overhaul and begin an alternate adjust of the potential longest edge hopeful recognizable proof in the present ST. It might be seen that the nature of our quick calculation hinges on upon the nature of the instatement to rapidly uncover the longest edges. In spite of the fact that the consecutive instatement gives us a traversing tree, when the information is haphazardly archived, such a tree could be far from being optimal. This scenario might be represented by a two-dimensional five group information set demonstrated in Figure. 1. Indicated in Figure.2 is its spreading over tree after the consecutive instatement (SI). So as to rapidly recognize the longest edges, we propose to accompany the successive introduction by different runs of a recursive method reputed to be the divisive progressive grouping calculation (DHCA).

b) MST-Inspired Clustering Algorithm

The usage of the DHCA in our methodology is through the configuration of a C++ information structure called Node. The Node information structure has numerous part variables that recall the records of the subset of the information things that are grouped into it from its parent level, the lists of its haphazardly picked k bunch focuses from its own set for its relatives, and a primary part capacity that produces k new hubs by grouping its own set into k sub groups. The yields of the Node information structure are at most k new Nodes as the descendents of the present one. The divisive various levelled grouping process begins with making a Node occasion, called the top Node. This top Node has each information thing in the information set as its examples. From these specimens, this top Node haphazardly picks k information focuses as its bunching focuses and allocates every example to its closest one, creating k information subsets as k Nodes. Just when the amount of specimens in a Node is bigger than a predefined bunch size will that Node be pushed to the once more of the top Node, shaping a cluster of Nodes. This process precedes recursively. With the new Nodes being produced on the fly and pushed to the once more of the Node exhibit, they will be handled in place until no new Nodes are created and the close of the existing Node show is arrived.

Procedure Name	**DHCA_ST**
Input:	
Dist_st, edge_st array	The ST distance array and index
Dist_knn,edge_knn Nearest	The auxiliary arrays to remember k-Neighbours(kNN) for each data item
kNN	The no.of NNs of a data item
nodeArray	An array of the Node structures
currentNode	The current Node in the Node array
k	The number of clusters at each step
data	The input data set
maxclustersize	The maximum size of each clusters
threshold	The value used to filter

```
Output:
 Updated dist_st,edge_st,dist_knn,edge_knn and new generated<=k
Nodes which are pushed to the back of nodeArray
Begin
    Randomly select k centers from sampleNumbers of
    currentNode;
    Generate k newNodes;
    For each sample i in sampleNumbers of currentNode
that is not
    a center
    {
        find its nearest center j out of k;
if((dist_st[i]<distance(i , j)&&
            (sampleNumber[i]>sampleNumber[j]))
        {
            Update dist_knn, edge_knn;
        }
        if(dist_st[i]>threshold)
        {
    assign sampleNumbers[i] to groups of center j;
    }
}
  for each newNode j=1 to k
  {
      if(newNode[j].sampleNumbers.size()>maxclustersize)

        {
          Push newNode[j] to the end of nodeAyyay;
        }
      }
End
```

IV. Result Analysis

We led far reaching examinations to assess our calculation against the k implies calculation and two other state of the workmanship MST built bunching calculations with respect to three standard engineered information sets and two genuine information sets. The exploratory results show that our proposed MST motivated grouping calculation is extremely successful and stable when connected to different bunching issues. Since there regularly exist a few structures in the information sets, our calculation does possibly require yet can immediately determine the fancied number of bunches without anyone else present.

