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ReCoCa Scheme For Wireless Multimedia Sensor Networks

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Abstract

In recent years, rapid growth in low-power circuitry and in cheap complementary metal-oxide semiconductors (CMOS) fosters the growth of a new type of sensor nodes that can retrieve multimedia rich contents such as videos, audio streams, and images along with the ordinary data. These new sensor nodes which were equipped with cameras and microphones are known as multimedia sensors. Wireless multimedia sensor networks (WMSN) have very wide range of applications ranging from environmental monitoring, traffic surveillance and control systems to the healthcare systems and the battel field application. All these applications operate in real time. These applications require information in real time with lesser delay, sensors communicate with each other to provide the required information in lesser time.

A region-based co-operative caching (ReCoCa) scheme for WMSN considers each node differently according to the contention introduced by each link. The proposed method selects some notes on the basis of their traffic flow and contention value. A cashing discovery mechanism is proposed which searches the requested data item based on the region. A value based cache replacement method which deletes data items according to the value of the function is also proposed. Simulation results demonstrate the effect of number of notes and Node density in the network over cache overhead and effect of data availability over average delay to serve a request.

Key Words: Multimedia sensor Networks; WMSN; Wireless multimedia sensor network cooperative caching; cache replacement; WSN.

1. Introduction

Wireless multimedia sensor networks have gained worldwide attention in recent years, particularly the development of smart sensors. These sensors are small, with limited processing and computing resources and they are much cheaper than traditional sensors. Smart sensors notes are low power devices with one or more sensors, a processor, memory, power consumption supply. These sensors may be type of thermal, chemical, biological, optical, magnetic etc. to measure properties of the environment.

WMSNs are the form of mobile ad-hoc networks which provide communication among heterogeneous devices.

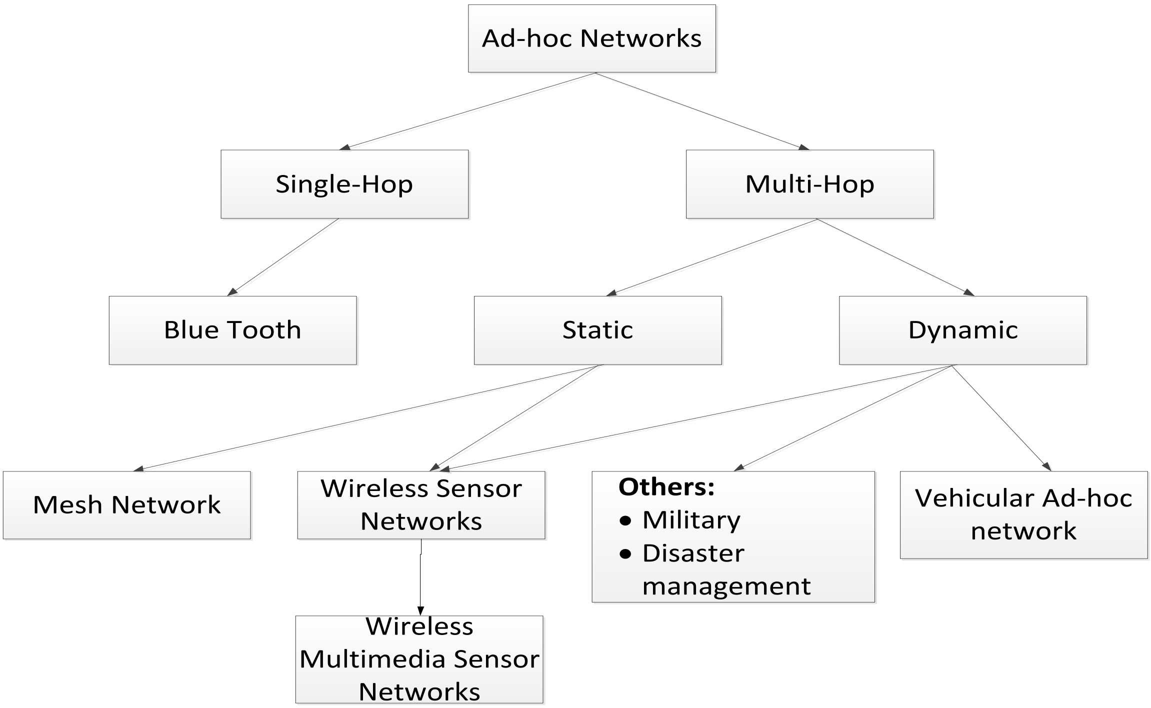

Figure 1: Classification of wireless ad-hoc network

WMSNs provide an exciting area of research at the intersection of a number of disciplines and technologies. There is a good scope for applications of WMSNs ranging from environmental monitoring, multimedia surveillance system, traffic control and health monitoring. Each device is equipped with microphones and still cameras along with ordinary sensing devices which are capable of sensing scalar data like temperature, pressure and humidity along with multimedia data like images, voice and moving pictures. WMSNs applications mainly require application level QoS (e.g. latency minimization). To ensure such a high level of QoS in resource constraint environment is challenging task. Most of the concerns of MANETs are common in WMSNs, because WMSNs are the special case of the MANETs. Rather than moving at random, WMSNs are mainly static in nature. Because of the absence of the mobility, high bandwidth usage and more energy consumption, the schemes and mechanism proposed so far for providing QoS in MANETs are not suitable for WMSNs.

In WMSNs, very large amount of data is generated. This data includes scalar data like pressure, temperature as well as multimedia data such as videos, still images etc. Most of the WMSNs applications require high level of QoS (e.g. minimum latency delay, low access cost). To provide such a high level of QoS in an environment with extreme resource constraints, with variable channel capacity and with the requirements for multimedia in-network processing, cooperative caching is an important mechanism to provide application level services.

In cooperative caching, when a data item is not available at any node, it sends a request message in the neighbourhood to search the data. If data item is cached by any neighbour node, it will send the requested data to the requesting node. If more than one node caches the same data then all these node will serve the request which will result in wastage of energy, bandwidth and number of messages in the network. If data item is served by a node which introduce more traffic in the network and has high contention delay at MAC layer, will further increase the access delay. If requested data item is served by a node which is far away from the requesting node, then the communication cost will increase as well as the access delay to serve the request. If each request is being served by data centre itself, it will increase the access delay, energy consumption and communication cost. So data items should be cached near the requesting node to minimize all these factors like number of messages, reduction in energy consumption, etc.

The main objective of this research is stated as

- To propose an efficient cooperative caching mechanism for WMSNs.

