Best Cover Set Selection
with Multi-Criteria Approach in Mission-Critical Surveillance for Wireless Image Sensor Networks

Mamour DIOP, Congduc PHAM, Ousmane THIARÉ

LIUPPA (Pau, France) & LANI (Saint-Louis, Senegal)

IFIP Wireless Days 2012
November 21-23, Dublin, Ireland

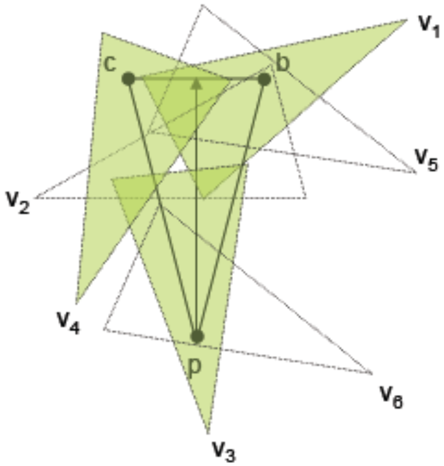
{elhadji.diop, congduc.pham}@univ-pau.fr, ousmane.thiare@ugb.edu.sn

Motivations

Cover sets

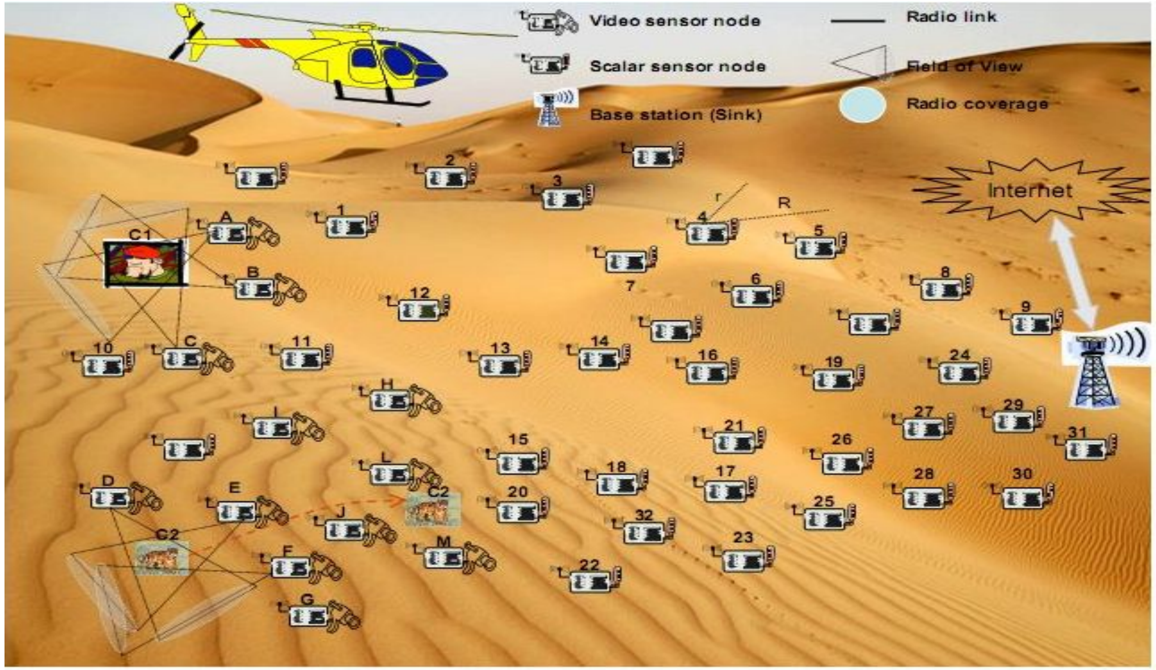
Co(V)= {
{V },
{V_1, V_3, V_4},
{V_2, V_3, V_4},
{V_3, V_4, V_5},
{V_1, V_4, V_6},
{V_2, V_4, V_6},
{V_4, V_5, V_6}
}