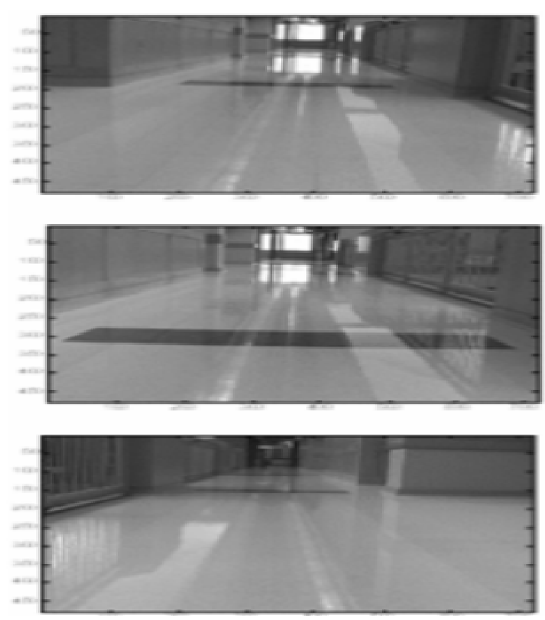

Figure 3 : Original Image Considered

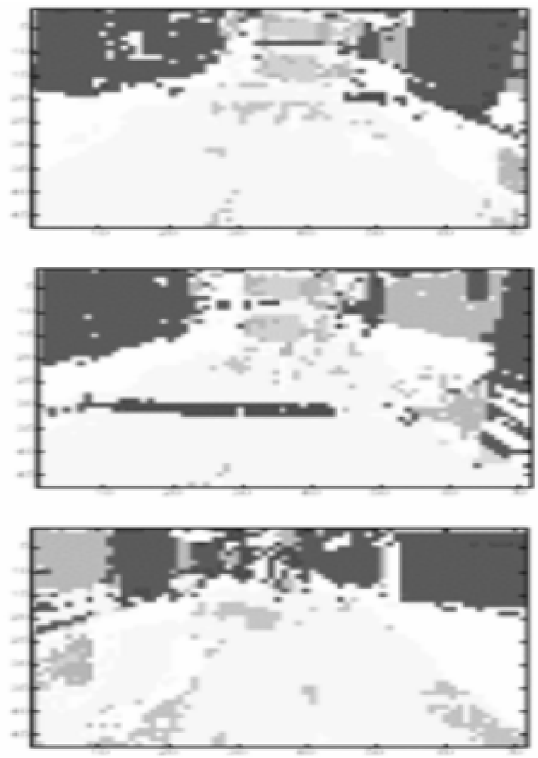

Figure 4 : Image obtained on MST

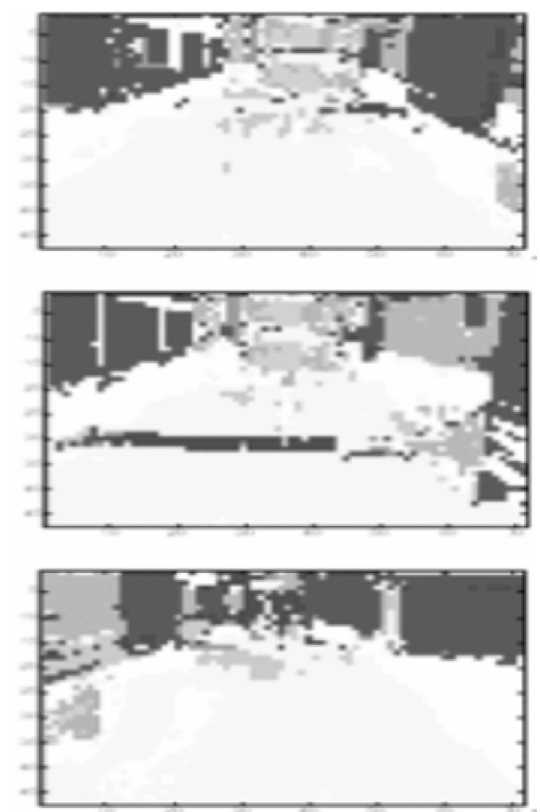

Figure 5 : Image obtained on PRIM's MST

V. Conclusion

As a diagram allotment procedure, the MST-based bunching calculations are of developing criticalness in discovering the unpredictable borders. A focal issue in such bunching calculations is the standard quadratic time unpredictability on the development of a MST. In this paper, we put forth a more effective technique that can rapidly recognize the longest edges in a MST in order to spare some processings. Our commitment is the configuration of another MST motivated grouping calculation for vast information sets (then again, without any particular necessities on the separation measure utilized) by using a DHCA in an effective execution of the curtail and the cycle property.

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Global Journal of Computer Science and Technology
Network, Web & Security
Volume 13 Issue 14 Version 1.0 Year 2013
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

Accuracy in Selecting Reconfigurable Web Services

By M N Sahulamid & M Regina Bagum
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Abstract - Service-Oriented Architecture (SOA) provides a flexible framework for service composition. Using standard-based protocols (such as SOAP and WSDL).There are several constraints meant for selecting the right and appropriate service to be designed as reconfigurable dynamic web services. Those constraints leverage to the following factors availability, response time, failure handling and supports dynamic configuration. Our paper presents the way of predicting the service methods which are really necessary for providing as a dynamic web service. Since all the service methods cannot be used as dynamically as it depends upon the number of users really using the service by the service providers.

GJCST-E Classification : H.3.5

Strictly as per the compliance and regulations of:

Global Journal of Computer Science and Technology (E) Volume XIII Issue XIV Version I Year 2013

Accuracy in Selecting Reconfigurable Web Services

M N Sahulamid [α] & M Regina Bagum [σ]

Abstract - Service-Oriented Architecture (SOA) provides a flexible framework for service composition. Using standard-based protocols (such as SOAP and WSDL).There are several constraints meant for selecting the right and appropriate service to be designed as reconfigurable dynamic web services. Those constraints leverage to the following factors availability, response time, failure handling and supports dynamic configuration. Our paper presents the way of predicting the service methods which are really necessary for providing as a dynamic web service. Since all the service methods cannot be used as dynamically as it depends upon the number of users really using the service by the service providers.

I. Introduction for Selecting Dynamic Web Services

Web Services are software applications or services that are uniquely identified by a URI (Uniform Resource Identifiers) and expose public interfaces for clients, using XML (extended markup language). Those web services can be discovered and used by other client applications using XML based messages and protocols such as HTTP.

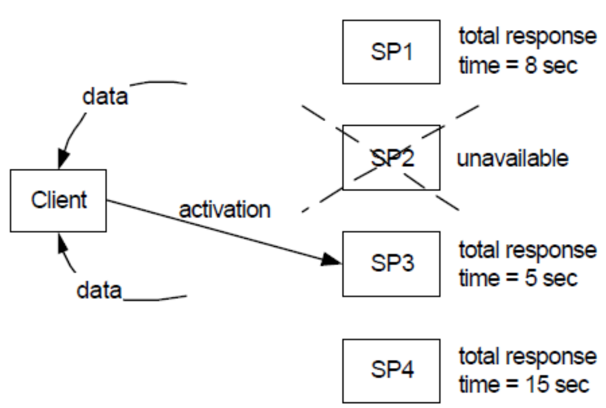

Figure 1 : Web service activation according to response time and availability

The emergence and continued development of web services standards such as SOAP (simple object access protocol) and WSDL (web services description language) [3] enable us to request and describe web services in a standard way. This will increase the ease of use of web services, enable interoperability between heterogeneous platforms and help businesses solve integration problems of their applications. Consequently, it is anticipated that web servers that host the services will be subject to increasing usage and have a higher load. Furthermore, the current simple modulus operand involving client/server activation of a single web service will be enhanced to support more complex scenarios, in which applications and service providers them selvesrely on other external web services as part of their business logic. The reliance on third party web services reduces the control of the

