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WIRELESS MULTICASTING OPERATION WITH COGNITIVE NETWORKS SYSTEM

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ABSTRACT

Multicasting is a more resourceful technique of maintain grouping communication than uni-casting or broad-casting, that allows transmission and routing of packets to multiple destinations using cognitive network resources. The multicast networking structure involves the communication network from one source to many destinations. The wireless network is made up of a collection of network elements with varying energy capacity.

Key Words: Wireless, Multicast, Network, Frame, Protocol.

1. INTRODUCTION:

Wireless communication is the transfer of information between two or more destination places that are not associated with an electrical conductor. The information is delivered to each of the links only once, and copies are created when the links to the destinations split, thus creating an optimal distribution path. Multicasting reduces unnecessary packet duplication. A wireless network utilizes radio communication, unlike wired networks which employ electrical conductors [1]. Wireless multicasting can therefore be loosely defined as the process of multicasting over wireless networks. The cognitive network consists of radios with fully directional antennas in receive mode1 each element transmits omni-directionally and receives directionally with a fixed beam width θ", that can take on a bore sight angle ***Ø 2 (0, 2π).*** The cognitive network framework encompasses a wide spectrum of possible implementations and solutions. The cognitive process consists of three cognitive elements that distribute the operation of the cognitive process both functionally and spatially.

2. Cognitive Networking System:

The multicast networking system involves the communication network from one source to many destinations. Many factors may affect a wireless multicast flow's lifetime. For instance, traffic congestion can cause timeouts in upper layer protocols, interference can cause loss of connectivity at the physical layer, and mobility can cause unexpected disconnections in traffic routing. However, for mobile and portable devices, one of the chief factors in the lifetime of a flow is the utilization of the energy contained in the batteries of the mobile radios. Particularly for multi-hop wireless flows, the lifetime is limited by the radios whose battery fails first. This is the radio whose lifetime our cognitive network attempts to maximize [2].

The wireless network is made up of a collection of network elements with varying energy capacity. Some elements may be battery powered, with limited capacity, while others may be less mobile, with large and high capacity batteries. The lifetime of a data path, however, is limited by the radio utilizing the largest fraction of its battery capacity. By minimizing the utilization of this bottleneck radio, the lifetime of the path can be maximized. Furthermore, consider a network where radios are equipped with directional antennas, which are useful to reduce interference, improve spatial multiplexing, and increase range.

We model a network consisting of a set of radios N = {1, 2, . . . , n}, in which the objective is to create a maximum lifetime multicast tree between source s and destination set D. As described earlier, the cognitive network controls three modifiable network parameters: the radio transmission power contained in the elements of vector ***"pt"***, the antenna directionality angles are contained in the elements of vector ***"Ø"*** and element routing tables (contained in each node of the multicast tree ***"T"***. The states of the modifiable elements are part of the action set ***"A"***, of which the action vector a contains the current state of each modifiable element [3]. In the model used here, the lifetime of a radio is inversely proportional to the utilization of the radio's battery, that is define in the equation.......... ***"I"***.

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$$\mu_i = \frac{pt_i}{ca_i}$$

......................*I*

Where "pt_i" is radio "*i's*" transmission power and "ca_i" is the remaining energy capacity of its battery. The lifetime of a data path is limited by the radio utilizing the largest fraction of its battery capacity, so over the entire multicast tree "*T*", the lifetime will be inversely proportional to the utilization of the max-utilization radio, that is define in the equation.......... *"II"*.

$$\mu_T = \max_{j \in T} \{\mu_j\}$$

......................*II*

3. Multicasting Operation with Directional Mode:

The network consists of radios with fully direc antennas in receive mode1 each element transm directionally and receives directionally with a fixed width "θ", that can take on a bore sight angle Ø 2 The operation of an ad-hoc network with dire antennas system in receive mode shown in figure 1 *is* Omni-directional receive operation Directional receive operation *and "C"* is Multi cast The shaded areas extending from the radios rep regions of increased gain [4].

