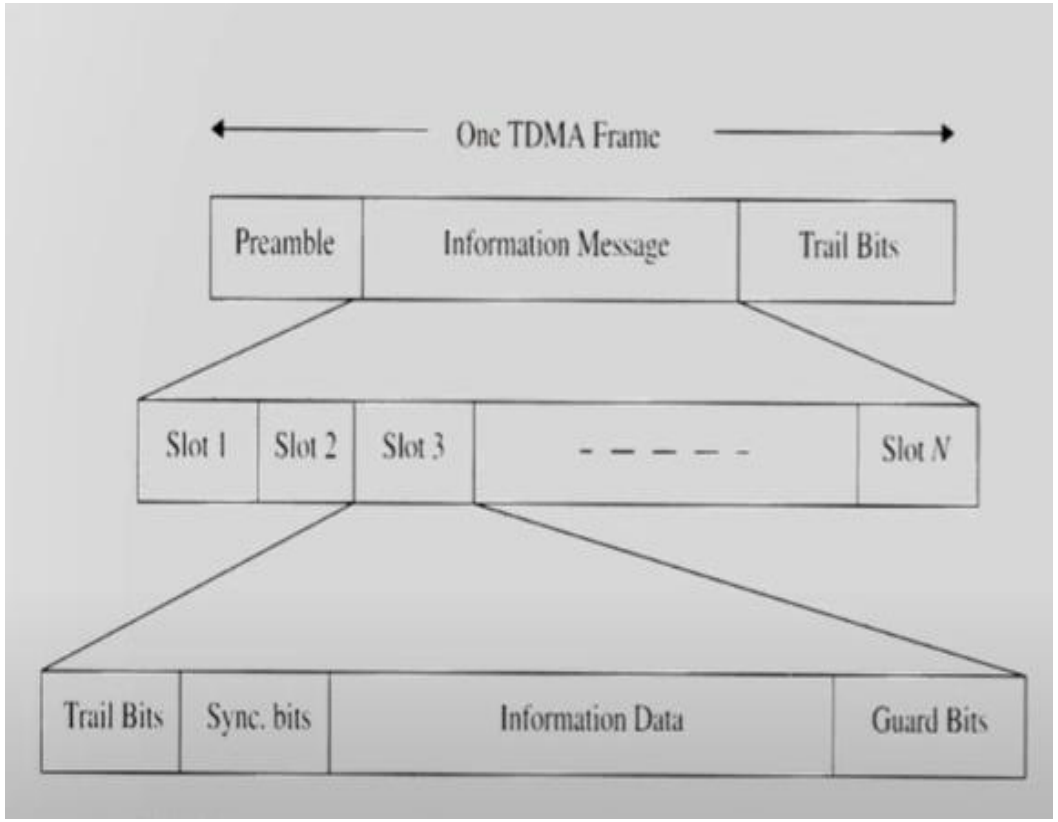
TDMA FRAME STRUCTURE



- PREAMBLE:
  - Consists of Address and Synchronization bits which is used by base stations,subscribers to identify each others
- INFORMATION MESSAGE
  - Contains multiple slots of user information
  - Each slot will have
  - Trail Bits
  - Sync Bits
  - Information
  - Guard Bits
- TAIL BITS

FEATURES OF TDMA

- In case of TDMA a single carrier frequency is shared among several users.The time slots used by the users depends on several factors such as modulation techniques and the available bandwidth
- The Handoff process is much simpler in the case of TDMA because of its discontinuity and it is able to listen to the other base stations during its idle slot time
- The transmission rates are very high in the case of TDMA as compared to the FDMA.
- The guard time present in the case of TDMA should be minimum.
- The main Advantage of TDMA is that it is very cost-effective.
- TDMA technology is used to separate users in time and ensure that there will not be any interference which is presented from any other simultaneous transmissions

EFFICIENCY IN TDMA

- Calculation of Efficiency becomes trivial as TDMA uses high Overhead than compared to FDMA
- The efficiency of TDMA System is a measure of the percentage of transmitted data that contains the information as opposed to providing overhead for the Scheme