Organization over its application and (sometimes) mission-critical code. The control and information of certain parts of the system is pushed outside organizational boundaries. Scenarios involving reliance on external web services raise several new issues and challenges. An example of common scenario would be of clients consuming external web services, which in turn outsource their computational resources to other service providers. Furthermore, runtime information such as service load and availability or business related constraints might affect the selection process of an external web service, and not be predecided, as it is today. In the existing frameworks for web services there is no incentive to bind dynamically to a specific web service. However, once runtime information concerning those web services is available to the application, a dynamic binding becomes advantageous over a static, pre-decided one. We suggest a model that provides the web service client runtime information that is pertinent to its execution and business logic. The client application can then dynamically bind to the temporarily best service, from a selection of acceptable web services it works with, and according to the client's set of constraints. A client may want to apply some business rules when dynamically choosing a web service, or may be more concerned with response time or availability. When response time is critical (e.g. stock quotes service etc.) it is important for an application to activate the fastest web service available at that given time, or have some mechanism that ensures availability and reliability. When several clients participate in such a scenario, an indirect load balancing mechanism is created, which helps to direct clients to available and relatively fast web services.

Figures 1 illustrate a client activation decisions based on information gathered at runtime from the service providers according to the client constraints.

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In figure 1, the client is concerned with availability and response times of a web service; after retrieving related information from the service providers, it activates the fastest available web service. This behaviour contributes to the robustness of the client application. Figure 1 shows client activation, based on response time and quality of service. According to the client's business constraints, it may prefer to switch to another service provider when it observe a change in the combination of quality and response time offered by the service providers.

II. Related Work

Architecture

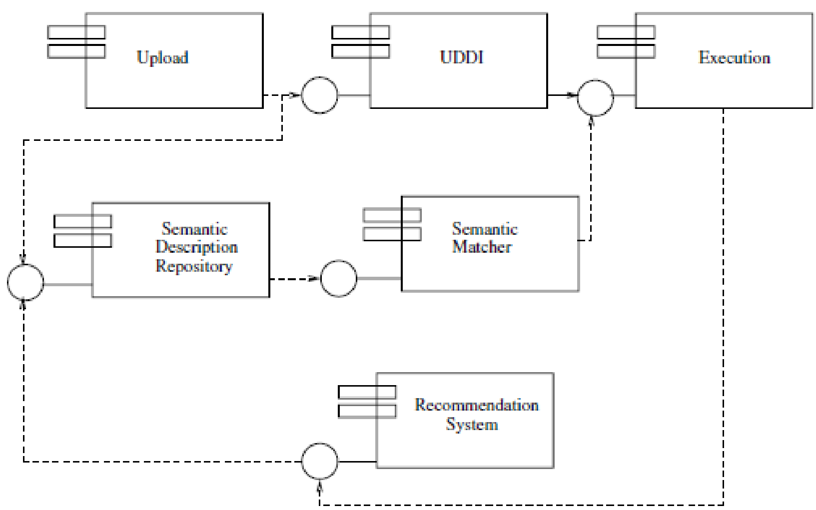


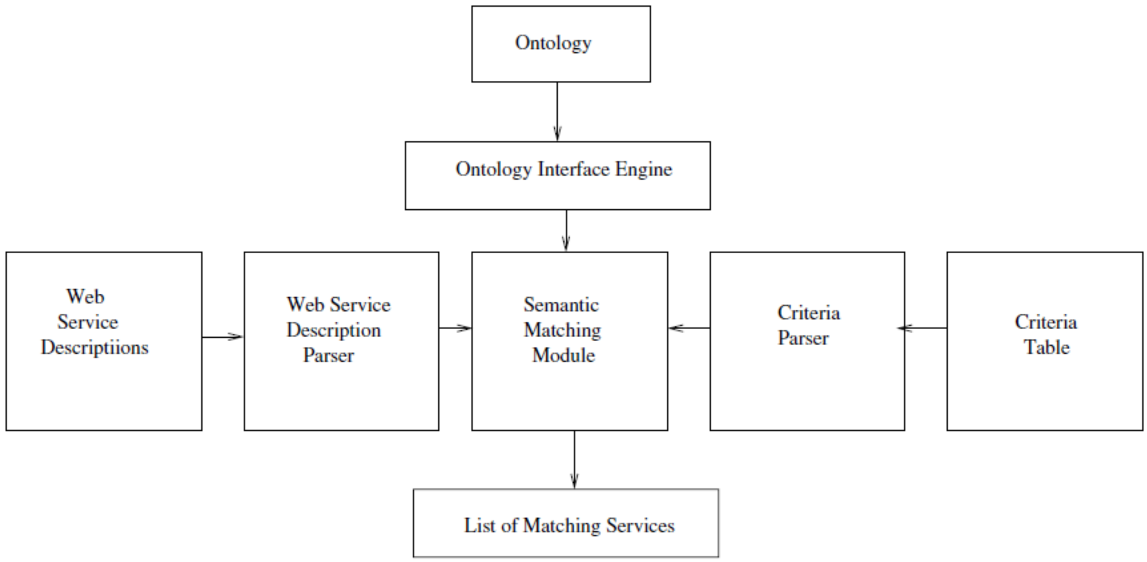
Figure 2 : Architecture of the Dynamic Web Service Selection Framework

Figure 2 shows different components involved in a Dynamic web service selection Framework. The upload component uploads semantic description and WSDL parameters of a web service. The information from WSDL document is extracted and stored in UDDI repository. The semantic matcher matches semantic descriptions of services with user requirements and proposes a list of services matching with his requirements. The user can execute any of matching services using execution environment. The recommendation component asks the user to rate the executed service, so it will be used for recommendation purpose.