|Co(V)| = 7



Optimized Selection

- Energy efficiency
- Better image quality
- Less packet loss
- Low latency



Multi-Criteria Approach

Cover Set Score

$$Score(Co_i(v)) = \frac{\sum_{j=1}^{k} P_{i.j}}{k}, 1 \leqslant i \leqslant n$$

Cover Set Energy

$$E(Co_i(v)) = \min_{u \in Co_i(v)} E(u)$$

Selection Algorithm

$$Score(Co_t(v)) = \max_{Co_i(v) \in Co(v), i \neq t} Score(Co_i(v))$$

and

$$E(Co_t(v)) \geqslant E_{threshold}$$

Defining Relevant Weights (1)

Lifetime Class

Cardinality

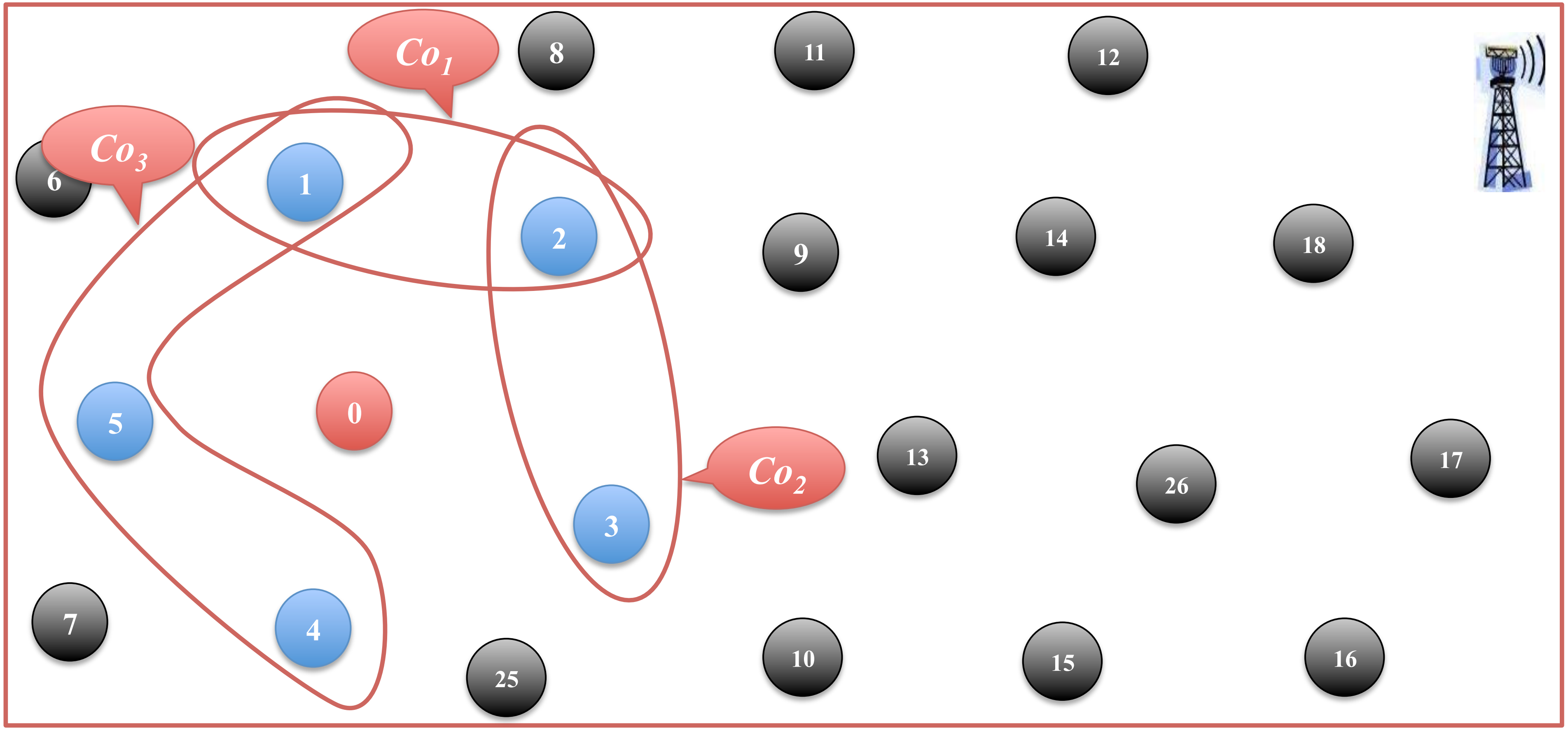
$$|Co_i(v)| < |Co_j(v)| => P_{i.1} > P_{j.1}$$

