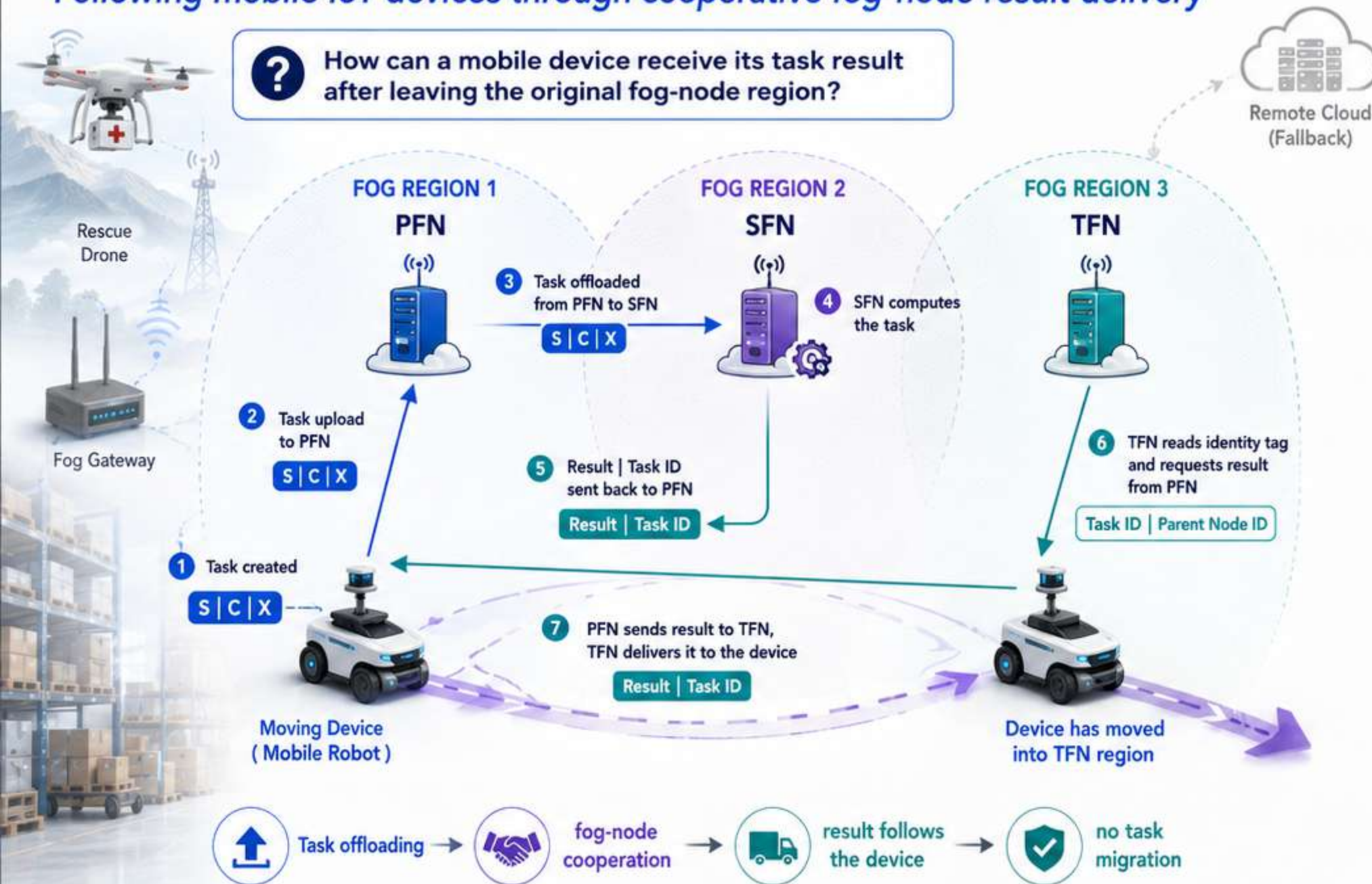


Mobility-Aware Task Offloading Without Migration

Following mobile IoT devices through cooperative fog-node result delivery

? How can a mobile device receive its task result after leaving the original fog-node region?



No running task migration

HIGHLIGHTS OF THE PAPER

01



MIGRATION-FREE MOBILITY SUPPORT

The method supports moving end-devices through task offloading and result forwarding rather than container or virtual-machine migration.

02



THREE MOBILITY CASES

It handles local PFN execution, PFN-to-SFN offloading and result retrieval after the device enters a new fog region.

03



TASK AND NODE IDENTIFICATION

Task ID and parent-node ID allow the current fog node to locate and deliver a result computed elsewhere.

04



EXPERIMENTAL FINDINGS

Up to **44.4%** lower execution time. Network usage is up to **68.4%** lower than iFogSim2 and **31%** lower than MobFogSim. Cloud-execution cost is reduced by **62.8%** and **10.5%**, respectively.