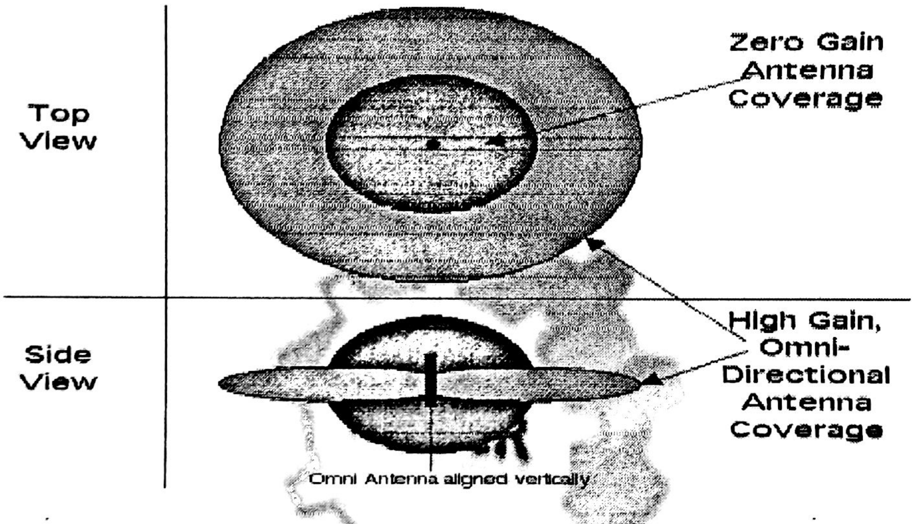


Figure 1.1 (A): Omni-directional receives operation

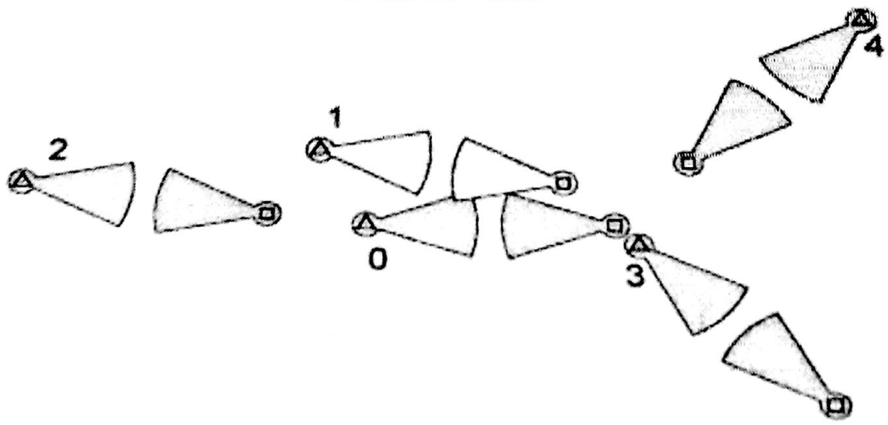
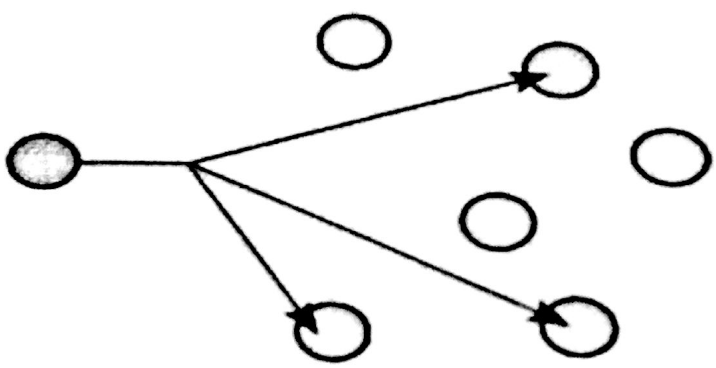


Figure 1.1 (B): Directional receives operation



When radio *"i"* transmits, the signal experiences gain factor *"gb"* within the main beam of the antenna system that is define with equation *"III"*.

$$gb = \frac{2\pi}{\theta} \qquad \text{.......................III}$$

Some energy leaks outside the main beam in side lobes. The fraction that ends up in the beam is pct ε (0, 1) and the fraction outside the beam is (1 – pct). We also consider a path loss attenuation factor, proportional to equation *"IV"*.