Degree of influence

$$I_{degree}(Co_i(v)) < I_{degree}(Co_j(v)) => P_{i.2} > P_{j.2}$$

Illustration

Lifetime Class



Defining Relevant Weights (2)

Appilcation's Criticality Class

Reliability

- **1-hop Available Neighbors**

$$P_{i.3} = \frac{1}{|Co_i(v)|} \sum_{t=1}^{|Co_i(v)|} \frac{Nb1HAvNeighbors(v_t)}{NbOptimalPaths(v_t)}$$

- **2-hop Available Neighbors**

$$P_{i.4} = \frac{1}{|Co_i(v)|} \sum_{t=1}^{|Co_i(v)|} \frac{Nb2HAvNeighbors(v_t)}{Nb1HAvNeighbors(v_t)}$$

Defining Relevant Weights (3)

Appilcation's Criticality Class

Latency

- **Closest 1-hop Available Neighbors**

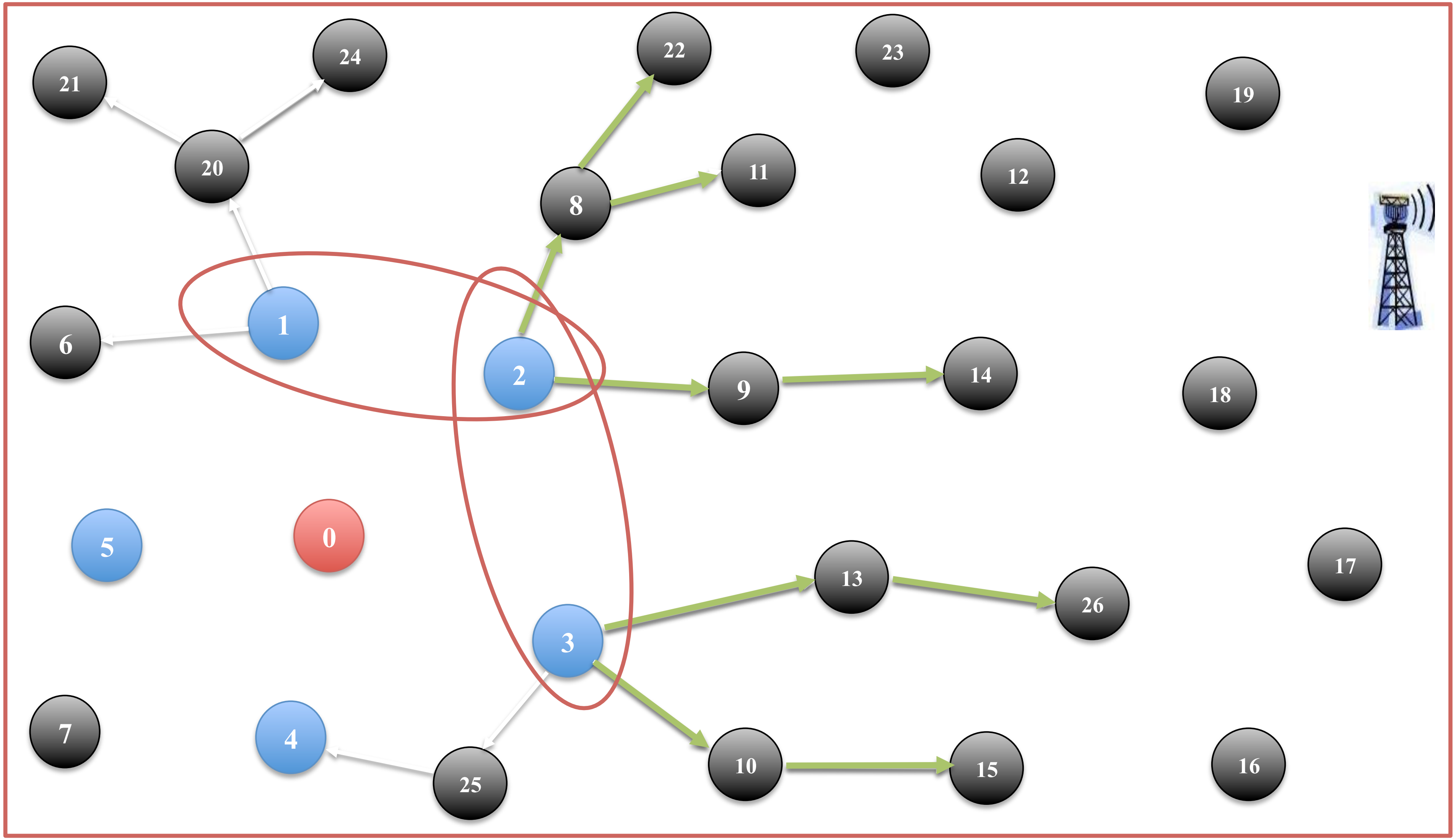
$$P_{i.5} = \frac{1}{|Co_i(v)|} \sum_{t=1}^{|Co_i(v)|} \frac{NbC1HAvNeighbors(v_t)}{NbOptimalPaths(v_t)}$$