It can be subdivided further into smaller objectives:

- To propose an efficient method for selecting special nodes. These special nodes will communicate with other nodes on the behalf of requesting node to reduce the communication cost.
- To propose an efficient data discovery protocol for searching the requested data in order to reduce access delay and caching overheads.
- To propose an effective cache replacement policy for proper use of cache space at each node.
- To explain the effect of different parameters on the performance of proposed caching scheme.

2. Characteristics

A WMSN typically consists of a large number of low-cost, low-power and multifunctional multimedia sensor nodes that are deployed in a region of interest. These sensor nodes are small in size, but are equipped with sensors, embedded microprocessors, CMOS cameras, microphones and radio transceivers and therefore have not only sensing capability, but also capturing rich multimedia contents like still images, videos, data processing and communicating capabilities. They communicate over a short distance via a wireless medium and collaborate to accomplish a common task, for example, environment monitoring, battlefield surveillance and industrial process control. Compared with traditional wireless communication networks, for example, cellular systems and MANET, sensor networks have the following unique features:

- **Application-specific Quality of Service requirements:**The wide variety of applications of WMSNs will have different QoS requirements. In addition to data delivery modes typical of scalar sensor networks, multimedia data include snapshot and streaming multimedia contents. Snapshot-type multimedia content contains event-triggered observations obtained in a short period of time (e.g. still image). Streaming multimedia content is generated over a longer period of time and requires sustained information delivery and typically needs to be delivered on time.
- **High bandwidth demand:** Multimedia content, especially video streams, requires transmission bandwidth that is orders of magnitude higher than that supported by currently available sensors. For example, the nominal transmission rate of the state-of-the-art IEEE 802.15.4 compliant components, such as Crossbow's MICAz or TelosB motes, is 250 Kbit/s. Data rates at least one order of magnitude higher may be required for high-end multimedia sensors with comparable power consumption. Hence, high data rate and low power consumption transmission techniques need to be leveraged.
- **Multimedia source coding techniques:** Uncompressed raw video streams require excessive bandwidth for a multi-hop wireless environment. Hence, efficient processing techniques for lossy compression are necessary for multimedia sensor networks. Traditional video coding techniques used for wired and wireless communications are based on intraframe compression techniques to reduce redundancy within one frame and on interframe compression techniques which exploits redundancy among subsequent frames to reduce the amount of data to be transmitted and stored. However, recent research [13] shows that a framework called distributed source coding which exploits the source statistics at the decoders, which allows the use of simple encoders can be used in WMSNs and especially for video sensor networks, where it may not be feasible to use existing video encoders at the source node due to processing and energy constraints.
- **Multimedia in-network processing:**A WMSN allows performing multimedia in-network processing algorithms on the raw data extracted from the environment. Multimedia in-network processing requires new architectures for collaborative, distributed and resource-constrained processing that allow for filtering and extraction of semantically relevant information at the edge of the sensor network. This may increase the system scalability by reducing the transmission of redundant information and merging data originated from multiple views on different media and with multiple resolutions.
- **Power consumption:** Power consumption is a fundamental concern in WMSNs, even more than the traditional WSNs. In fact, sensors are battery-constrained devices, while multimedia applications produce high volumes of data, which require high transmission rates and extensive processing. While the energy consumption of traditional sensor nodes is known to be dominated by the communication functionalities, this may not necessarily be true in WMSNs.

- **Multimedia coverage:** Some multimedia sensors, in particular video sensors, have larger sensing radius and are sensitive to the direction of acquisition (directivity). Furthermore, video sensors can capture images only when there is an unobstructed line of sight between the event and the sensors. Hence, coverage models developed for traditional WSNs are not sufficient for planning of a multimedia sensor network.
- **Integration with Internet architecture:** It is of fundamental importance for the commercial development of a sensor network to provide services that allow querying the network to retrieve useful information from anywhere and at any time. For this reason, future WMSNs will be remotely accessible from the Internet.

3. Architecture of a multimedia sensor

- **Internal architecture of multimedia sensor:** A multimedia sensor device may be composed of several basic components as shown in Figure 2.4. It consist a sensing unit, a processing unit (CPU), a communication subsystem, a coordination subsystem, a storage unit (memory) and an optional mobility/actuation unit [12].

  - Sensing units are usually composed of two subunits: sensors (cameras, microphones and/or scalar sensors) and analog-to digital converters (ADCs). The analog signals produced by the sensors based on the observed events are converted into digital signals by the ADC and then fed into the processing unit. The processing unit executes the system software in charge of coordinating sensing and communication tasks and is interfaced with a storage unit. A communication subsystem interfaces the device to the network and is composed of a transceiver unit and of communication software.

    Communication subsystem includes communication protocol stack and system software such as middleware, operating systems and virtual machines. A coordination subsystem is in charge of coordinating the operation of different network devices by performing operations such as network synchronization and location management. An optional mobility/actuation unit can enable movement or manipulation of objects. Finally, the whole system is powered by a power unit.