$$gp_{ij} = \frac{1}{d(i,j)^{\alpha}} \qquad \text{................IV}$$

where *d(i, j)* is the Euclidean distance between source *"i"* ...estination" j" and *"α"* is the path loss exponent. ...mbining these gains and attenuations, the overall gain ...m a transmission by radio *"i"* received at radio *"j"* is ...wn with equation *"V"*.

$$g_{ij}(\phi_j) = \begin{cases} gb \cdot gp_{ij} \cdot pct & \phi_j \in a(i,j) \pm \frac{\theta}{2} \\ gp_{ij} \cdot (1 - pct) & \end{cases} \qquad \text{.........V}$$

Where a *(i, j)* is the angular function between radios *"i"* and *"j"*.

4. Cognitive Network Frame Structure:

The cognitive network framework encompasses a wide spectrum of possible implementations and solutions. This approach allows the framework to be a method for approaching problems in complex networks, rather than a specific solution [5]. The framework sits on top of existing network layers, processes, and protocols, adjusting elements of the software adaptable network to achieve an end-to-end goal. In this, how a cognitive network that solves the multicast lifetime problem fits into the framework. We examine each layer, showing how the requirements layer provides goals to the cognitive elements, how the cognitive process performs the feedback loop, and identify the functionality of the software adaptable network and its idea define in the *figure 1.2.*