Semantic Matcher

Service providers publish DAML-S [5] descriptions of services to a Semantic Description Repository. A service user gives his requirements using DAML-S description. The semantic matcher finds the match between user requirement and all published service descriptions using a Semantic Matching Algorithm. It along with Recommendation System gives matching services in an order.

Figure 3 shows the detailed architecture of a Semantic Matcher [6][7][4]. The Ontology Inference Engine creates a knowledge base from the specified ontology in a DAML-S description and a request description. Web Service Description parser parses the Web Service Descriptions to find out different parameters to be matched. The criteria table specifies service attributes to be compared and the



least preferred similarity measures for those attributes. The similarity measure can be exact, plug-in, sub sumption, container, disjoint, part of. If the two conceptual annotations are syntactically identical, the mapping is called an Exact map. If the second conceptual annotation specializes the first, the mapping is called Plug-in. If the first conceptual annotation specializes the second, the mapping is called Sub sumption map.

If the first conceptual annotation contains the second, the mapping is called a Container map and if first conceptual annotation is part of the second, the mapping is called Part of map. Otherwise the mapping is called disjoint map.

Recommendation System

The Dynamic Web Service Selection Framework has are commendation system, which recommends the best service satisfying the user's requirements. When a user uses a web service, it asks user to rate a web service; so that users can help each other to find a better web service. This is especially important when there are more than one web services which have same functionality but their quality of service is different. We provide the user, a metric to help him decide the rating of a web service. It will be a comparison matrix of runtime behavior of a web service and the users expected QoS parameters like max execution time, average execution time, max response time, average response time etc. Web service with better quality of service will get more rating than other service which offers same functionality but poor service quality. The recommendation system uses the item based collaborative filtering approach [8]. As users rate web services, it is possible to predict how a given user will rate a particular web service. Once it knows prediction of ratings to each web service satisfying user requirements, it can recommend web services in order of their ratings. This approach looks at the set of web services the target user has rated and computes how similar they are to the web service for which user rating is to be predicted. Once the similar web services are found, the prediction is computed by taking a weighted average of the target user's ratings on these similar web services. The item based collaborative filtering approach has two aspects namely similarity computation and prediction generation.

a) Similarity Computation

The similarity [8][9] between two web services is computed by subtracting the average rating of the two web services. Considering only users who have rated both web service A and web service B, say that there are 10 such users, we sum the ratings that A and B got, say 65 and 85.Clearly B is ranked higher than A by 2 on average. The similarity between web services is computed whenever users rate a web service. The result of similarity computation is stored in a similarity matrix.

b) Prediction Generation

The prediction function [8][9] predicts how a particular user will rate a web service. It computes prediction on a web service i for a user u by computing the sum of ratings given by the user on the web services similar to i. Each rating is weighted by the corresponding similarity *Si,j* between web services i and j.*Pu, i*=_all similar items, j(*si,j* ∗*Ru,j*)_all similar items, j(/*si,j*/)Basically it tries to capture how the active user rates the similar web services. The weighted sum is scaled by the sum of the similarity terms to make sure the prediction is with in the predefined range. If the user has used a similar service, it predicts his likely satisfaction index for this service/service chain. If no similar service has been used before, it considers the average rating of all the users for similar services.

III. Dynamic Web Service Invocation - Advanced

a) Headers

Besides parameters, a web service operation may include "headers". Headers are basically additional parameters that are carried inside the header of a SOAP request/response instead of in the body. In general headers are used to specify additional information not strictly related to the semantics of an operation such a as the credentials (username and password) required to invoke it.

The WSData class allows managing parameters and headers homogeneously: while the

voidset Parameter(<parameter-name>, < parameter-value>)
AbsObjectgetParameter(<parameter-name>)
String get Parameter String(<parameter-name>),
Intget Parameter Integer(<parameter-name>),
booleanget Parameter Boolean(<parameter-name>)
methods are available to manage parameters, the
voidset Header(<header-name>, <header-value>)
AbsObjectgetHeader(<header-name>)
String getHeaderString(<header-name>)
integergetHeaderInteger(<header-name>)
booleangetHeaderBoolean(<header-name>)
methods are available to manage headers.

b) Proxy

In many cases both the access to a WSDL (at Dynamic Client initialization time) and the actual web service invocation require passing through an HTTP Proxy. The Dynamic Client class provides the following methods to set proxy information.

