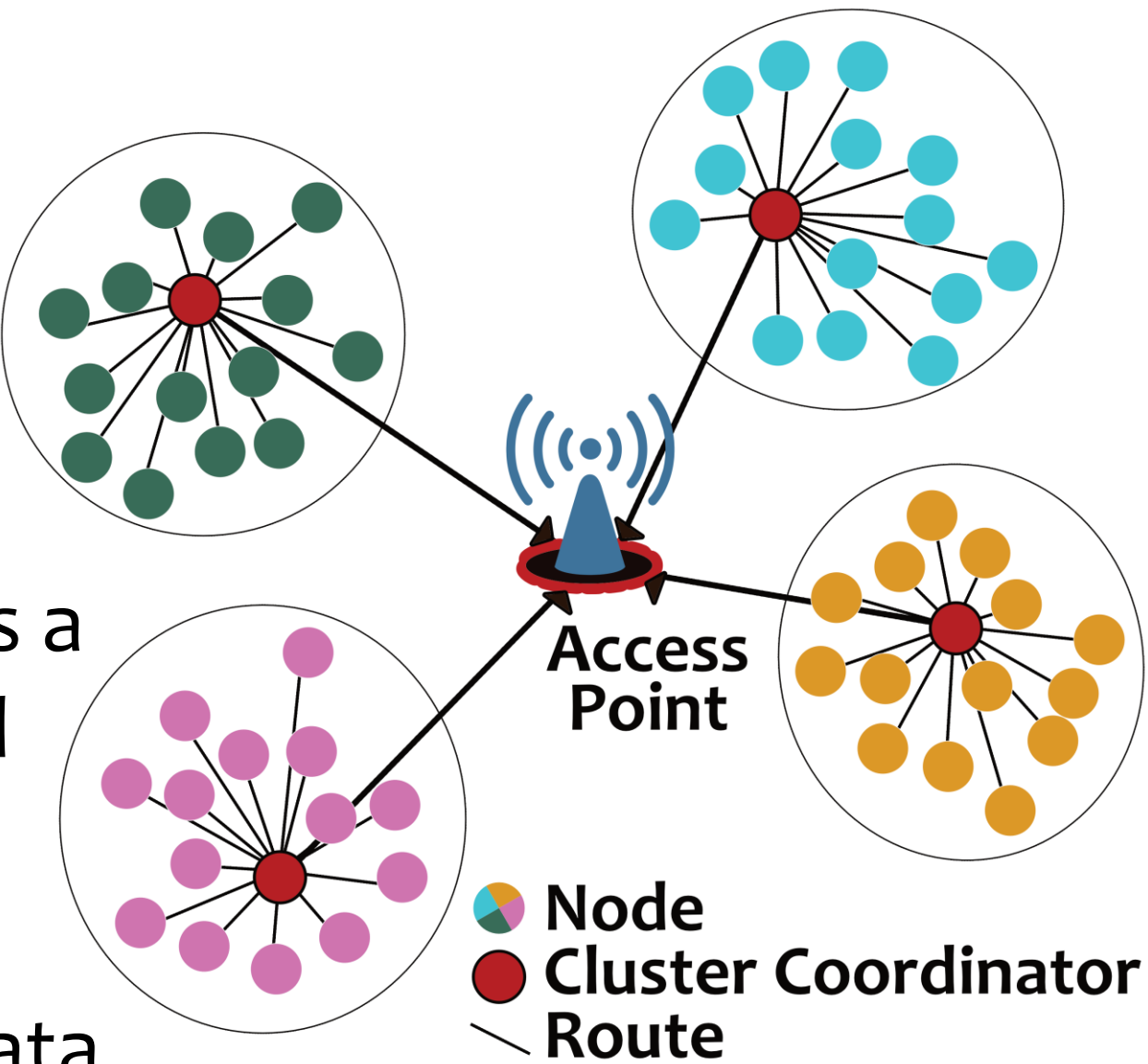# ONLINE LEARNING WITH EXPERTS ADVICE IN DISTRIBUTED WIRELESS NETWORKS

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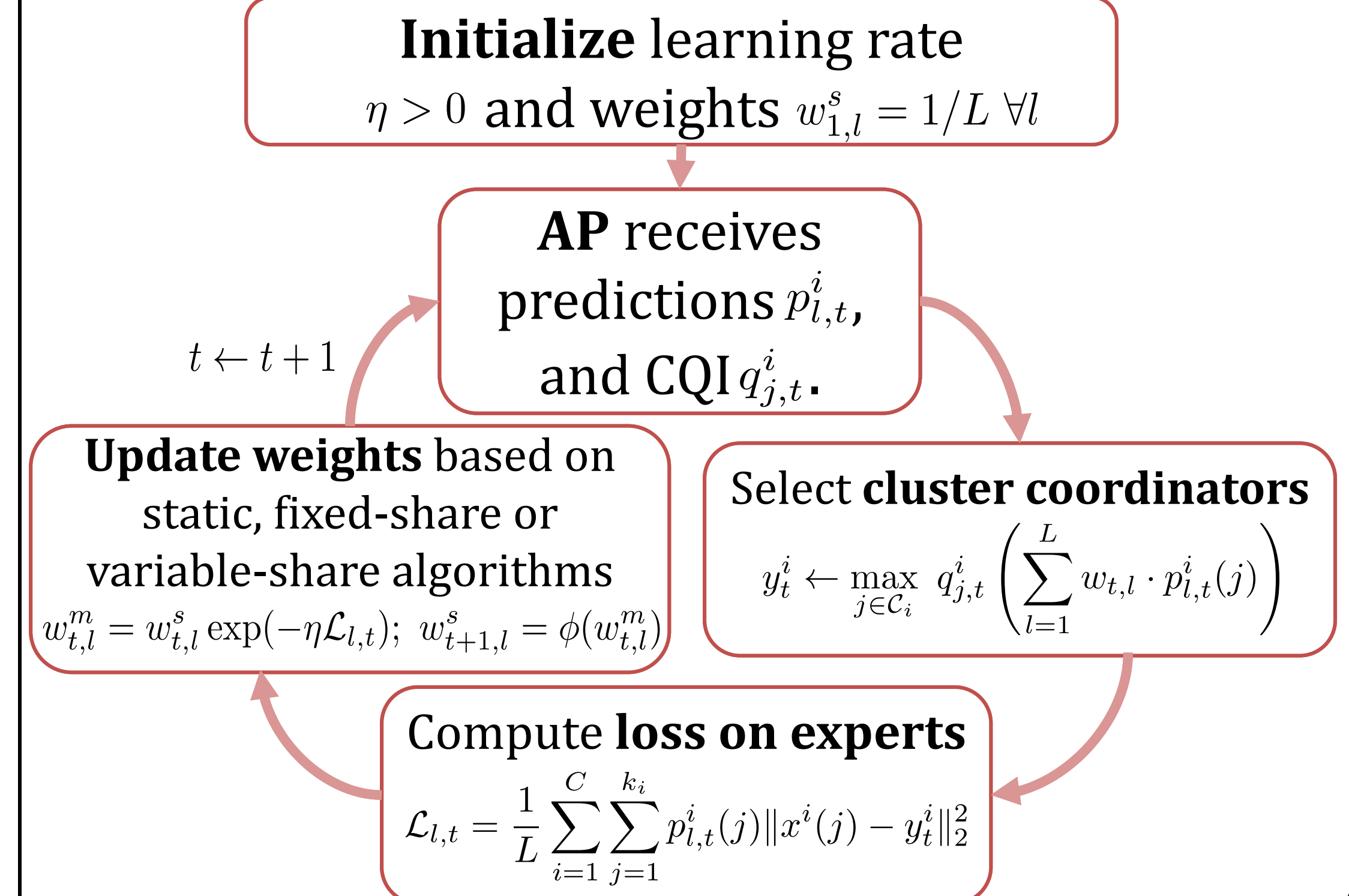
INTRODUCTION

- *Experts Advice in Communications!*

- Online Learning Scheme

- This works studies expert advice framework in a distributed wireless network with machine nodes working in clusters. Using node energy consumption as our performance metric, we compare the static, fixed share, and the variable share expert algorithms in choosing cluster coordinator nodes. It is found that the static expert algorithm does better than fixed and variable share algorithms.