Frame Efficiency (η_f) is calculated by

$$\eta_f = \left(1 - \frac{b_{OH}}{b_T}\right) \text{X } 100\%$$

b_{OH} - Number of overhead bits per frame
bT – Total Number of Bits per Frame

$$b_{OH} = N_r B_r + N_t B_p + N_t B_g + N_r B_g$$

N_r – Number of reference burst per frame
B_r – Number of overhead bits per reference burst
N_t – Number of Traffic Burst per Frame
B_p – Number of Overhead bits per Preamble in each slot
B_g – Number of Equalent bits in each guard time interval

Number of channels in TDMA Systems

- The number of TDMA channels slot that can be provided in a TDMA system is found by multiplying the number of TDMA slots per channel by the number of channel available.

$$N = \frac{m(B_{tot} - 2B_{guard})}{B_c}$$

m – maximum number of TDMA users supported in channel

- It is also important to note that the 2 Guard Bands,one at the lower and other at the higher end of the allotted frequency are required to ensure that users at the edge do not bleed over into an adjacent radio channels

TDMA-based MAC protocol implementation for VANETs

```
% Parameters
num_vehicles = 10;
num_time_slots = 5;
time_slot_duration = 1.0;  % seconds
simulation_duration = num_time_slots * time_slot_duration;

% Generate TDMA schedule (random assignment for demonstration)
tdma_schedule = randi([1, num_vehicles], num_vehicles, num_time_slots);

% Vehicle positions (random positions for demonstration)
vehicle_positions = rand(num_vehicles, 2) * 100;  % Random positions in a 100x100 area

% Simulation loop
for time_slot = 1:num_time_slots

    % Display TDMA schedule for the current time slot
    disp(['TDMA Schedule for Time Slot ', num2str(time_slot)]);
    disp(tdma_schedule(:, time_slot)');

    % Visualize the VANET (plot vehicle positions)
    figure;
    scatter(vehicle_positions(:, 1), vehicle_positions(:, 2), 'o', 'filled');
    title(['VANET Visualization - Time Slot ', num2str(time_slot)]);
    xlabel('X Position');
    ylabel('Y Position');
    xlim([0 100]);
    ylim([0 100]);
    hold on;

    % Simulate vehicle transmissions for the current time slot
    for vehicle = 1:num_vehicles
        if tdma_schedule(vehicle, time_slot) == vehicle
            % If it's this vehicle's turn to transmit
            transmitMessage(vehicle, vehicle_positions(vehicle, :));
        end
    end

    hold off;
    pause(time_slot_duration);
end

% Function to handle transmission (replace with actual transmission logic)
function transmitMessage(vehicle, position)
    disp(['Vehicle ', num2str(vehicle), ' transmitted a message at position (', num2str(position(1)), ', ', num2str(position(2)), ')']);
    % Add logic to visualize the transmission (e.g., draw a line)
    % Here, you can add lines or markers to represent the transmission
    plot(position(1), position(2), 'rx', 'MarkerSize', 10);
end
```

Output

```
TDMA Schedule for Time Slot 1
     9    10     2    10     7     1     3     6    10    10

Vehicle 10 transmitted a message at position (22.3812, 25.7508)
TDMA Schedule for Time Slot 2
     2    10    10     5     9     2     5    10     8    10

Vehicle 10 transmitted a message at position (22.3812, 25.7508)
TDMA Schedule for Time Slot 3
     7     1     9    10     7     8     8     4     7     2

TDMA Schedule for Time Slot 4
     8     1     3     1     1     9     7     4    10     1

Vehicle 3 transmitted a message at position (65.5098, 50.5957)
Vehicle 7 transmitted a message at position (95.9744, 54.7216)
TDMA Schedule for Time Slot 5
     5     4     8     8     2     5     5     7     8     8
```