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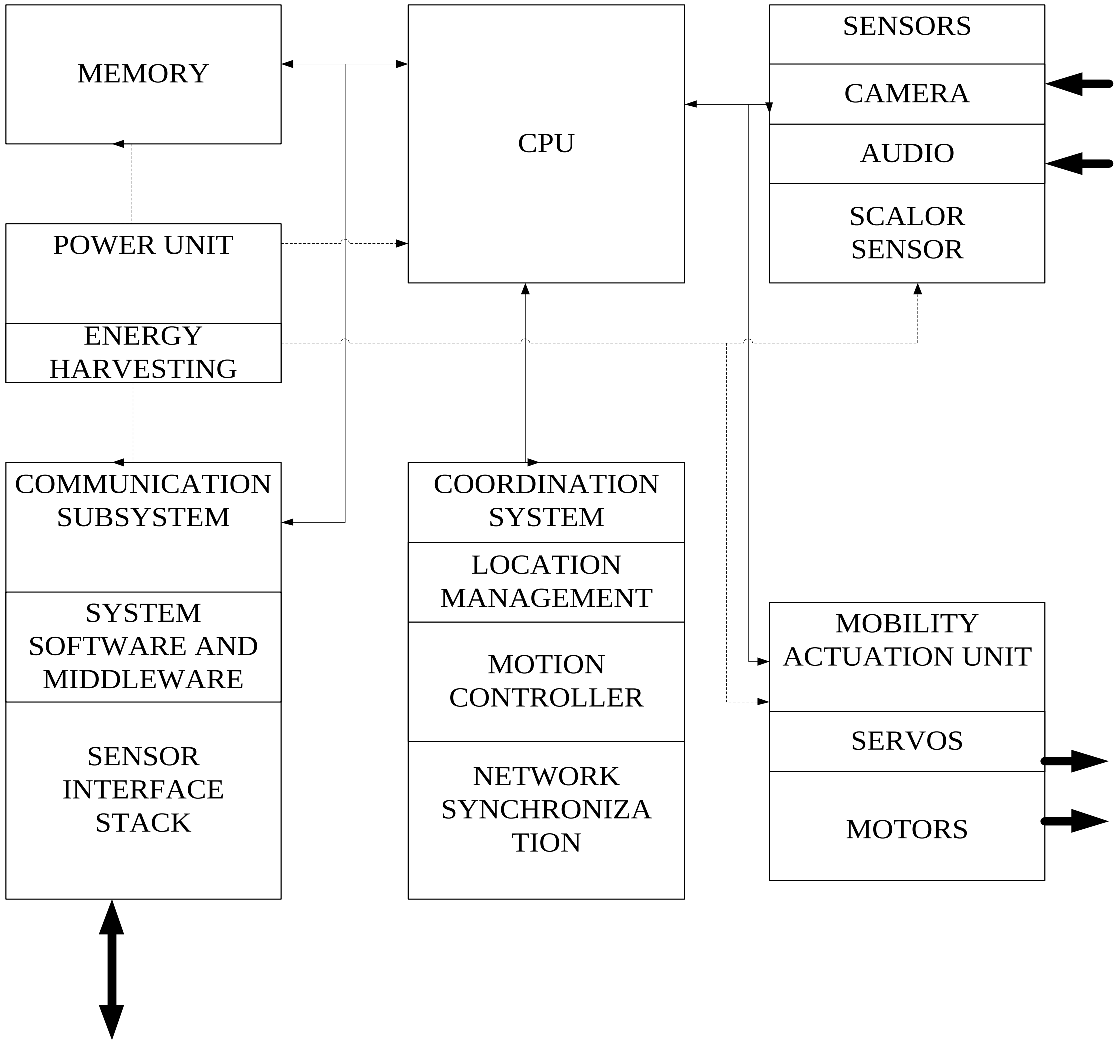

Figure 2: Internal architecture of sensor node [12].

- **Network architecture of WMSNs:** A multimedia sensor network typically consists of a large number of audio sensor nodes, video sensor nodes along with scalar sensor nodes densely deployed in a region of interest and one or more data sinks or base stations, multimedia processing hubs, storage hubs and gateway that are located close to or inside the sensing region [12]. Wireless gateways are connected to the wired network like internet which is connected to the users. Different architectures are proposed for efficient and more scalable working of WMSNs depending on the specific application QoS requirements and constraints [14]. In general, network architectures for WMSNs can be divided into three different categories [15, 16, 17, 18] as described following.
- **Single-tier flat architecture:** In this architecture, the network consists of homogeneous sensor nodes with same capabilities and functionalities. All nodes can perform any function such as image capturing, multimedia processing and data transferring to sink over a multi-hop path [11, 12, 19] as shown in Figure 2.5.

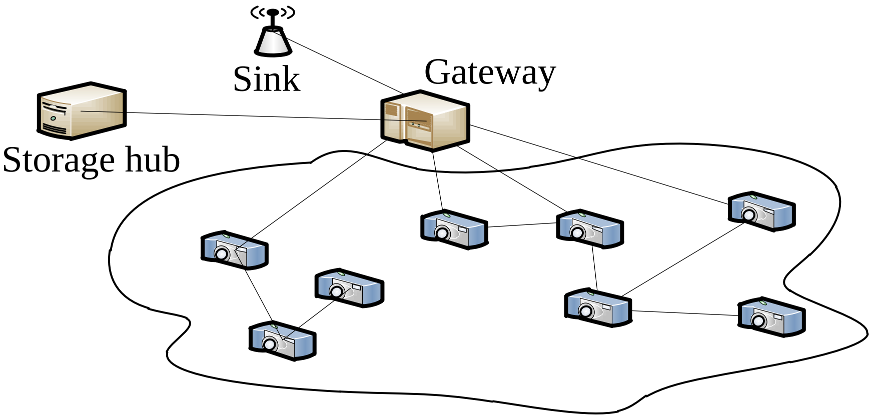

Figure 3: Single-tier flat architecture.

- **Single-tier clustered architecture:** Single-tier clustered architecture consists of heterogeneous sensors such as camera, audio and scalar sensors grouped together to form a cluster. All heterogeneous sensors belonging to the same cluster send their sensed data to the cluster head which has more resources and can perform complex data processing. The cluster head is connected either directly or indirectly to the sink or the gateway through multi-hop path [11, 12, 19] as shown in Figure 3.
- **Multi-tier architecture:** In this architecture, the first tier consists of scalar sensors that perform simple tasks, like measuring scalar data from surrounding environment (e.g., light, temperature, etc.), the second tier consists of camera sensors that perform more complex tasks such as image capturing or object recognition and at the third tier consists of more powerful and high resolution video camera sensors that are capable of performing more complex tasks, like video streaming or object tracking [11, 19, 20]. Each tier has a central hub for data processing and communicating with the upper tier. The third tier is connected with the sink or the gateway through a multi-hub path [21, 22, 23] as shown in Figure 4

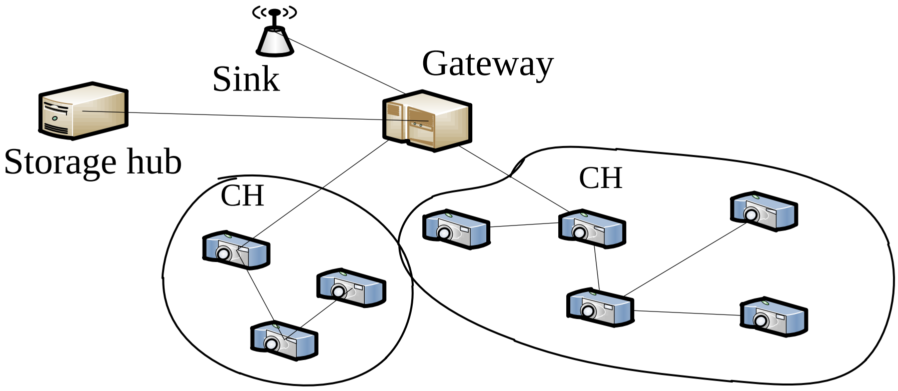

Figure 4: Single-tier clustered architecture.