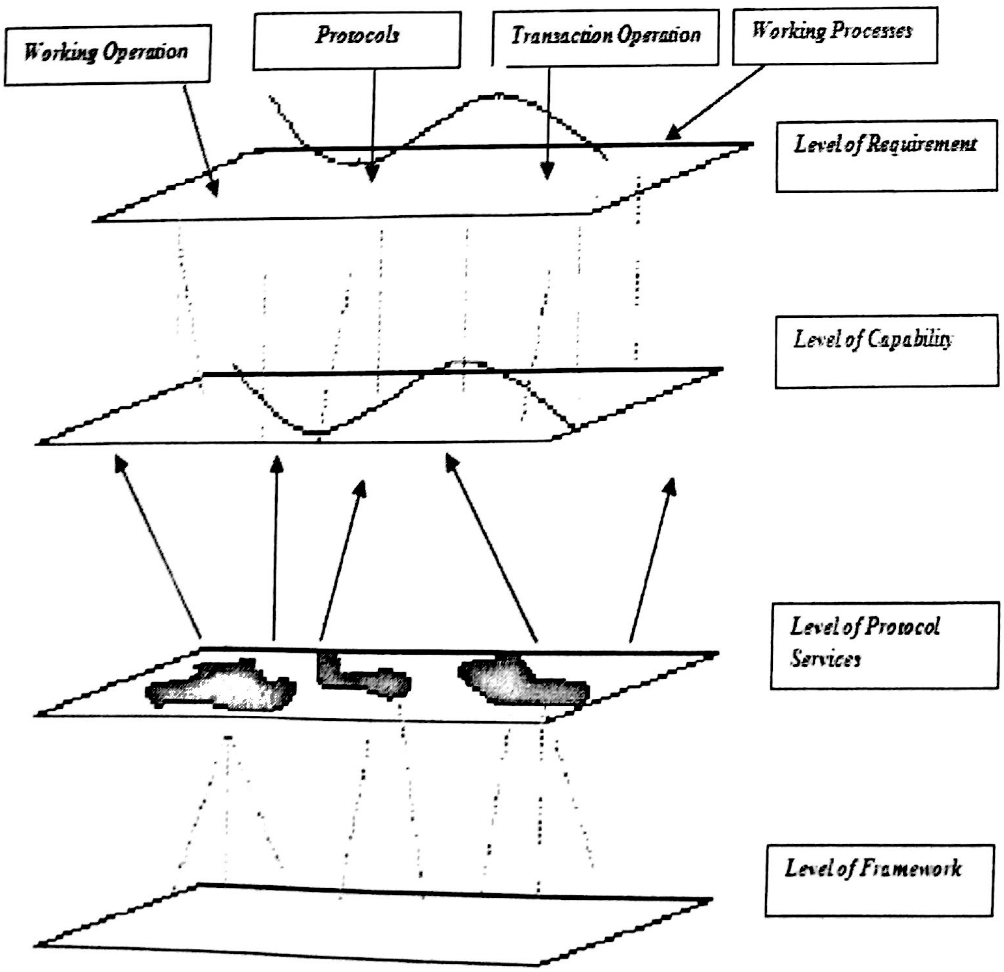


Figure 1.2: Cognitive Network Frame Structure

5. Cognitive Network Process:

The cognitive process consists of three cognitive elements that distribute the operation of the cognitive process both functionally and spatially: power control, direction control and routing control. Power control adjusts the physical transmission power **(pt_i)**, direction control adjusts the medium access control spatial operation **($Ø_i$)**, and routing control adjusts the network layer's routing functionality ***(T)***.

The software adaptive network status sensors provide each cognitive element with partial-knowledge of the network. Battery utilization and routing tables are only reported within a radio's k-hop neighborhood [6]. The k-hop neighborhood of a radio is defined to be every radio reachable in the routing tree via k hops, following the routing tree both up and down branches that is shown in the ***figure 1.3***.

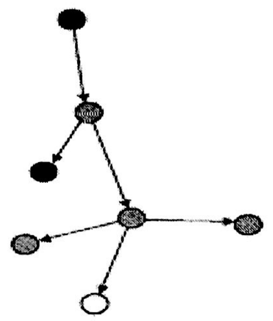


Figure 1.3: Routing tree both up and down branches

The set of k-hop neighbors for radio i is represented by N^{K}_{i}. The software adaptive network also provides information about the required power needed to meet the signal to interference and noise ratio requirement of each of the next hop child radios in the multicast route. The set of child radios for radio are represented by C_i.

6. Cognitive Network Process Elements:

The cognitive process consist by the three cognitive elements such as power control, direction control, routing control described above, and each operating on every radio in the network [7]. In this, the strategies utilized by these elements to achieve the above objectives goals and identify the critical design decisions used by each cognitive element.

A. Power Control:

Power Control's purpose is to minimize the transmission power on every radio subject to the system constraint. This means that a radio will attempt to transmit at the minimum power that connects it to all of its children through the local control of **"pt_i"**. The objective can be represented by the utility function, define by equation ***"VI"***.

$$u_i^{\mathrm{PC}}(\mathbf{a}) = -\left(\max_{k\in C_i}\left\{\frac{no_k}{g_{ik}}\right\} - pt_i\right)^2$$

Which is maximized when the transmitting radio exactly the power needed to reach the child radio the greatest noise and least gain factor? ***"C_i"*** is the set of child radios that receive from radio ***"i"*** in the multicast tree.

B. Direction Control:

Direction control purpose is to maximize the receiving radio's SINR by controlling the directional angle of antenna beam ***"$Ø_i$" locally*** at every antenna. One that the utility can take is in following equation ***"VII"***.

$$u_i^{\mathrm{DC}}(\mathbf{a}) = pr_i - no_i$$

....................VII

By rotating the directional antenna, the radio increase the gain from the parent radio, attenuating interfering signals.

C. Routing Control:

The purpose of routing control is to minimize each radio battery utilization by manipulating the routing tree used by the network. The utility can be expressed equation ***"VII"***.

$$u_i^{\mathrm{RC}}(\mathbf{a}) = \frac{1}{\mu_i}$$

.........................VII

By manipulating the children radios that it has to transmit to, radios can reduce their transmission power battery utilization.

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3. WATERMARK EMBEDDING AND EXTRACTING PROCESS

In Embedding process insert or embed the watermark information within the original image by modifying all or selected pixel values (spatial domain); or coefficients (frequency domain), in such a way that the watermark is undetectable to human eye and is achieved by minimizing the embedding distortion to the host image [8].

The system block diagram for the embedding process is shown in Figure 3.