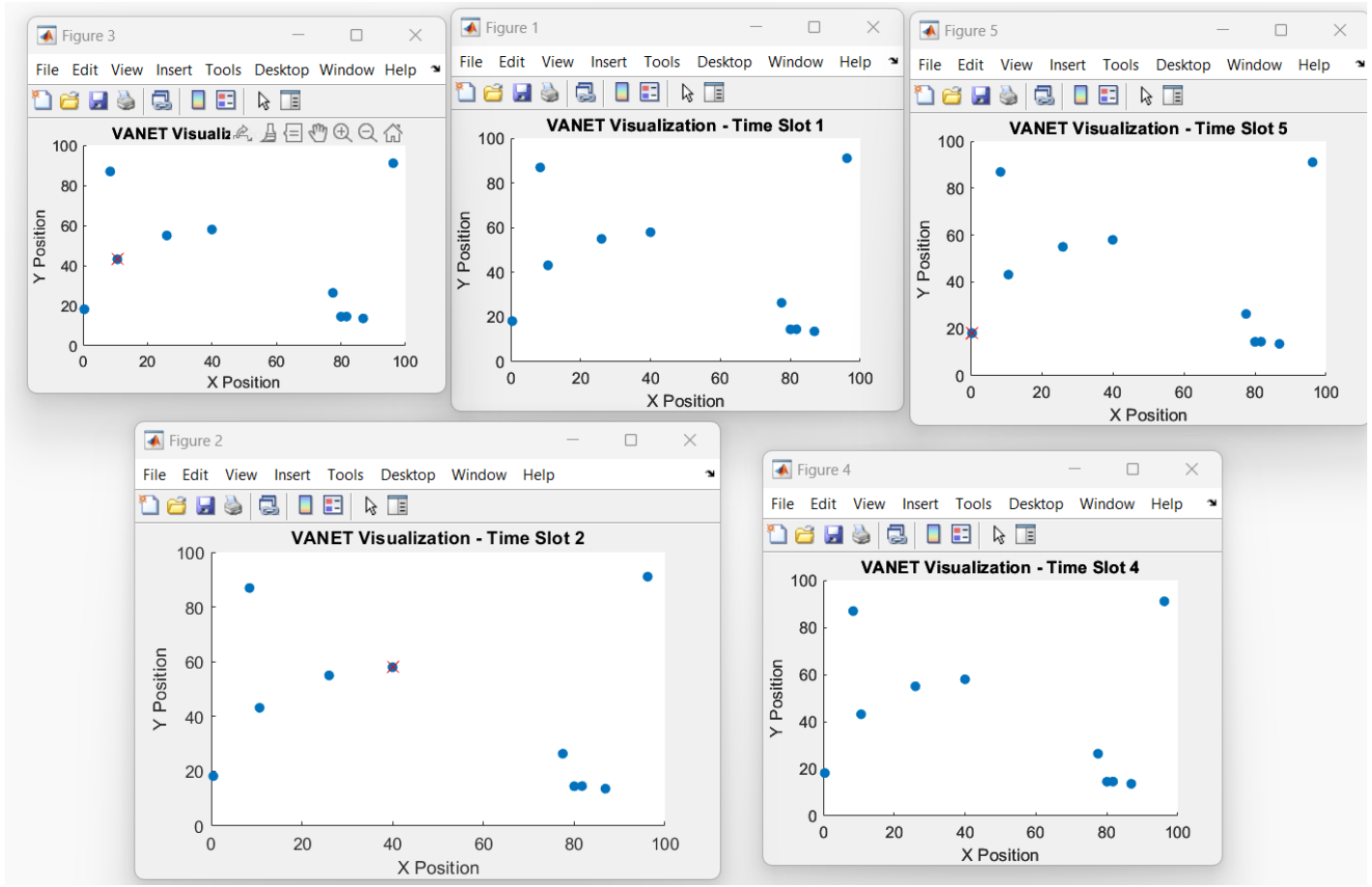


Figure 3
File Edit View Insert Tools Desktop Window Help
VANET Visualiz
Y Position
X Position
Figure 1
File Edit View Insert Tools Desktop Window Help
VANET Visualization - Time Slot 1
Y Position
X Position
Figure 5
File Edit View Insert Tools Desktop Window Help
VANET Visualization - Time Slot 5
Y Position
X Position
Figure 2
File Edit View Insert Tools Desktop Window Help
VANET Visualization - Time Slot 2
Y Position
X Position
Figure 4
File Edit View Insert Tools Desktop Window Help
VANET Visualization - Time Slot 4
Y Position
X Position