4. Applications of WMSNs

WMSN applications can be divided in to two categories:

1. Monitoring
2. Tracking

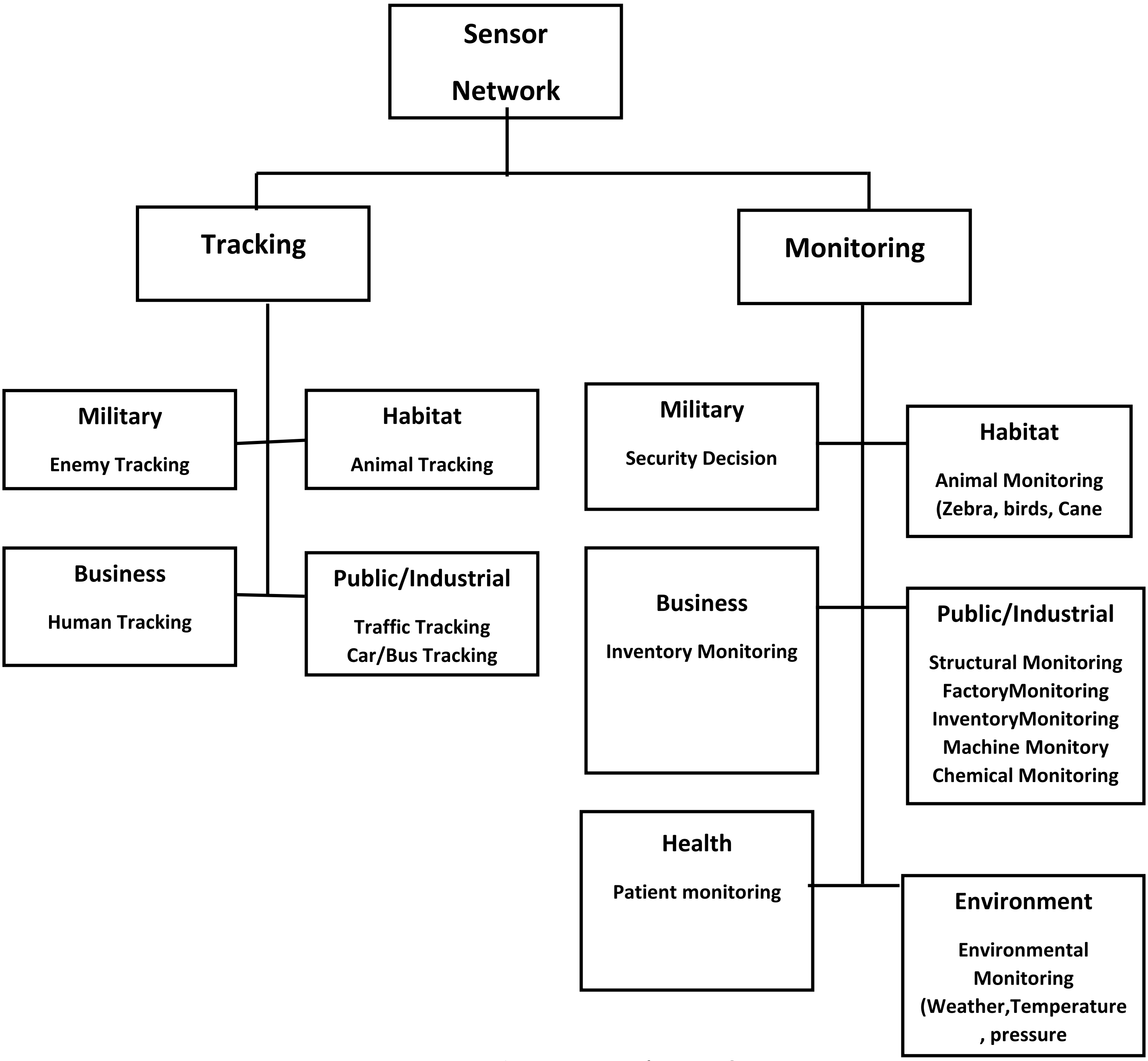

Figure 5: Overview of Sensor application

WMSNs enable several new applications, which are described as follows:

- **Multimedia Surveillance Sensor Networks:** Wireless video sensor networks are composed of interconnected battery-powered miniature video cameras, each packaged with a low-power wireless transceiver capable of processing, sending and receiving data. Video and audio sensors are used to enhance and complement existing surveillance systems against crime and terrorist attacks. Large scale networks of video sensors can extend the ability of law enforcement agencies to monitor areas, public events, private properties and borders, help to infer and record potentially relevant activities (thefts, car accidents, traffic violations) and make video/audio streams or reports available for future queries.
- **Traffic avoidance, enforcement and control systems:** It will be possible to monitor car traffic in big cities or highways and deploy services that offer traffic routing advice to avoid congestion. Multimedia sensors may also monitor the flow of vehicular traffic on highways and retrieve aggregate information such as average speed and number of cars. Sensors could also detect violations and transmit video streams to law enforcement agencies to identify the violator or buffer images and streams in case of accidents for subsequent accident scene analysis. In addition, smart parking advice systems based on WMSNs [24] will allow monitoring available parking spaces and provide drivers with automated parking advice, thus improving mobility in urban areas.

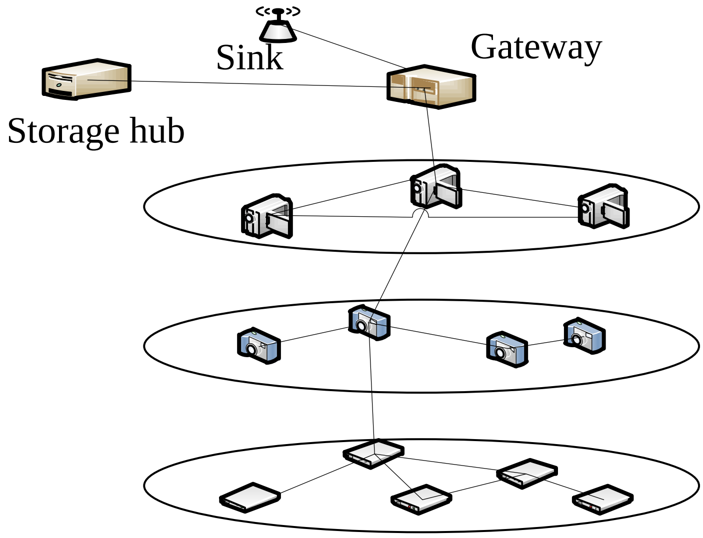

Figure 6: Multi-tier clustered architecture.