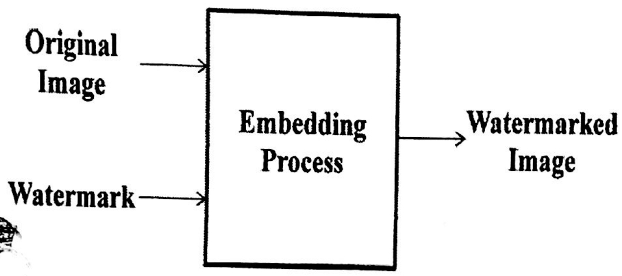

Figure 3: Watermark Embidding Process

The watermark extraction follows a reverse embedding lgorithm, but with a similar input parameter set [9]. In this aper we used the DCT domain for Watermark embedding and tracting process on permuted image.

WATERMARK EMBEDDING LGORITHM

ie algorithm which is used to embed a watermark on an image given below. We take input as Original Image and Watermark ata and produce output as Watermarked Image.

tep1: Start
tep2: Read input gray scale Image in 256 × 256 standard and Vatermark Data.
Step3: If the Watermark is small then it is padded with ones 1's) so the small watermark image scale up to the max message gth for original image.
4: Permuted the original image using pseudo random se ence.
Step5: Perform DCT on Each 8*8 block of image and Embed the watermarking information into the (3,3) and (4,4) pixel of the 8x8 DCT coefficient block by classical coefficient exchange scheme. DCT of each block is calculated.
Step6: DCT co-efficient at the position say (3,3) and (4,4) are compared for every block. The DCT block will encode a "0" if pixel at position (3,3) is greater than or equal to the pixel at the position (4,4) otherwise it will encode a "1". The coefficients are then swapped if the relative size of each coefficient does not agree with the bit that is to be encoded.
Step7: Re-permuted the image.
Step8: Stop.

The insertion of the watermark in the mid band of the coefficient block of each averaged DCT block gives extra robustness to the watermark.

5. WATERMARK EXTRACTING ALGORITHM

For check the original image is watermarked or not, after embedding the watermark into original image we apply the watermark extracting algorithm. The algorithm which is used to extract a watermark is given below.

Step1: Start
Step2: Permuted the Watermarked Image pseudo random sequence.
Step3: Subdivide the Watermarked image into 8x8 sub-Images using DCT domain.
Step4: DCT co-efficient at the position say (3,3) and (4,4) are compared for every block. If pixel at position (3,3) is greater than or equal to the pixel at the position (4,4) then Watermark bit hidden would be black or DCT block will encode a "0" else white or DCT block will encode a "1".
Step5: Stop.

6. SIMULATION RESULTS AND THEIR ANALYSIS

Two metrics for quality of watermarked images have been used which are Peak Signal to Noise Ratio (PSNR) and Similarity Factor(SM).

In order to test the performance of this watermarking scheme, we have used 256×256 gray scale images which are Lighthouse, Girl and Pepper. The original watermark is shown in figure 4. The watermarked images and the extracted watermark are shown in figure 5-7.

For image with 255 gray levels, the PSNR is defined as:

$$PSNR = 10\log_{10}\left(\frac{(255)^2}{MSE}\right)db$$

Where MSE is the mean square error of two images of N x N pixels is defined as

$$MSE = \frac{1}{N^2}\sum_{i=1}^{N}\sum_{j=1}^{N}\left(p_{ij} - p'_{ij}\right)^2$$

Where P_{ij} is the original pixel value and p'_{ij} is the reconstructed pixel value.

The similarity factor has value [0,1] calculated using following equation . If SM = 1 then the embedded watermark and the extracted watermark are same. Generally value of SM>.75 is accepted as reasonable watermark extraction.

$$SM = \frac{\sum_{i=1}^{M}\sum_{j=1}^{N} W_M(i,j)W_M^*(i,j)}{\sqrt{\sum_{i=1}^{M}\sum_{j=1}^{N} W_M(i,j)^2 \times \sum_{i=1}^{M}\sum_{j=1}^{N} W_M^*(i,j)^2}}$$

Where W_M is Original Watermark and W_M^* is detected watermark.