The proposed simulation reports **zero migration downtime** because no migration procedure is performed.



Move the result to the device, not the running task.

Connected Vehicle

Fog Gateway

Wearable Health Monitor

Why Mobility Makes Fog Computing Difficult

A task may still be running when the device leaves the service region.

1. Task Creation (At Mobile Device)

Mobile application device creates a recurring task.



2. Traditional Migration (Baseline)

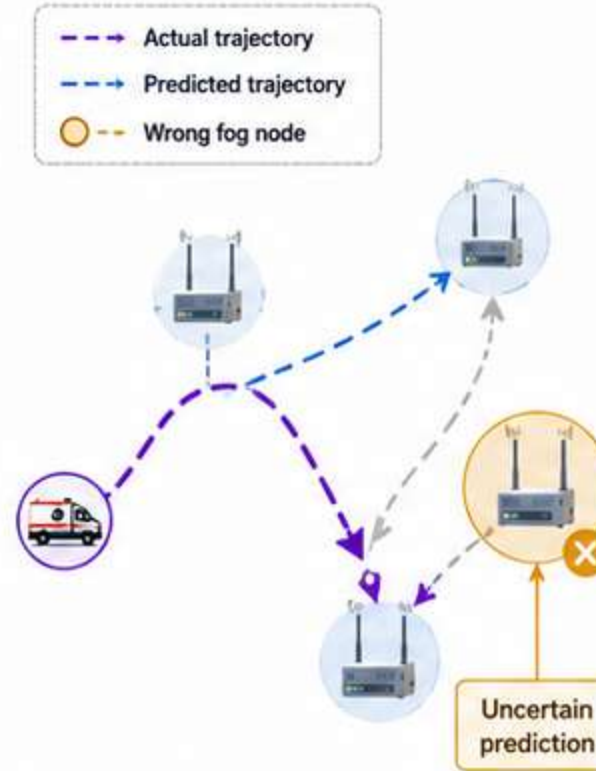
Task migrates as the device crosses service boundary.



Research annotation: Migration transfers execution state and introduces communication, latency and downtime costs.

3. Location Prediction (Challenge)

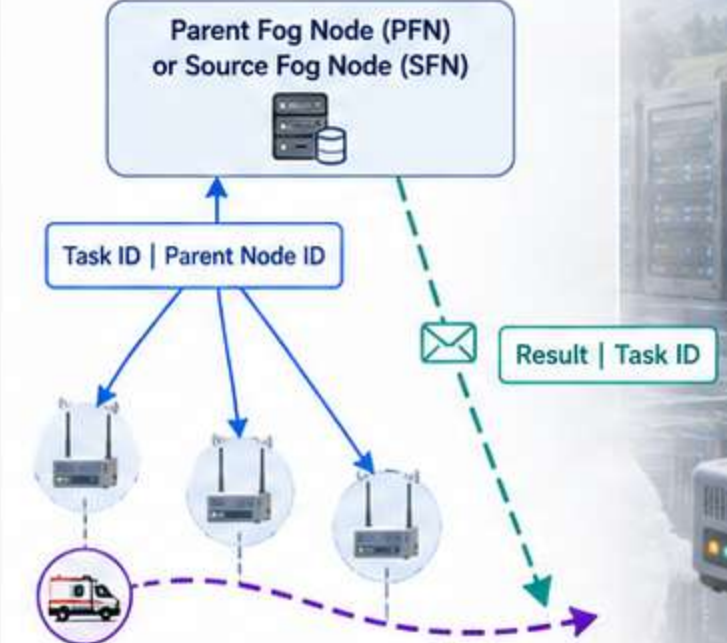
Predict the next location to pre-place the task.



Research annotation: Predicting future location is unreliable when movement is dynamic.

4. Proposed Idea (This Work)

Keep the task at a parent fog node (PFN) or source fog node (SFN).



Research annotation: The proposed method decouples task execution from the device's current location.



Research Gap

Existing mobility methods mainly migrate the task or predict the next location.
This paper instead coordinates fog nodes to deliver the result.

Legend (Colors)

- Deep Navy – Text & headings
- Cobalt Blue – Upload / state transfer
- Teal – Result path
- Violet – Mobility path (device)
- Amber – Migration overhead / warnings
- Slate Grey – Cloud fallback



The device is free to move while cooperative fog nodes preserve result access.

Inside the Mobility-Aware Fog Architecture

PFN execution, SFN offloading and result retrieval across fog regions.