- **Closest 2-hop Available Neighbors**

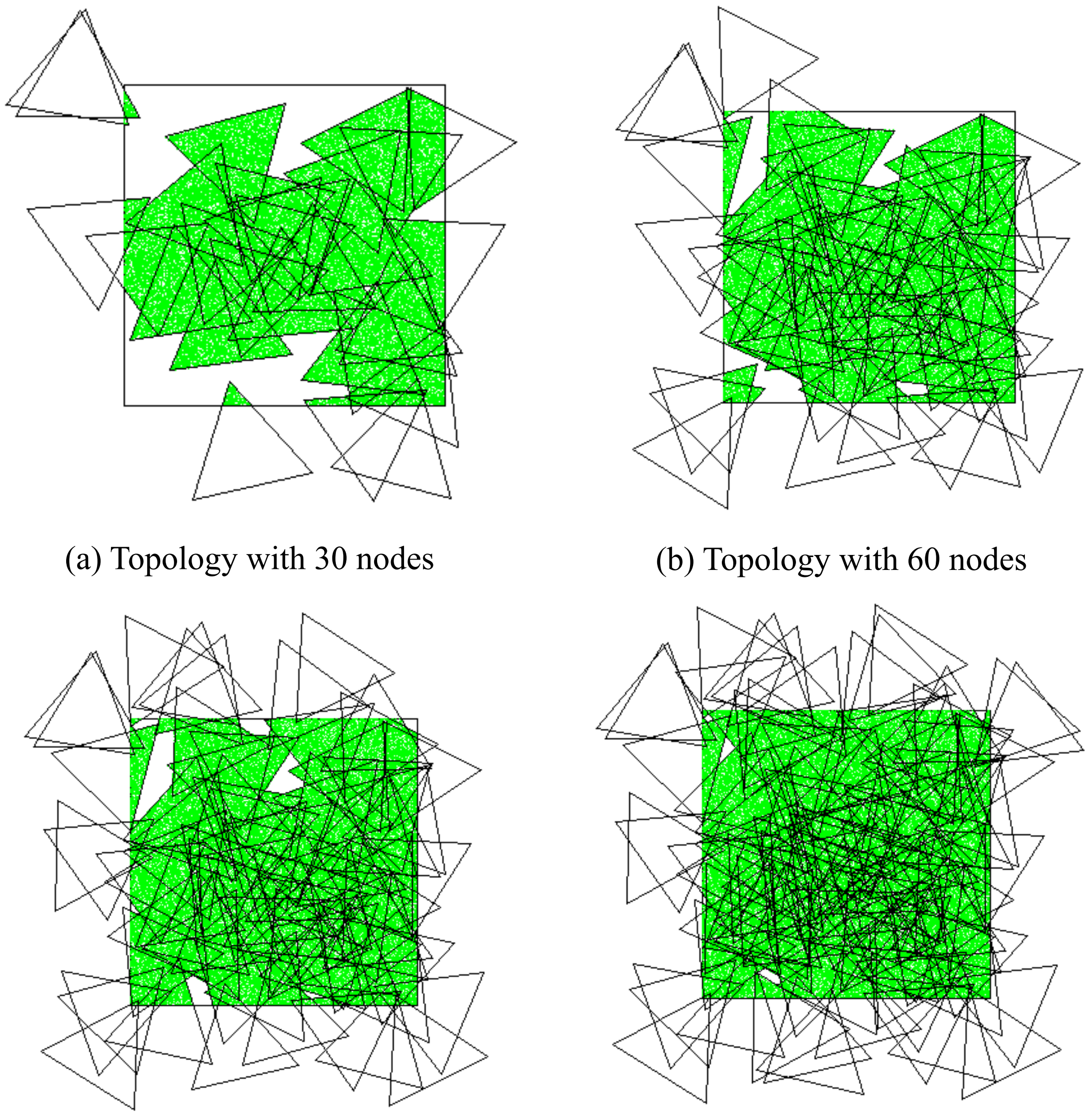
$$P_{i.6} = \frac{1}{|Co_i(v)|} \sum_{t=1}^{|Co_i(v)|} \frac{NbC2HAvNeighbors(v_t)}{NbC1HAvNeighbors(v_t)}$$