- setProxyHost(<host>): Set the proxy host (e.g. 163.162.10.12)
- setProxyPort(<port>): Set the proxy port (e.g. 8080)
- setNonProxyHosts(<listOfAddresses>): Set a list of addresses (possibly including '*') that will be accessed without using the proxy. The separator is the '|' character
- setProxyAuthentication(<user>, <password>): Set the credentials (if any) required to access the proxy

The following code snipped provides an example.

dc.**setProxyHost**("10.12.175.14");
dc.**setProxyPort**("8080");
dc.**setNonProxyHosts**("163.163.*|*.telecomitalia.it");
dc.**setProxyAuthentication**("myUser", "myPwd");
dc.initClient(new URI("http://myWSDL"));

c) Security

Certain web services require HTTP Basic Authentication. The Dynamic Client class provides the following methods to set HTTP related information.

- setDefaultHttpUsername(): Specifies the http username used in all requests.
- setDefaultHttpPassword(): Specifies the http password used in all requests.

The following code snipped provides an example.

dc.**setDefaultHttpUsername**("MyHttpUsername");
dc.**setDefaultHttpPassword**("MyHttpPassword");

If the credential of HTTP Basic Authentication are different in all requests is possible specify them in invoke(…) method with Security Properties object.

Instead, if the credential of HTTP Basic Authentication are different for the WSDL discovery is possible specify them in initClient(…) method.

The following code snipped provides an example dc.**initClient** (new URI("http://myWSDL"), "MyHttpUsername", "MyHttpUsername"); Other web services require WS-Security Username Token. The DynamicClient class provides the following methods to set WSS related information.

- setDefaultWSSUsername(): Specifies the wss username used in all requests.
- setDefaultWSSPassword(): Specifies the wss password used in all requests.
- setDefaultWSSPasswordType(): Specifies the wss password type used in all requests (TEXT or DIGEST, see SecurityProperties object).

The following code snipped provides an example.

dc.**setDefaultWSSUsername**("MyWSSUsername");
dc.**setDefaultWSSPassword**("MyWSSPassword");
dc.**setDefaultWSSPasswordType**(SecurityProperties.PW_TEXT);

If the credential of WS-Security Username Token are different in all requests is possible specify them in invoke(…) method with Security Properties object.

Other web services require WS-Security Timestamp. The Dynamic Client class provides the following method to set WSS related information.

- setDefaultWSSTimeToLive(): Specifies the wss request time to live (in second) used in all requests.

The following code snipped provides an example.

dc.**setDefaultWSSTimeToLive**(60);

If the credential of WS-Security Timestamp are different in all requests is possible specify them in invoke(…) method with Security Properties object.

Other web services require SSL connections with or without certificates. The Dynamic Client class provides the following methods to set SSL related information.

- enableCertificateChecking(): Enables the certificates checking mechanism. When this mechanism is enabled (the default situation) a trust store holding certificates of trusted remote servers must be indicated (see the setTrustStore() method).
- disableCertificateChecking(): Disables the certificate checking mechanism.

- setTrustStore(<file.keystore>): Specifies the keystore holding certificates of trusted remote servers
- setTrustStorePassword(<password>): Specifies the password used to protect the keystore of trusted certificates

The following code snipped provides an example.

```
dc.setTrustStore("C:/myFolder/cert.keystore");
dc.setTrustStorePassword("myPassword");
dc.initClient(new URI("http://myWSDL"));
```

d) Caching

Considering that the initialization of a Dynamic Client (initClient() method) is a long operation that may take some seconds, a good approach is to create a single Dynamic Client instance for each WSDL and reuse it whenever an operation of a service described in that WSDL must be invoked (note that the invoke() methods of the Dynamic Client class are thread safe and therefore can be called by two or more threads in parallel). In order to facilitate this practice the WSDC provides a class called Dynamic Client Cache that manages all issues related to creation, initialization and caching of Dynamic Client objects in a thread safe mode. The Dynamic Client Cache class follows the singleton pattern and therefore the first step when using it is to retrieve the singleton Dynamic Client Cache instance by means of the get Instance() method.

The following code snippet shows how to use the DynamicClientCache class.

```
DynamicClientCache dcc = DynamicClientCache.getInstance();
DynamicClient client = dcc.get(new URI("http://myWSDL"));
WSData output = client.invoke("sum", input);
```

The get() method of the DynamicClientCache class first checks if a DynamicClient object was already created to access the given WSDL and returns it in that case. Only if no DynamicClient object is already available a new one is created and initialized.

IV. Service Selection Algorithms for General Flow Structure

Many real-world service processes have services that are not in strictly sequential order. They may have parallel operations to perform several services at the same time, conditional branch operations, and loops for using a service more than once in a flow. The function graph for composite service with general composition patterns may contain complex structures among function nodes. In order to simplify the problem and construct a service candidate graph with a DAG structure, we first remove the loop operations by unfolding the cycles as in [Zeng et al. 2004]. A cycle is unfolded by cloning the function nodes involved in the cycle as many times as the maximal loop count.

V. Conclusion

We have studied the problem of service selection with multiple QoS constraints and proposed several algorithms. The selection of dynamic web service is depends upon the Execution price, Execution duration, Reputation, Successful execution rate, Availability, response time $\leq$ 600, cost $\leq$ 25 0, availability $\geq$ 85%.