- **Advanced health care delivery:** Multimedia sensor networks can be used to monitor and study the behaviour of elderly people as a means to identify the causes of illnesses that affect them such as dementia [25]. Telemedicine sensor networks [26] can be integrated with 3G multimedia networks to provide ubiquitous health care services. Patients will carry medical sensors to monitor parameters, for example, body temperature, blood pressure, electrocardiogram and breathing activity. Furthermore, remote medical centres will perform advanced remote monitoring of their patients via video and audio sensors, location sensors, motion or activity sensors, which can also be embedded in wrist devices [26].
- **Environmental monitoring:** Several projects on habitat monitoring that use acoustic and video feeds are being envisaged, in which information has to be conveyed in a time-critical fashion. For example, arrays of video sensors are already used by oceanographers to determine the evolution of sandbars via image processing techniques [27].
- **Industrial process control:** Multimedia content, such as images, temperature or pressure, may be used for time-critical industrial process control. For example, in quality control of manufacturing processes, details or final products are automatically inspected to find defects. The integration of machine vision systems with WMSNs can simplify and add flexibility to the systems for visual inspections and automated actions that require high-speed, high-magnification and continuous operation [12].
- **Gaming:** Network gaming is emerging as a popular recreational activity. WMSNs will enhance the gaming experience by diffusion of multimedia sensors in games. As an example, virtual reality games that assimilate touch and sight inputs of the user as part of the player response [28, 29], need to return multimedia data under strict time constraints. In addition, WMSN application in gaming systems will be closely associated with sensor placement and the ease in which they can be carried on the person of the player. An interesting integration of online and physical gaming is seen in the game, Can You See Me Now (CYSMN) [30].

5. Concept of caching

Caching basically means to save frequently-used information into an easy to get area. Usually, this means storing it into memory. Caching has three main goals: reducing disk access, improving CPU utilization and speeding up the time as measured by how long it takes a user to see a result. Concept of caching has been widely discussed in almost every aspect of computer science. Caching is used in central processing unit (CPU), in file systems of operating systems, in database systems and many more.

Caching in wireless network

In the context of wireless network, a number of caching strategies have been proposed for broadcast cellular network. In [35], author presented a self-tunable cache-replacement policy that exploits available communication bandwidth and client resources by client-side data caching, which helps reduce latency and conserve network resources. SliCache cache-replacement policy slices (segments) the cache space that are used to accommodate the cache objects. An object or data that appear only at once in the whole request stream will be stored in R-segment. While the data or object that appears or requests for frequently by client will be stored in I-segment. In SliCache, different ranking functions are used to rank the objects in the slices. Objects in the I-segment are checked at least twice before purging them where as in R-segment, objects are checked only once before replacement.

Caching techniques have been broadly discussed in the field of mobile ad-hoc network (MANET) to facilitate data access. In [36, 37], author presented a cooperative caching scheme called CoCa. The CoCa framework facilitates mobile nodes to share their cached contents with each other in order to reduce the number of server requests and the number of access misses. In conventional mobile systems, the storage hierarchy consists of three layers: Mobile Client Cache, Mobile Support Station (MSS) Cache and MSS Disk. In CoCa a new logical layer is inserted between the Mobile Client Cache layer and the MSS Cache layer. This layer is called the Peer Cache layer (Figure 2.9). When an MH suffers from a cache miss (called a local cache miss), it looks up the required data item from its neighbouring peers' cache before sending the request to MSS. Only when it cannot find the data item from its peers' cache (called a global cache miss) it will request the data item from the MSS. A cache signature scheme is used in CoCa that provide hints for the mobile hosts (MH) to determine whether a required data item is cached by their neighbouring peers. Thus, the MH can make a local decision on whether to search for the required data item from its neighbouring peers or directly requesting the data item from the mobile support stations. CoCa is shown effective reduction in the number of server requests and power consumption, as well as shortening the access latency as the number of neighboring peers increases.

The author extended CoCa with a group-based cooperative caching scheme, called GroCoCa [38]. In GroCoCa, MHs that are geographically and operationally close are coupled to form a group called tightly coupled group (TCG). Two cooperative cache management protocols: cooperative cache admission control and cooperative cache replacement are proposed in GroCoCa for a MH to manage its own cache space with respect to itself and its TCG members. When a MH encounters a local cache miss, it sends a request to its peers. If some peers can serve the request and the local cache is not full, the MH caches the item. However, if the local cache is full, the MH does not cache the item when it is supplied by a peer in the same TCG. If the cache is full but the data item comes from a peer outside of its TCG, the MH will cache the data item by removing the least valuable data item. GroCoCa improves system performance at the cost of extra power consumption.

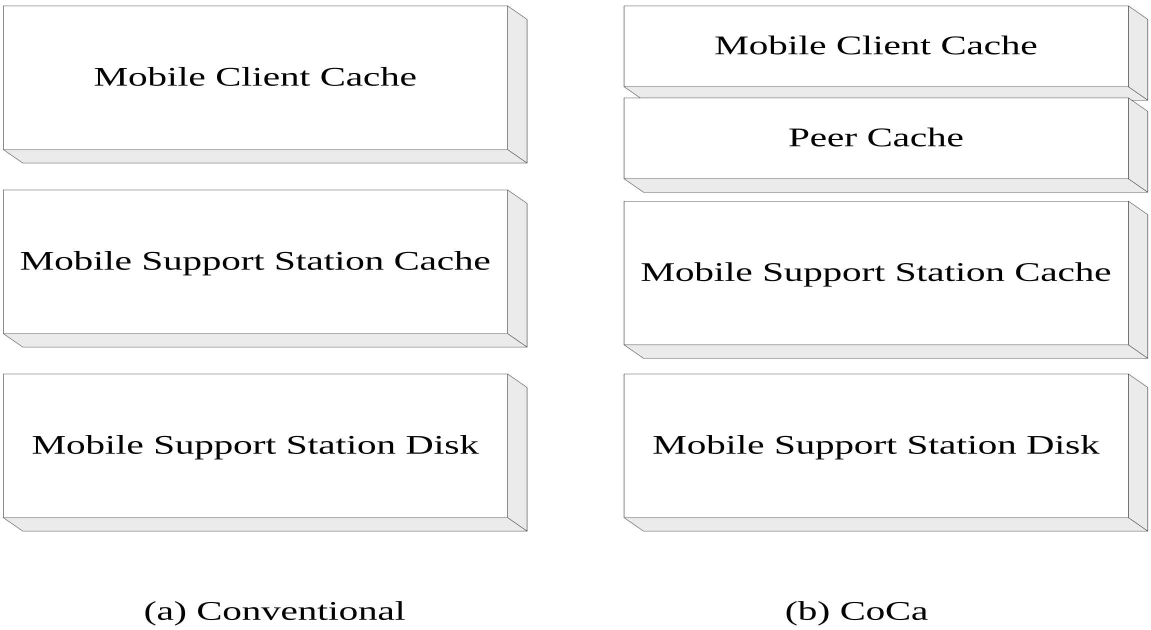

Figure 7: Storage hierarchy of mobile systems [36].