Illustration

Appilcation's Criticality Class



Simulation Results: Topologies



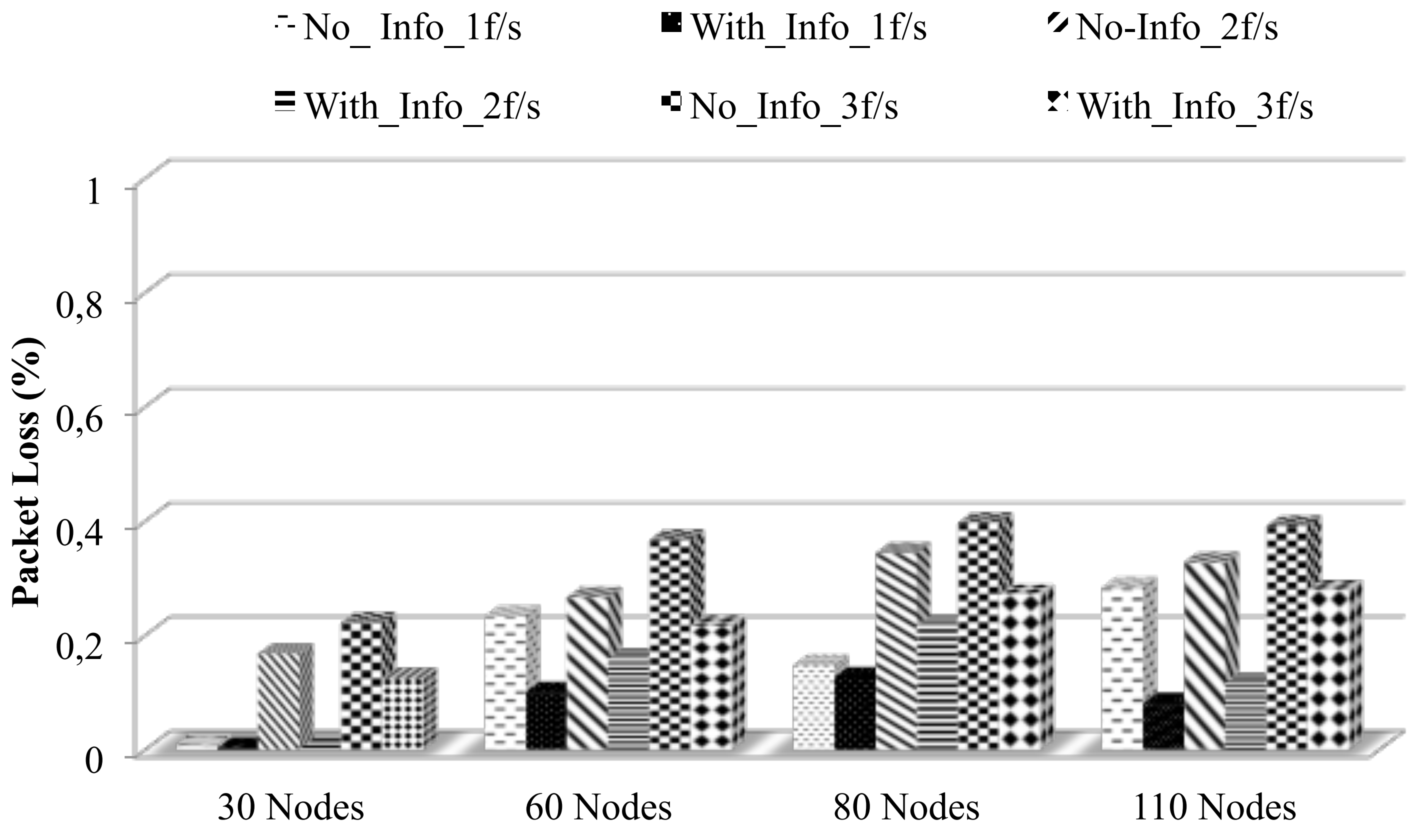
(a) Topology with 30 nodes (b) Topology with 60 nodes