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Global Journal of Computer Science and Technology
Network, Web & Security
Volume 13 Issue 14 Version 1.0 Year 2013
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

An Efficient Security Mechanisms for Different Sort of Attacks in CWSN

By K. Katyayini & S.V. Ramanamurthy
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Abstract - One of the major important aspects of wireless sensor networks (WSNs) is their capability to collect and process huge amounts of information in parallel with the help of small, power limited devices enabling their use in observation, target detection and various other monitoring applications. Recently, new ideas have been proposed to develop cognitive WSNs (CWSNs) to enhance awareness about the network and environment, and make adaptive decisions based on the application goals. A CWSN is a special network, which has many constraints compared to traditional wireless network. But the major problem is security. In this paper discovering various security threats in these networks and various defense mechanisms to counter these vulnerabilities. Various types of attacks on CWSNs are categorized under different classes based on their natures and targets, and corresponding to each attack class, appropriate security mechanisms are discussed.

Keywords : *WSN, WSN attacks, cognitive WSN.*

GJCST-E Classification : *D.4.6*

AN EFFICIENT SECURITY MECHANISMS FOR DIFFERENT SORT OF ATTACKS IN CWSN

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Keywords : WSN, WSN attacks, cognitive WSN.

I. Introduction

Over the last decade, wireless sensor networks (WSNs) have attracted a lot of interest in the research community due to their wide range of potential applications. A WSN consists of hundreds or even thousands of small devices each with sensing, processing, and communication capabilities to monitor a real-world environment. They are envisioned to play an important role in a wide variety of areas ranging from critical military surveillance applications to forest fire monitoring and building security monitoring (Akyildiz et al., 2002). Most of the WSN deployments operate in the unlicensed ISM bands (2.4GHz). Several other small range wireless protocols like Wi-Fi, Bluetooth etc. also use the same band. This has led to overcrowding in this band with the increasing deployment of WSN-based applications. As a result, coexistence issues in the ISM bands have attracted extensive research attention (Cavalcanti et al., 2007).

The increasing demand for spectrum in wireless communication has made efficient spectrum utilization a big challenge. To address this important requirement, cognitive radio (CR) has emerged as the key technology. A CR is an intelligent wireless communication system that is aware of its surrounding environment, and adapts its internal parameters to achieve reliable and efficient communication and optimum utilization of the resources (Mitola, 2000).With the advent of CR technology, we have a different perspective of the traditional WSNs. In the current cognitive wireless sensor networks (CWSNs), the nodes change their transmission and reception parameters according to the radio environment. Cognitive capabilities are based on four activities: (i) monitoring of spectrum sensing, (ii) analysis and characterization of the environment, (iii) optimization of the best communication strategy based on different constraints such as reliability, power, security and privacy issues etc., and (iv) adaptation and collaboration strategy. The cognitive technology will not only enable access to new spectrum but it will provide better propagation characteristics leading to reduction in power consumption, network life-time and reliability in a WSN. With cognitive capabilities, WSN will be capable of finding a free channel in the unlicensed band to transmit or could find a free channel in the licensed band for communication. A CWSN, therefore, will be able to provide access not only to new spectrum bands in addition to the available 2.4 GHz band, but also to the spectrum band that has better propagation characteristics. If a channel in a lower frequency band is accessed, it will certainly allow communications with higher transmission range in a CWSN, and hence fewer sensor nodes will be required to provide coverage in a specific area with a higher network life-time due to lower energy consumption in the nodes. CWNs will also provide better propagation characteristics by adaptively changing systems parameters like modulation schemes, transmit power, carrier frequency and constellation size. The result will be a more reliable communication with reduced power consumption, increased network life-time and higher reliability and enhanced quality of service (QoS) guarantee to applications.

There is some basic difference between WSN and CWSN. In CWSN nodes change their transmission and reception parameters according to the radio environment. Cognitive capabilities are based in four technical components: sensing spectrum monitoring, analysis and environment characterization, optimization for the best communication strategy based on different constrains (reliability, power consumption, security, etc.) and adaptation and collaboration strategy. Adding those cognition capabilities to the existing WSN infrastructure

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will bring about many benefits. In fact, WSN is one of the areas with the highest demand for cognitive networking. In WSN, node resources are constrained mainly in terms of battery and computation power but also in terms of spectrum availability.

Hence with cognitive capabilities, WSN could find a free channel in the unlicensed band to transmit or could find a free channel in the licensed band to communicate. CWSN could provide access not only to new spectrum (rather than the worldwide available 2.4 GHz band), but also to the spectrum with better propagation characteristics. A channel decision of lower frequency leads more advantages in a CWSN such us higher transmission range, fewer sensor nodes required to cover a specific area and lower energy consumption.

This way, CWSN is a new concept proposed in literature [4] with the following advantages:

- Higher transmission range.
- Fewer sensor nodes required to cover a specific area.
- Better use of the spectrum.
- Lower energy consumption.
- Better communication quality.
- Lower delays.
- Better data reliability.

II. Motivation

The ultimate goal is to design WSNs which are more aware of the concurrent conditions of the network, can make decisions based on the information, and take actions. Based on definition of cognitive WSN in [5], a cognitive WSN should be aware of the amount of sensory data being communicated and know when and where to forward it. It can allow the network to avoid communicating sensed data when it is not necessary. The energy available to each node is fed back to determine a maximum average power. This in turn dictates a maximum duty cycle for the node and a constraint on the maximum sleep time [6]. In addition, because cognitive sensor networks should have such high level of knowledge about the environment and the types of information exchanged, they must be application specific. The main aspects of the cognitive network are behavior-oriented architecture with agents that have a sensor-based robust behavior with slow rate of processing, distributed control, small size, and inexpensive low power consumption hardware [6]. We believe that cognition, when incorporated in sensor networks will enable achieving the following objectives: (i) Make the network aware of, and dynamically adapt to, application requirements and the environment in which it is deployed. (ii) Provide a holistic approach to enable the sensor network to achieve its end-to-end goals, i.e. gather information about the network status from network and MAC layers, application requirements from the application layer and achieve the objectives of the network.