In [39], author proposed three caching mechanisms CacheData, CachePath and Hybrid Cache. These protocols tried to exploit both the data and locality in homogeneous manner. In CacheData, intermediate nodes can cache data to serve the future requests instead of fetching data from the data server. An intermediate node caches a passing by data item locally when it finds that data item is popular or the node has enough free space and does not cache the data item if all requests for it are from the same node.

This rule is proposed in order to reduce the cache space requirement because the mobile nodes have limited cache spaces. However, in CacheData if all requests for a data item is generated from a single node and the entire intermediate node caches the requested data item, it wastes a large amount of cache space.

In CachePath, a mobile node may cache the information of a path to a nearby data requester while forwarding the data and use the path information to redirect future requests to the nearby caching site. By caching the data path for each data item, bandwidth and the query delay can be reduced since the requested data can be obtained through fewer numbers of hops. CachePath performs better in some situations such as small cache size or low data update. However, the cached path may not be reliable and using it may increase the overhead.

HybridCache protocol combines the CacheData and CachePath protocol while removing their weaknesses.

In HybridCache, when a mobile node forwards a data item, it caches the data or the path based on some criteria. These criteria include the data item size, the time-to-leave of the data item and the number of hops that a cached path can save (H_{save}). If size of the data is small, CacheData should be adopted because the data item only needs a very small part of the cache otherwise, CachePath should be adopted to save cache space. If time-to-live value is small, CachePath is not a good choice because the data item may be invalid soon. Thus, CacheData should be used in this situation. If the value of Hsave is large, CachePath is a good choice because it can save a large number of hops.

In [40], author presented a caching mechanism based on zoning of the mobile nodes. These zones are formed on the basis of geographical proximity of the nodes. In Zone cooperative (ZC), nodes belonging to the vicinity of the given node form a co-operative cache system for this node since the cost for communication within the zone is low both in terms of energy consumption and message exchanges. Each node maintains a cache to store the frequently accessed data items. These data items in the cache satisfy not only the node's own requests, but also the data requests passing through it from other nodes. When a MH requests a data item it searches its local cache first. In case of local cache miss, MH searches if data item is cached by any other MH in home zone. If any MH within home zone cached the requested data it will forward the data to the requester node otherwise in the case of zone cache miss, the request is forwarded to the neighbour along the routing path. If the data item is not found on the zones along the routing path (i.e., a remote cache miss), the request finally reaches the data source and the data source sends back the requested data. As a part of cache management, a value-based replacement policy based on popularity, distance, size and time-to-live was developed to improve the data accessibility and reduce the local cache miss ratio. However, every node that lies on the path towards the data centre has to broadcast the packet to nodes in its zone in order to discover if there is a cached copy that satisfies the requested data item. This increases the communication overhead and energy consumption.

In Cluster cooperative (CC), author presented a scheme for caching in MANETs [41]. The goal of CC is to reduce the cache discovery overhead and provide better cooperative caching performance. In CC scheme, the network topology is partitioned into non-overlapping clusters based on the physical network proximity. .In each cluster, CC dynamically chooses a super node as cache state node (CSN), to maintain the cluster cache state (CCS) information of different nodes within its cluster domain. The cache state node is defined as the first node that enters the cluster. When a client requests for a data item, it searches its local cache first. In the case of local cache miss, client sends a request to CSN to check whether the requested data item is cached by any cluster member or not. In cache of cluster cache miss, the request is forwarded to the next client node along the path. Upon receiving the request, each client along the path searches the data in its local cache as well as cluster cache. If the data item is not found on the clusters along the routing path, the request finally reaches the data source and the data source sends back the requested data. In CC, authors propose a utility based cooperative replacement strategy called least utility value with migration (LUV-Mi) to optimize the local and cluster caching performance. CC also uses a simple weak consistency model based on the TTL, in which a client considers a cached copy up-to-date if its TTL has not expired. The client removes the cached data when the TTL expires. A client refreshes a cached data item and its TTL if a fresh copy of the same data passes by. The CC protocol reveals a smaller overhead in terms of messages exchange between nodes. CC mechanism also improves cache hit ratio and average query latency.

A lot of research has been done for cooperative caching in WSN. However, protocol developed for MANETs are very relevant to the sensor network but are not suitable for sensor networks. Many cooperative caching schemes have been proposed for sensor network. Sharma *et al* proposed a cooperative caching scheme for sensor network based on the dual radio data dissemination (DRDD) [42]. This caching scheme exploits cooperation among various sensor nodes in a zone formed around few sensor nodes. Instead of using clustering mechanism to define zone, dual radio mode of sensor nodes i.e. high and low power transmission ranges is used to define zone size. Authors propose a unique token based policy for cache admission. Each sink has its own cache token. When a node or sink holds the cache token, it caches any data item passing through it in response to a query from that particular sink only. A value based policy is proposed for cache replacement which is based on the access probability and time-to-live values. A data item having least value based on access probability and time-to-live values will be replaced first.

Dimokas*et al* [43] proposed a cooperative caching mechanism for sensor network. This protocol is based upon the selection of the sensor nodes which will take special roles in running the caching and request forwarding mechanism. The authors proposed two methods for the selection of these special sensor nodes namely: Power community index (PCI) and scaled power community index (scaPCI). This mechanism calculates the value of PCI and scaPCI for each node based on the two-hop neighbourhood of that node. After calculating these values, the node characterizes some of its neighbouring node as Community Caching Nodes (CCNs). When a node requests for a data item, it searches its local cache first. In the case of local cache miss, request is forwarded to the CCNs. If requested data item is not cached by any two-hop neighbours of the requesting node, then request is forwarded to the data centre. Each node that lies along the path of the request towards data centre, upon receiving the request searches its local cache. If no node which lies along the path towards data centre satisfies the request, the request will be served by data centre. Authors propose a function-based replacement policy where data item which incurs maximum cost will be deleted first.