PROBLEM STATEMENT

- Single cell with one access point and n nodes.
- Nodes grouped into clusters.
- Each cluster chooses a coordinator for local data aggregation.
- Cluster coordinator sends aggregated data to the AP.

Access Point

- Node
- Cluster Coordinator
- Route

How to choose the cluster coordinators?

EXPERTS ALGORITHM

Initialize learning rate $\eta > 0$ and weights $w_{1,l}^s = 1/L \ \forall l$

AP receives predictions $p_{l,t}^i$, and CQI $q_{j,t}^i$.

Select **cluster coordinators**
$$y_t^i \leftarrow \max_{j \in \mathcal{C}_i} \ q_{j,t}^i \left(\sum_{l=1}^{L} w_{t,l} \cdot p_{l,t}^i(j) \right)$$

Compute **loss on experts**
$$\mathcal{L}_{l,t} = \frac{1}{L} \sum_{i=1}^{C} \sum_{j=1}^{k_i} p_{l,t}^i(j) \|x^i(j) - y_t^i\|_2^2$$

Update weights based on static, fixed-share or variable-share algorithms
$$w_{t,l}^m = w_{t,l}^s \exp(-\eta \mathcal{L}_{l,t}); \ w_{t+1,l}^s = \phi(w_{t,l}^m)$$

$t \leftarrow t+1$

RESULTS

- We use three experts: least cluster-to-AP distance, cluster-to-centroid distance, and uniformly random coordinator selector.
- With different choices of learning rate and share weight, static expert outperforms the rest.
- It gives a uniformly distributed energy consumption.
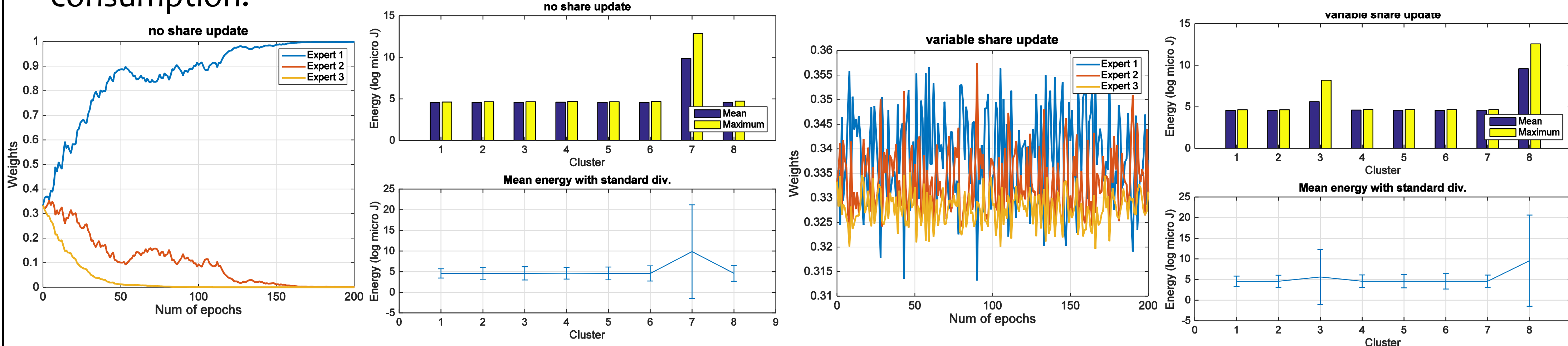
CONCLUSION

- Applied expert advice framework to the problem of coordinator selection in wireless networks.
- Used node energy consumption as the performance metric.
- Showed that static expert algorithm outperforms fixed and the variable share algorithms.

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