Since WSN is comprised of low power consumption devices with limited processor capabilities, cognition should be implemented in such an infrastructure. To avoid imposing high load of processing or forcing a costly upgrade on all devices of a WSN, this work proposes implementing new devices called cognitive nodes. By using cognitive nodes in the network, the performance of the network would be improved and the cost as well, so the cost must justify the performance[9]. Cognitive nodes are designed such that they use the same infrastructure as sensor nodes but are able to handle cognition processes and manage decisions and actions by commanding other nodes. This way the cost added due to cognition will be as low as possible and can benefit from previous developments in the design of sensor nodes. Since WSN employs nodes with limited batteries which need to last for a long time one of the challenges is how to maximize lifetime. Transmission is one of the most power consuming processes in sensor nodes and nonefficient transmissions of data can lead to a shorter lifetime. So this work tries to schedule nodes' transmission rate by the means of cognition to maximize lifetime. In addition, since in a WSN, there are redundant sensor nodes deployed, efficient scheduling of the redundant nodes can lead to an improved lifetime.

The Main Characteristics of a CWSN can be divided in to three parts:

- Awareness
- Decision making
- Taking appropriate action

III. Related Work

First works about security in CR were developed specifically to analyse the effects produced by cognitive features and how they could be used to mitigate the negative effects. So, as we have said, in the article [7] each characteristic and the attacks that could take advantage of it are analysed. A different point of view is shown in the article of Zhang and Li [1]. They make a survey about the weaknesses introduced by the nature of CR. They base the security of the system in two tasks: protection and detection, and divide the attacks and countermeasures depending on which layer of the protocol stack affects. The article [2] studies threats that affect the ability to learn of cognitive networks and the dynamic spectrum access. To conclude the general references about security, it should be noted the article of Goergen and Clancy [9] where an attack classification in cognitive networks is done: DSA attacks, objective function attacks and malicious behaviour attacks.

In [3], two specific attacks against cognitive networks are analysed: primary user emulation (PUE), and sensing data falsification. It also provides some countermeasures well adapted to static scenarios such as TV system. In [4], a secure protocol spectrum sensing is presented. It bases its functionality on the generation and transmission of specific keys to each node. As a third example of safety sensing investigation, the research [5] proposes a collaborative algorithm based on energy detection and weighted combining (similar to a reputation system) to prevent malicious users.

Related to specifics attacks, the most studied against CR is the PUE, which was defined by Chen and Park [6] for the first time in 2006. Since then, research of the same authors [7] has focused on countermeasures against PUE. Also, in [18] a way to detect the PUs through an analytical model that does not require location information is shown. As well as the PUE attack, the community of researchers in CR has been studying other kind of attacks originate from different wireless networks, such as denial of service (DoS) attack or jamming attack. These attacks have special characteristics in cognitive networks, for example, article [9] studies these features for DoS, and [2] shows a countermeasure based on frequency hopping (technically possible in CR) to avoid jamming attacks.

IV. Attacks in CWSN

a) Communication Attacks

This types of attacks the attacker affects data transmissions between nodes with a concrete purpose. The goal could be from isolate a node to try to change the behavior of whole network.

b) Replay Attack

It consists on the replay of messages from inside or outside the current run of communication [6]. For example, message is directed to other than the intended node. This receiver node replays the message to the intended principal and this receives the delayed message. This delay is fundamental to calculate network characteristics (channel, topology, routing, etc.).

c) Jamming Attack

In this attacks, the transmission of a radio signal that interferes with the radio frequencies used by nodes. Jamming attack is one of the most studied attacks against WSN [7]. However, CWSN has great advantages to solve jamming but also can produce negative effects like energy consumption or communication failures. A typical jamming attack is a high power transmission using the PU frequency.

d) Collision Attack

It consist of the intention of violate the communication protocol [8]. This attack does not consume much energy of the attacker but can cause a lot of disruptions to the network operation. Due to the wireless broadcast nature, it is not trivial to identify the attacker.

e) Routing ill-directing attack

In this attack, a malicious node simply refuses to route messages. Examples of this kind of attacks are the grey hole and black hole ones. In these attacks, the nodes refuse all packets that arrive or a percentage thereof. Because of this misinformation, the network can change the routes, the topology or leaving isolated nodes.

f) Sybil Attack

It is defined as a malicious device illegitimately taking multiple identities. Sybil attack is effective against routing algorithms, voting, reputation systems and foiling misbehavior detection.

g) Against privacy attacks

It is also important attack class is attacks against privacy. CWSNs allow sharing resources to establish a communication and to be aware of environment. Attackers could use this access to take some of node information. The attacks against node privacy include eavesdropping, through taping the information; the attacker could easily discover the communication contents. Impersonating attack, where the attacker joins to the network and it can impersonate the original victim sensor node to receive packet, and traffic analysis, using wireless and cognitive features to listen in the entire spectrum. Traffic analysis attacks [19] try to deduce the context information of nodes analysing the traffic pattern from eavesdropping on wireless communication. Acquired information could be used to prepare a most harmful attack. For example, spectrum information can be used to know what the weakest spectrum zone is or where the PUs are emitting.