In [44], author proposed a novel architecture, called Proximity Regions for Caching in Cooperative MP2P Networks (PReCinCt) caching scheme that caches relevant data among a set of peers in a region. The authors define a new cache replacement policy by considering not only each peer's own access frequency but also the importance of data items to other peers in the same region. The proposed caching strategy, Gready-Dual Least Distance (GD-LD), uses a utility function to evaluate the importance of each data item based on a combination of three factors: the popularity of the item in the region, size of the item and the region distance between the requesting and responding peers. PReCinCt efficiently supports scalable data retrieval in large-scale mobile peer-to-peer system networks. PReCinCt mechanism improves the cost of consistency maintenance in terms of latency and energy consumption. PreCinCt also includes an effective cache consistency scheme called push with adaptive pull that incurs less control message overheads. However PReCinCt shows poor robustness under different mobility models and node disconnection rates and PreCinCt protocol is not adaptive to real network environments.

However, less research work has been done in the field of cooperative caching in multimedia sensor network. NICoCa is proposed in [45] which consider the importance of every node based on the shortest path based on node importance index. NICoCa protocol exploits sensor nodes which reside in positions of the network that allow them to forward packets or communicate decisions within short latency. These sensor nodes are called mediator nodes. These mediator nodes are created dynamically to avoid the creation of hot spot in the communication and depletion of the energy. In NICoCa protocol, when a node request for a data item it searches its local cache first. In case of local cache miss, request is broadcasted with in one-hop region and received by mediator nodes. These mediator nodes search the requested data in their respective one-hop region and if data is not present at any of theirs one-hop neighbours, then the request will be forwarded to the data centre. Any node which lies along the path of the request towards the data centre, searches its local cache. If data is not cached at this node, then the request is forwarded to the data centre and finally served by data centre. However, NICoCa protocol has poor robustness, since the removal of a single node might change the values of importance of many other neighbouring nodes and consequently the performance of the protocol.

6. Conclusions

Wireless multimedia sensor networks provide an exciting area of research at the intersection of a number of disciplines and technologies. In this scheme, a cooperative caching mechanism is proposed for increasing the probability of data availability among the neighbors while reducing the caching overhead and average delay to serve the request. The proposed scheme selects some of the neighbouring nodes of a node as head nodes based on the traffic flow and contention value. These nodes are used to communicate with other nodes outside the regions. An approach has also been proposed for the discovery of requested data item. This scheme will help to search the requested data item effectively. A scheme is also proposed for removing a data item from the cache space when there is no space available for caching another data item.

This research work can be extended in the following directions:

- In the proposed work, traffic flow and contention value is calculated for each node. Whenever a node leaves the network or a new node is introduced in the network, both the traffic flow and the contention value changes which are needed to be calculated again. In a dynamic environment, where topology changes rapidly, calculation of traffic flow and contention value will significantly increase the message overhead which will degrade the performance of proposed scheme. Therefore, in future work can be done to reduce the overhead of calculating the traffic flow and contention value can be minimized without affecting the performance of the system.
- In system model, one can assume that data is not updated periodically which is not possible in real life environment. In future updating of data values can be considered to improve the functionality of the proposed scheme.
- One can assume that when a packet is arrived at any node, transmission channel is idle, which is not a regular scenario in real time applications. In real time applications many nodes transfer the data simultaneously on the channel. In future the analysis of the performance of the proposed protocol can be considered in which nodes are using channel together.

References

[1] I. Akyildiz, W. Su, Y. Sankarasubramaniam, E. Cayirci, "A survey of wireless sensor networks," IEEE Communication Magazine, Vol. 20, No. 7, pp. 921-960, 2002.

[2] R. Min, M. Bhardwaj, S.H. Cho, E. Shih, A. Sinha, A. Wang, A. Chandrakasan, E.S.A. Sinha, "Low-power wireless sensor networks," 14th International Conference on VLSI Design (VLSI Design 2001), pp. 205-210, 2001.

[3] J.N. Al-karaki, A.E. Kamal, "Routing techniques in wireless sensor networks: a survey," IEEE Wireless Communication, pp. 6-28, 2004.

[4] K. Akkaya, M. Younis, "A survey on routing protocols for wireless sensor networks" Ad Hoc Network, pp. 325-349, 2005.

[5] W. Su, C. S. Raghavendra, K. Sivalingam, T. Znati, ''Communication protocols for sensor networks,'' In Wireless Sensor Networks, New York, 2004.

[6] C.Y. Chong, S. P. Kumar, ''Sensor networks: evolution, opportunities, and challenges,'' In Proceedings of the IEEE, Vol. 91, No. 8, pp. 1247-1256, 2003.

[7] W. M. Merrill, K. Sohrabi, L. Girod, J. Elson, F. Newberg, and W. Kaiser, "Open standard development platforms for distributed sensor networks," In Proceeding of SPIE, Unattended Ground Sensor Technologies and Applications IV, Vol. 4743, pp. 327-337, April 2002.

[8] J. Hill, R. Szewcyk, A. Woo, D. Culler, S. Hollar, and K. Pister, "System architecture directions for networked sensors," 8th International Conference on Architectural Support for Programming Languages and Operating Systems, Cambridge, MA, pp. 93-104, 2000.

[9] E. Gurses, O. B. Akan, "Multimedia communication in wireless sensor networks," Annual Telecommunication, Vol. 60, No. 7, pp. 799-827, 2005.

[10] S. Misra, M. Reisslein, G. Xue, "A survey of multimedia streaming in wireless sensor networks," IEEE Communication Surveys and tutorials, Vol. 10, No. 4, pp. 18-39, 2008.

[11] I. F. Akyildiz, T. Melodia, K. R. Chowdhury, "A survey on wireless multimedia sensor networks," Computer Network (Elsevier), Vol. 51, No. 4, pp. 921-960, 2007.

[12] I. F. Akyildiz, T. Melodia, K. R. Chowdhury, "Wireless Multimedia Sensor networks: Applications and testbeds," In Proceedings of the IEEE, Vol. 96, No. 10, pp. 1588-1605, October 2008.

[13] B. Girod , A. Aaron , S. Rane , D. Rebollo-Monedero , "Distributed video coding ," In Proceedings of the IEEE , Vol. 93 , No. 1, pp. 71-83, Jan. 2005.

[14] R.N. Sexena, A. Roy, J. Shin, "Cross-layer algorithms for QoS enhancement in wireless multimedia sensor networks," In IEICE Transaction on Communication, Vol. 91-B, No. 1, pp. 2716-2719, 2008.

DOI: 10.18535/ijecs/v5i6.47

[15] I. F. Akyildiz, I. H. Kasimoglu, “Wireless sensor and actor networks: research challenges,” Ad Hoc Networks (Elsevier), Vol. 2, No. 4, pp. 351-367, 2004.

[16] N. J. McCurdy, W. Griswold, “A system architecture for ubiquitous video,” 3rd Annual International Conference on Mobile Systems, Applications, and Services (Mobisys'05), 2005.

