APPENDIX

A. Algorithms

Algorithm 1 Conversion of Wireless Data Broadcast into DAG (CWDB-DAG)

Input: Data items to be broadcast on the ith channel in the jth time slot $c(i, j)$, $1 \leq i \leq N, T_1 \leq j \leq T_2$;

Output: Converted DAG $G(V, E)$, it is denoted by Matrix $M(num, num)$;

Let $num = 0$;
for $i = 1$ to N **do**
  for $j = T_1$ to T_2 **do**
    if $c(i, j) \neq NULL$ **then**
      $num++$; $node_{num}.time = j$; $node_{num}.data = c(i, j)$; $node_{num}.channel = i$;
    end if
  end for
end for
$M(num, num) = 0$;
for $i = 1$ to num **do**
  for $j = i + 1$ to num **do**
    if $node_i.data \neq node_j.data$ and $node_i.channel = node_j.channel$ **then**
      if $node_i.time < node_j.time$ **then**
        $M(i, j) = 1$; $node_j.indegree++$; $node_i.outdegree++$;
        break;
      else if $node_i.time < node_j.time$ **then**
        $M(j, i) = 1$; $node_i.indegree++$; $node_j.outdegree++$; **break**;
      end if
    end if
  end for
end for
for $i = 1$ to num **do**
  for $j = 1$ to num **do**
    if $node_i.data \neq node_j.data$ and $node_i.channel \neq node_j.channel$ **then**
      if $node_i.time < node_j.time - 1$ **then**
        $M(i, j) = 1$; $node_j.indegree++$; $node_i.outdegree++$; **break**;
      else if $node_j.time < node_i.time - 1$ **then**
        $M(j, i) = 1$; $node_i.indegree++$; $node_j.outdegree++$; **break**;
      end if
    end if
  end for
end for

Algorithm 2 Discovery of All Paths (DAP)

Input: $M(num, num)$;
Output: set of all paths P;

```
P ← NULL;
find the node set V_in which indegree of node is 0;
find the node set V_out which outdegree of node is 0;
while V_in ≠ NULL do
  get a node v_{in_i} ∈ V_in;
  get a node v_{out_j} ∈ V_out;
  find a path p_k from v_{in_i} to v_{out_j} through using DFS;
  mark all edges in p_k;
  if all edges e ∈ E are marked then
    break;
  else
    P ← p_k;
  end if
end while
```

Algorithm 3 Approximate Data Retrieval on Single Antenna (ADR-SA)

Input: broadcast cycle $[T_1, T_2]$, channel set with requested data items C, the set of requested data items D_k, and the number of channels N;
Output: optimal data retrieval sequence P_{opt};

```
t = T_1;
while t ≤ T_2 do
  convertedDAG(C, T_1, T_2, N);
end while
DAP(M);
find the minimal set cover S based on P and D_k;
according to D_k, delete un-requested data items in S;
P_opt ← S;
```

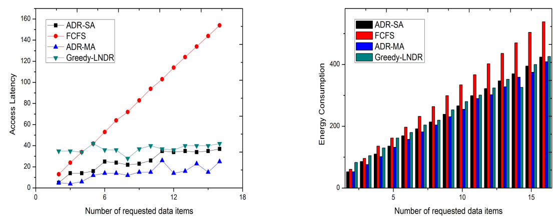
Algorithm 4 Approximate Data Retrieval on Multiple Antennae (ADR-MA)

Input: broadcast cycle $[T_1, T_2]$, channel set with data items C, the set of requested data items D_k, and the number of channels N;

Output: optimal data retrieval sequence P_{opt_1}, P_{opt_2};

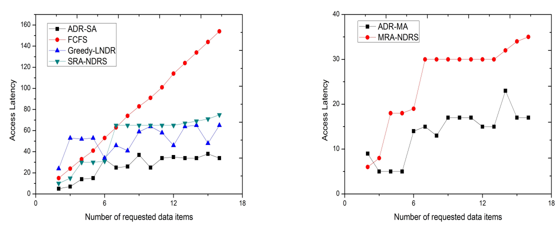
$t = T_1, antennae = 2$;
while $t \leq T_2$ **do**
  $converted\, DAG(C, T_1, T_2, N)$;
end while
$Path = DAP(M)$;
if $|D_k| \leq a$ **then**
  D_k is divided into two subsets of data items D_{k_1}, D_{k_2}, and store all patterns in $PAT = \{pat_1, pat_2, \cdots, pat_{|PAT|}\}$;
else
  for $i = 1$ to $\lfloor \frac{|D_k|}{2} \rfloor$ **do**
    randomly select i patterns pat of the split $\{D_{k_1}, D_{k_2}\}$ on D_k where $|D_{k_1}| = i$ and $|D_{k_2}| = |D_k| - i$, and store them to PAT_i;
    $PAT \leftarrow PAT \cup PAT_i$;
  end for
end if
for $i = 1$ to $|PAT|$ **do**
  find the minimal set cover sequences P_{opt_1} and P_{opt_2} from $Path$ on the basis of D_{k_1} and D_{k_2} in pat_i;
  according to P_{opt_1} and P_{opt_2}, compute the access latency and store as t_{pat_i};
end for
find a pattern which has the minimal access latency and output the corresponding retrieval sequences on two antennae P_{opt_1} and P_{opt_2}.

B. Experimental Results



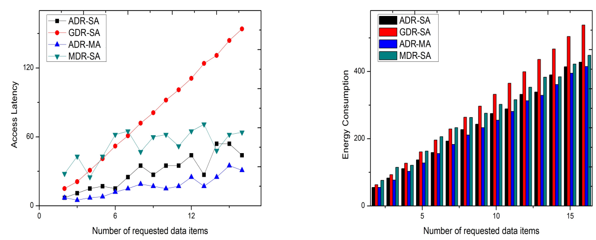
(a) Access Latency (b) Energy Consumption

FIGURE 7
Experimental results of access latency and energy consumption in wireless data broadcast with four channels



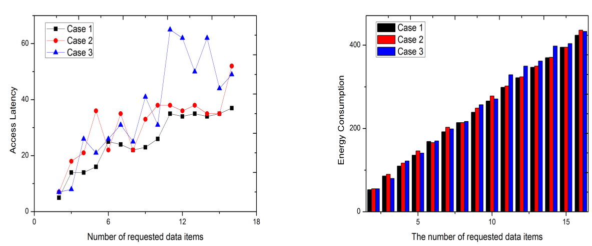
(a) Single Antenna (b) Multiple Antennae

FIGURE 8
Experimental results of access latency in wireless data broadcast with six channels and the client on single antennae and multiple antennae



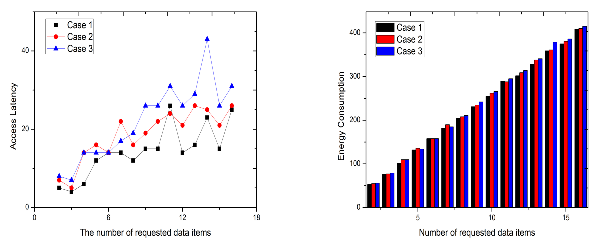
(a) Access Latency (b) Energy Consumption

FIGURE 9
Experimental results of access latency and energy consumption in wireless data broadcast with eight channels



(a) Access Latency (b) Energy Consumption

FIGURE 10
Experimental results of access latency and energy consumption for ADR-SA applied to three cases in wireless data broadcast with four channels



(a) Access Latency (b) Energy Consumption

FIGURE 11
Experimental results of access latency and energy consumption for ADR-MA applied to three cases in wireless data broadcast with four channels