h) Node-targeted attacks

Node-targeted attacks need more attention that in a normal WSN because of the propagation of information is more important for the correct working of CWSN. A node can be captured and attackers use reverse engineered and become an instrument for mounting counterattacks. Other possibility is to destroy the nodes. This destruction not only affects to node functionality, but also affects whole network. Usually, node-targeted attacks ought to be less important for WSN. However, distributed information and co-operational behavior in CWSN make a captured node a powerful weapon for attackers. Extracting a cryptographic key and modifying the internal device code are examples of node targeted attacks.

i) Power consumption attacks

CWSNs are susceptible to attack, because they are cheap small devices. Small size of nodes and batteries makes CWSN very vulnerable to power consumption attacks. The attacker can inflict sleep torture on an energy constrained node by engaging in it unnecessary communication work to quickly drain its battery power. Depriving the power of a few crucial nodes (e.g. Access Point) may lead communication breakdown of the entire network. Attacker node can request a channel change every time, increasing power consumption.

V. Proposed System

A robust authentication mechanism is a prime requirement in collaborative spectrum sensing. The authentication scheme may have different perspectives to different categories of nodes in a CWSN. The authentication of the primary users is a critical issue since an attacker may transmit signals with high power that has close resemblance with the signals of a primary user and launch a primary user emulation (PUE) attack (Chen et al., 2008c; Liu et al., 2010). To prevent such an attack, the secondary users should have a robust verification scheme for verifying the authenticity of the received signals. Similarly, when the secondary users receive the sensing reports from other users, they should be able to verify the authenticity of the other secondary users; otherwise, a potential adversary may be able to spoof the identity of a secondary user. The authentication of sensing reports distributed across the network is also a very important issue. Even if the authentications of the secondary users are done during the sensing report aggregation process, it is still possible for a malicious secondary user to send false sensing reports and launch spectrum sensing data falsification (SSDF) attack (Wang et al., 2009b). Hence, each sensing report in the aggregation process should be authenticated.

A popular approach for defending against unauthorized spectrum access is to deploy a spectrum monitoring system in the CR network. The spectrum monitoring system acts as a spectrum "watch guard" for detecting spectrum misuse and carries out the following functions: (i) monitoring of the spectrum usage in a specific spatial region and over a range of frequencies, (ii) identifying wireless services and the nodes providing such services. However, design of an effective spectrum monitoring system is a challenging task since natural or man-made obstacles can change the features of the radio signal, and identification of wireless services may be difficult if an attacker can successfully emulate a specific wireless service being provided in the network. To address these problems, spectrum monitoring systems can be distributed across the nodes. Information on the wireless services in an area can be transmitted to a central monitoring location, which can, then, correlate the various inputs and check the received information against other data like the known position of the wireless services in the area and their source.

The cognitive pilot channel (CPC) of a CR network is responsible for distributing the cognitive control messages. The CPC is vulnerable to numerous attacks including the DoS attacks and the saturation attacks on the control channels. A popular protection mechanism against the jamming attack in a specific spectrum band of a CR network is to use frequency hopping. The CPC could use more than one spectrum band and "hop" around the spectrum bands to avoid a possible jamming attack. The trade-off is an increased complexity of the CR network as the CR nodes should be notified about the change in the frequency band of the CPC. If an attacker effectively monitors the CPC, it could "chase" the CPC band for every change and eventually cause continual adaptation and outage of service to the CR network.

Yue et al. present two coding schemes for recovering lost packets transmitted through parallel channels coding technique (Yue & Wang, 2009). The two coding schemes, known as rateless coding and piecewise coding, can be adapted to CWSNs for protecting the CPC and CCC. Meucci et al. present a lightweight mechanism for achieving security in the PHY layer in a CR network using *orthogonal frequency division multiplexing* (OFDM) (Meucci et al., 2009). In the proposed scheme, the user's data symbols are mapped over the physical sub-carriers using a permutation strategy. The security in the PHY layer is achieved using a random and dynamic sub-carrier permutation which is based on a single pre-shared information.

VI. Conclusion

CWSNs are increasingly being used in military, environmental, health and commercial applications. These networks are inherently different from traditional wireless networks as well as WSNs. Security is a mandatory feature for the deployment of CWSNs. This article summarizes the attacks and their taxonomy and also an attempt has been made to explore the security mechanisms widely used to handle those attacks. The challenges of WSNs are also briefly discussed. Security issues are a novel research area. This survey will hopefully motivate future researchers to design smarter and more robust security mechanisms and make their networks safer.

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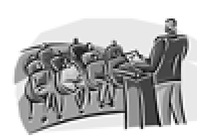

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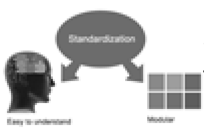

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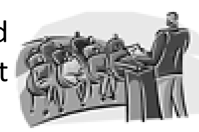

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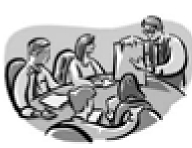

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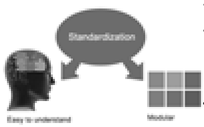

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1. General,

2. Ethical Guidelines,

3. Submission of Manuscripts,

4. Manuscript’s Category,

5. Structure and Format of Manuscript,

6. After Acceptance.

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- As always, give awareness to spelling, simplicity and correctness of sentences and phrases.

Procedures (Methods and Materials):

This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.
- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

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Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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ISSN 9754350