[17] S. Hengstler, H. Aghajan, “Application-oriented design of smart camera networks,” 1st ACM/IEEE International Conference on Distributed Smart Cameras (ICDSC '07), 2007.

[18] A. Barton-Sweeney, D. Lymberopoulos, A. Savvides, “Sensor localization and camera calibration in distributed camera sensor networks,” 3rd InternationalConference on Broadband Communications, Networks and Systems(BROADNETS'06), 2006.

[19] I.T. Almalkawi, M. Guerrero Zapata, J.N. Al-Karaki, J. Morillo-Pozo, “Wireless multimedia sensor networks: current trends and future directions,” Sensors 2010, pp. 6662-6717, 2010.

[20] S. Soro, W. B. Heinzelman, “On the coverage problem in video-based wireless sensor networks,” 2nd International Conference on Broadband Networks (BROADNETS '05), 2005.

[21] C. Margi, V. Petkov, K. Obraczka, R. Manduchi, “Energy consumption in a visual sensor network testbed,” 2nd International Conference on Testbeds and Research Infrastructures for the Development of Networks and communities, TRIDENTCOM, 2006.

[22] M. Rahimi, R. Baer, O.I. Iroezi, J.C. Garcia, J. Warrior, D. Estrin, M. Srivastava, “Cyclops: image sensing and interpretation in wireless sensor networks,” 3rd international conference on Embedded networked sensor systems, San Diego, CA, USA, pp. 192-204, 2005.

[23] N. Tezcan, W. Wang, “Self-orienting wireless multimedia sensor networks for maximizing multimedia coverage,” In Proceedings of IEEE International Conference on Communications, Beijing, China, pp. 2206-2210, 2008.

[24] J. Campbell, P. B. Gibbons, S. Nath, P. Pillai, S. Seshan, and R. Sukthankar, “IrisNet: An internet-scale architecture for multimedia sensors,” In Proceedings of ACM Multimedia Conference,2005.

[25] A. A. Reeves, “Remote monitoring of patients suffering from early symptoms of dementia,” International Workshop on Wearable Implantable Body Sensor Network, London, U.K., 2005.

[26] F. Hu and S. Kumar, “QoS considerations for wireless sensor networks in telemedicine,” International Conference on Internet Multimedia Management Systems, Orlando, Florida, pp. 323-334, 2003.

[27] R. Holman, J. Stanley, T. Ozkan-Haller, “Applying video sensor networks to near shore environment monitoring,” Pervasive Computing, Vol. 2, pp. 14-21, 2003.

[29] M. Capra, M. Radenkovic, S. Benford, L. Oppermann, A. Drozd, and M. Flintham, “The multimedia challenges raised by pervasive games,” ACM International Conference on Multimedia, Hilton, Singapore, pp. 89-95, 2005.

[30] S. Benford, R. Anastasi, M. Flintham, C. Greenhalgh, N. Tandavanitj, M. Adams, J. Row-Farr, “Coping with uncertainty in a location-based game,” Pervasive Computing, Vol. 2, No. 3, pp. 34-41, 2003.

[31] L. Fan, P. Cao, AZ Almeida, JM Broder, “Summary cache: a scalable wide-area web cache sharing protocol,” IEEE/ACM Transaction on Network, Vol. 8, No. 3, pp. 281-293, 2003.

[32] D. Katsaros, Y. Manolopoulos, “Caching in web memory hierarchies,” ACM symposium on applied computing, Cyprus, pp. 1109-1113, 2004.

[33] D. Wessels, K. Claffy, “ICP and the Squid Web cache,” IEEE Journal on Selected on Areas in Communication, Vol. 16, No. 3, pp. 345-357, 1998.

[34] H. Che, Y. Tung, Z. Wang, “Hierarchical web caching systems: modeling, design and experimental results,” IEEE Journal on Selected Areas in Communication, Vol. 20, No. 7, pp. 1305-1314, 2004.

[35] D. Katsaros, Y. Manolopoulos, “Web caching in broadcast mobile wireless environments,” IEEE Internet Computing, Vol. 8, No. 3, pp. 37-45, 2004.

[36] CY. Chow, HV. Leong, ATS. Chan, “Cache signatures for peer-to-peer cooperative caching in mobile environments,” IEEE international conference on advanced information networking and applications (AINA), Vol. 1, IEEE, Piscataway, pp. 96-101, 2004.

[37] CY. Chow, HV. Leong, ATS. Chan, “Peer-to-peer cooperative caching in mobile environments,” IEEE international conference on distributed computing systems workshops (ICDCSW), IEEE, Piscataway, pp. 528-533.

[38] CY. Chow, HV. Leong, ATS. Chan, “GroCoca: group based peer-to-peer cooperative caching in mobile environment,” IEEE Journal on Selected Areas in Communication, Vol. 25, No. 1, pp. 179-191, 2007.

[39] L. Yin, G. Cao, “Supporting cooperative caching in adhoc networks,” IEEE Transaction on Mobile Computing, Vol. 5, No. 1, pp. 77-89, 2006.

[40] N. Chand, RC. Joshi, M. Misra, “A zone co-operation approach for efficient caching in mobile ad hoc networks,” International Journal on Communication Systems, Vol.19, No. 9, pp. 1009-1028, 2006.

[41] N. Chand, RC. Joshi, M. Misra, “Cooperative caching strategy in mobile ad hoc networks based on clusters,” Wireless Personal Communication, Vol. 43, No. 1, pp. 41-63, 2007.

[42] T. P. Sharma, RC. Joshi, M. Misra, “Dual radio based cooperative caching for wireless sensor networks,” IEEE International Conference, 2008.

[43] D. Nikos, K. Dimitrios, M. Yannis, “High performance, low complexity cooperative caching for wireless sensor network,” Wireless Network,

Vol. 17, pp. 717-737, 2011.

[44] H. Shen, M. S. Joseph, M. Kumar, S. K. Das, “PReCinCt: A scheme for cooperative caching in mobile peer-to-peer systems,” International parallel and distributed processing symposium (IPDPS), 2005.

[45] D. Nikos, K. Dimitrios, M. Yannis, “Cooperative caching in wireless multimedia sensor networks,” Third International Mobile Multimedia Communication Conference (Mobimedia’07), August 2007

[46] Y. Yang, R. Kravets, “Achieving delay guarantees in ad hoc networks through dynamic contention window adaptation,” IEEE INFOCOM, 2006.

[47] C. Perkins, E. Royer, “Ad hoc on-demand distance vector routing,” IEEE workshop on mobile computing systems and applications, IEEE, Piscataway, pp. 90-100, 1999.