(c) Topology with 80 nodes (d) Topology with 110 nodes

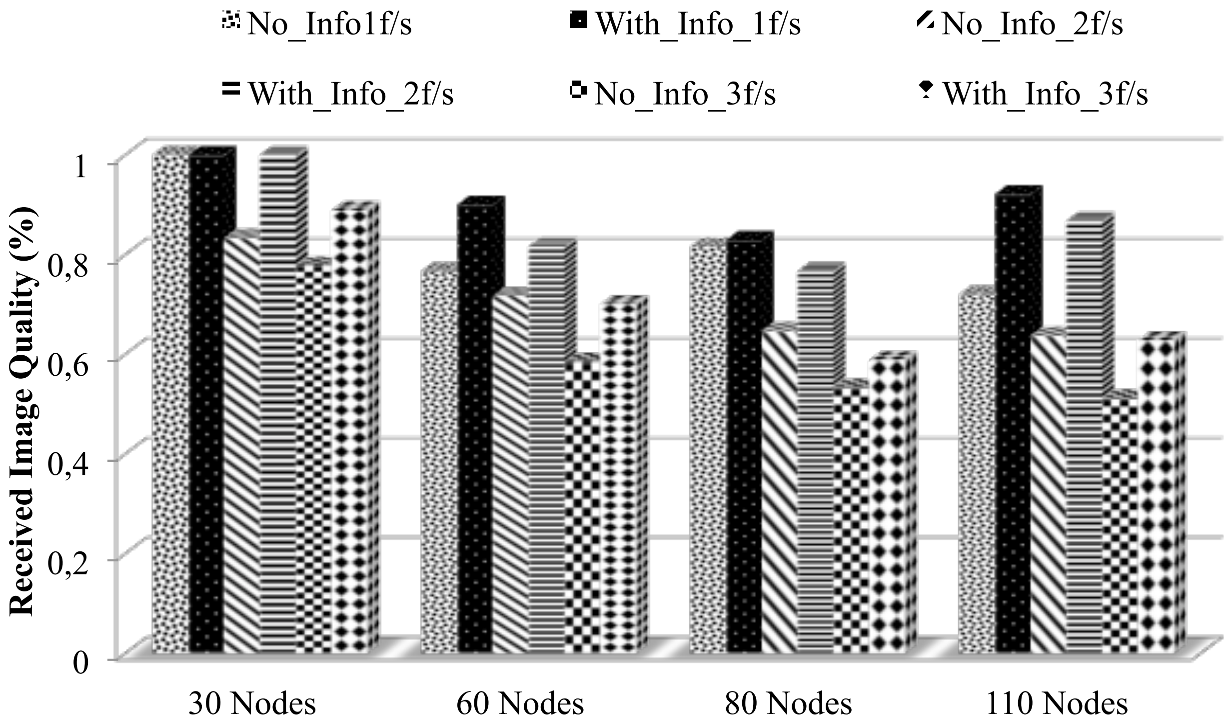
MODE

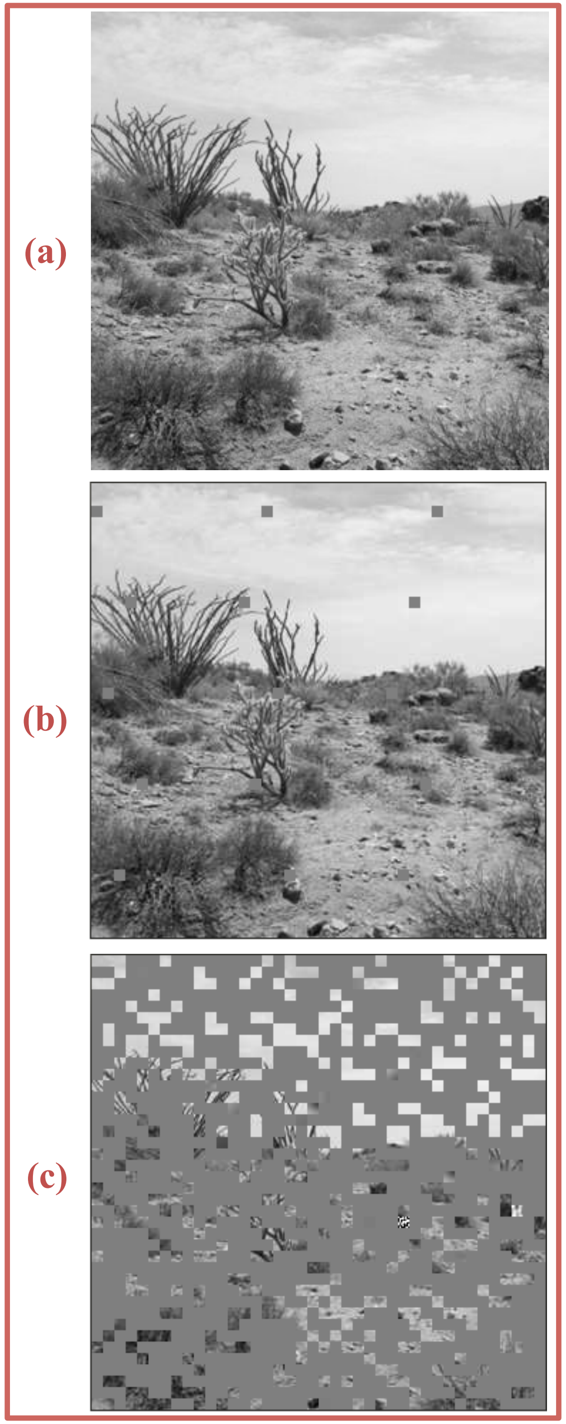
- NO_INFO
- WITH_INFO

Simulation Results: Packet Loss