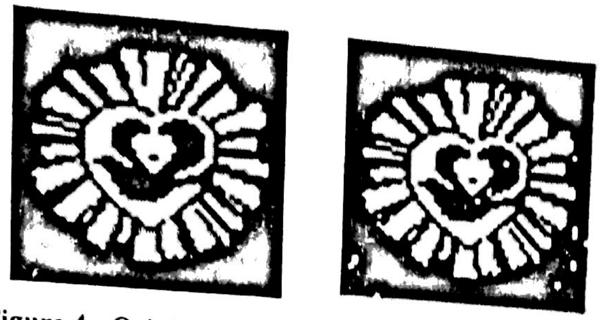

Figure 4: Original Watermark and extract watermark

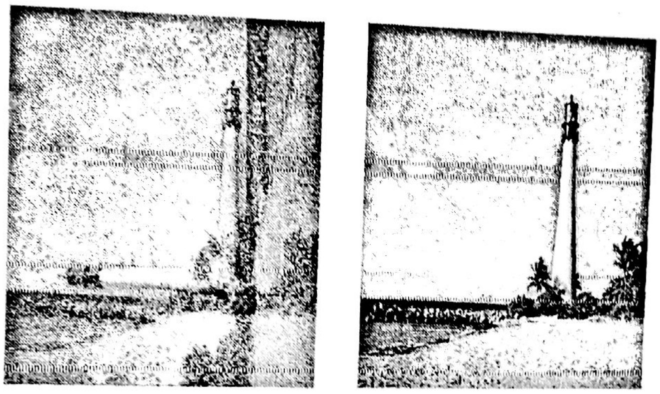

Figure 5: Permuted Lighthouse image and Watermarked Lighthouse image

Figure 6: Permuted Girl image and Watermarked Girl image

Figure 7: Permuted Pepper image and Watermarked Pepper image

The following Table 2 shows the PSNR of the different watermarked images and the Similarity factor (SM) of their extract watermarks.

Table 2: PSNR and SM values for different images

Image	Degree of Permutation	PSNR(db)	SM(db)
Lighthouse	100	40.36	0.89
	200	39.93	0.90
	400	36.13	0.97
Girl	100	43.94	0.99
	200	43.22	0.99
	400	40.10	1.00
Pepper	100	44.87	0.99
	200	40.79	0.99
	400	34.62	1.00

When PSNR is higher than 30, Watermarked image has a very good quality and the eye could hardly tell the difference between the original and the Watermarked image. While when SM is higher than 0.75, the extracted Watermarked is considered as valid one. From the above Table we can safely say that the watermarking schema discuss in this paper has a good invisibility and can extract the marks correct. Figure 8 show the graph between SM and different degree of permutation.

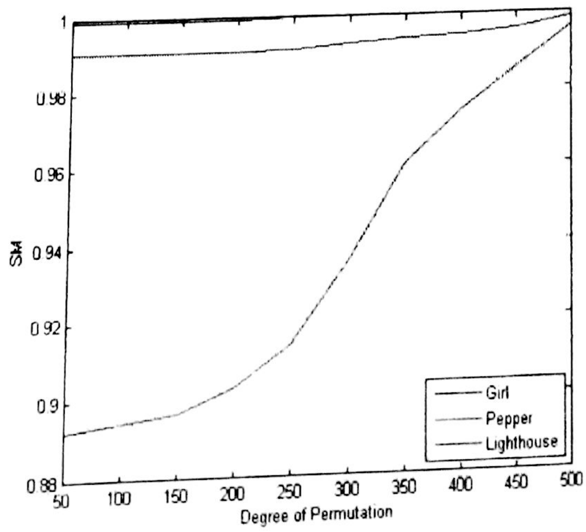

Figure 8: SM values of different watermarked images are increases using permutation

7. CONCLUSION

Digital Watermarking is the process of inserting watermark data into original images in a way that the degradation of quality is minimized and remain in an invisible level. Many digital watermarking algorithms have been proposed in special and transform domains. The techniques in the spatial domain still have relative low-bit capacity. On the other hand, frequency domain-based techniques can embed more bits for watermark and are more robust to attack. In this paper, we use DCT transform watermark algorithms based on robustness. We use the permutation method for more secure watermarking algorithm. The robustness of the watermarking methods has been measured by computing the Peak Signal to Noise Ratio (PSNR) of the Watermarked Image and Similarity between original Watermark and extract Watermark using Similarity Factor (SM).

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