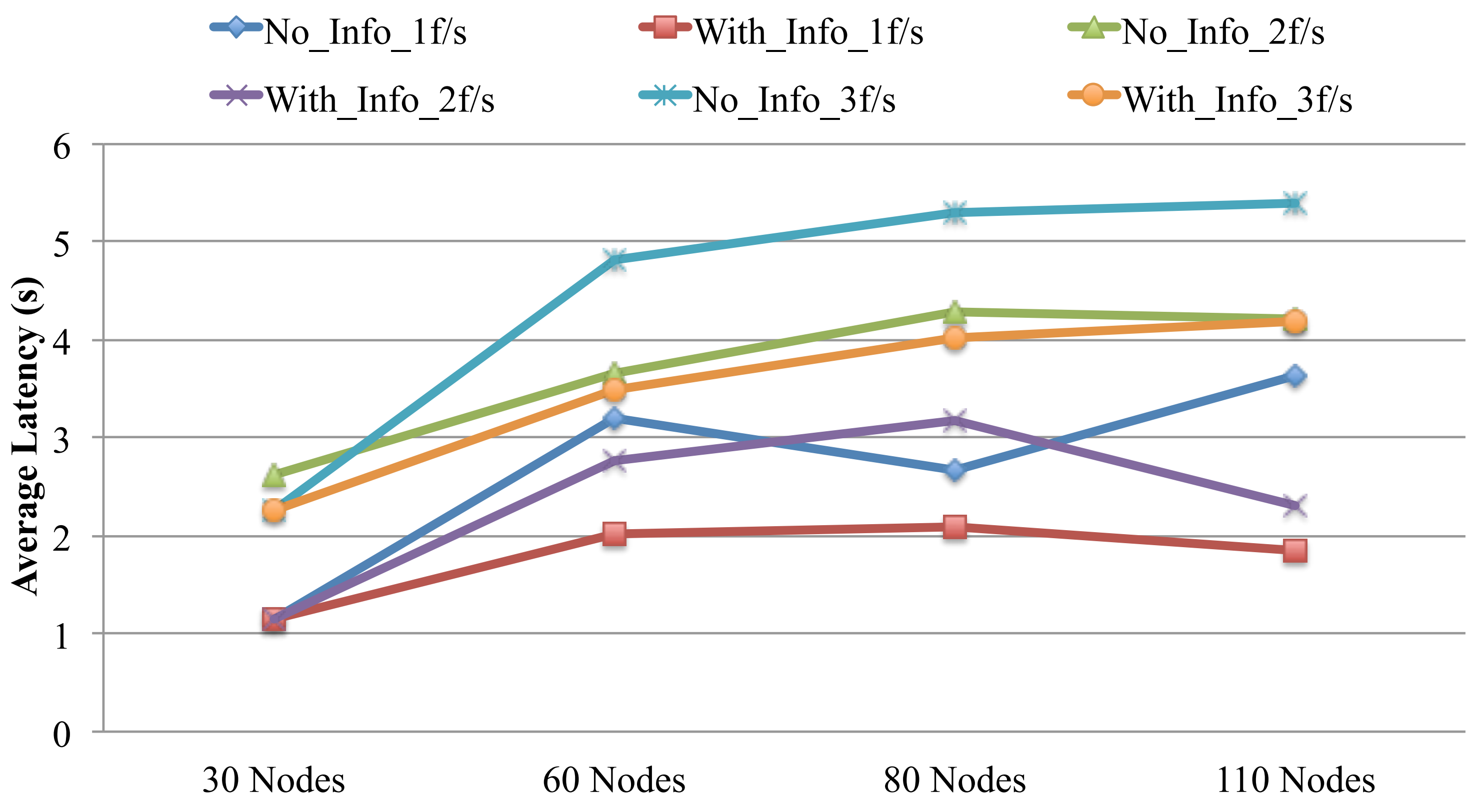
Simulation Results: Image Quality





Reconstructing image to the Sink →

Simulation results: Latency



Conclusion

Conclusion

- Optimized Selection with Multi-Criteria Approach to:
  - Ensure image transmission quality
  - Achieve optimal energy efficiency
- Basis for geographic multipath protocols

Prospects

- Management of shared paths

Thank you for your attention