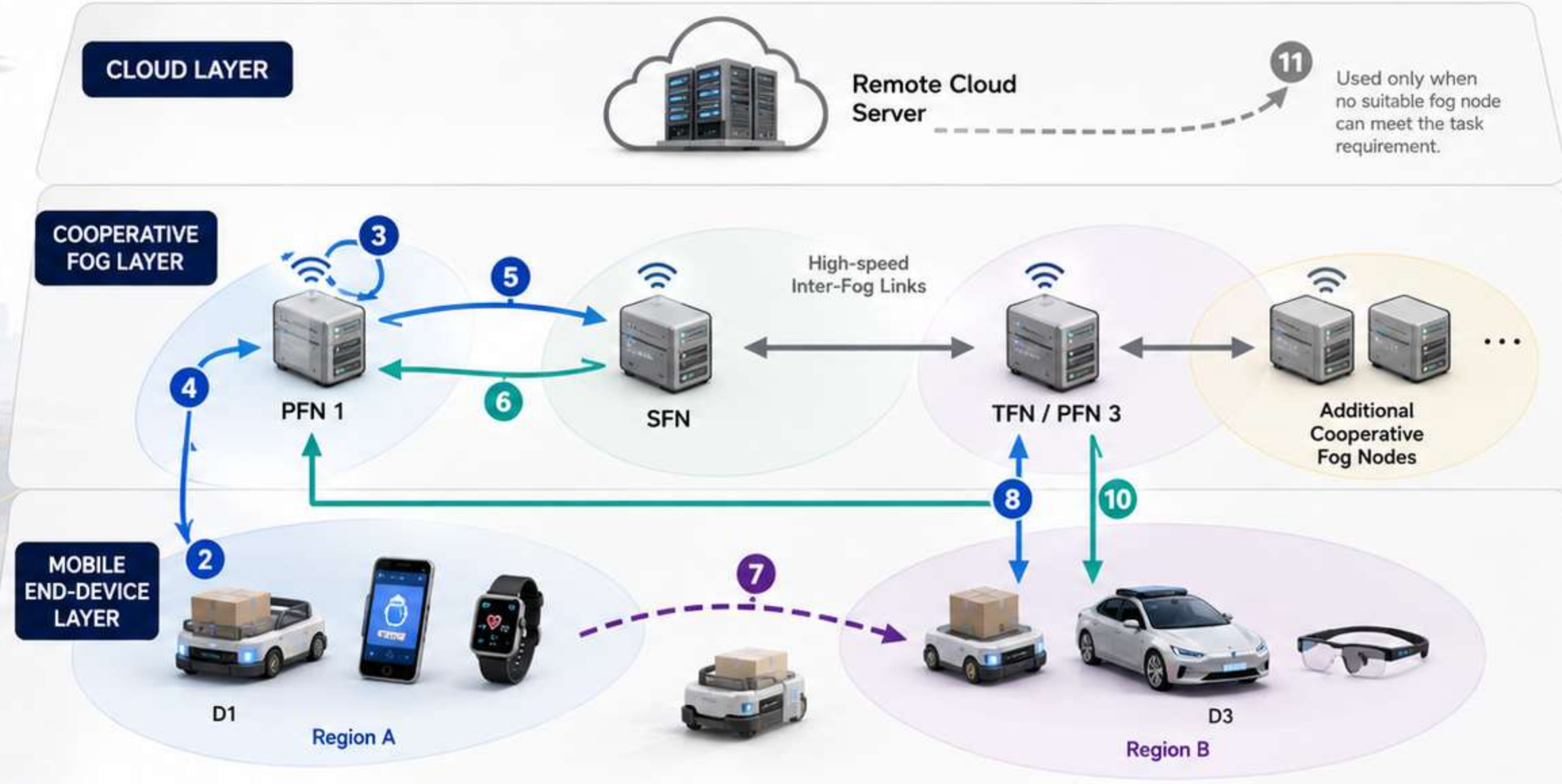
 Task Upload / Request

 Result Delivery

 Device Movement

 Cloud Fallback (Rare)

 Warning / Conditional



 **TASK IDENTITY**

Task ID | Parent Node ID

Identifies the task and the fog node responsible for its result.

 **SFN SELECTION**

An overutilized PFN selects an SFN using fog-node utilization history.

 **MAIN PRINCIPLE**

Execution location and result-delivery location do not need to be the same.

- 1 Mobile device generates task S | C | X.
- 2 Task is sent to nearest PFN.
- 3 PFN checks task requirements and utilization.
- 4 PFN computes locally if suitable.
- 5 Otherwise PFN selects an SFN.
- 6 SFN executes and returns the result to PFN.
- 7 Device may move to another fog region.
- 8 Current TFN checks Task ID and Parent Node ID.
- 9 TFN requests the result from original PFN.
- 10 TFN delivers the result to the mobile device.
- 11 Cloud is used only if fog execution is unavailable.

 Cooperative fog nodes

 High-speed inter-fog links

 Small result signal

 Fog cooperation keeps the service reachable even when the device changes regions.



4

Three Mobility Cases, One Offloading Strategy

Handle movement without transferring the running task

1 CASE 1 — IN RANGE, PFN AVAILABLE



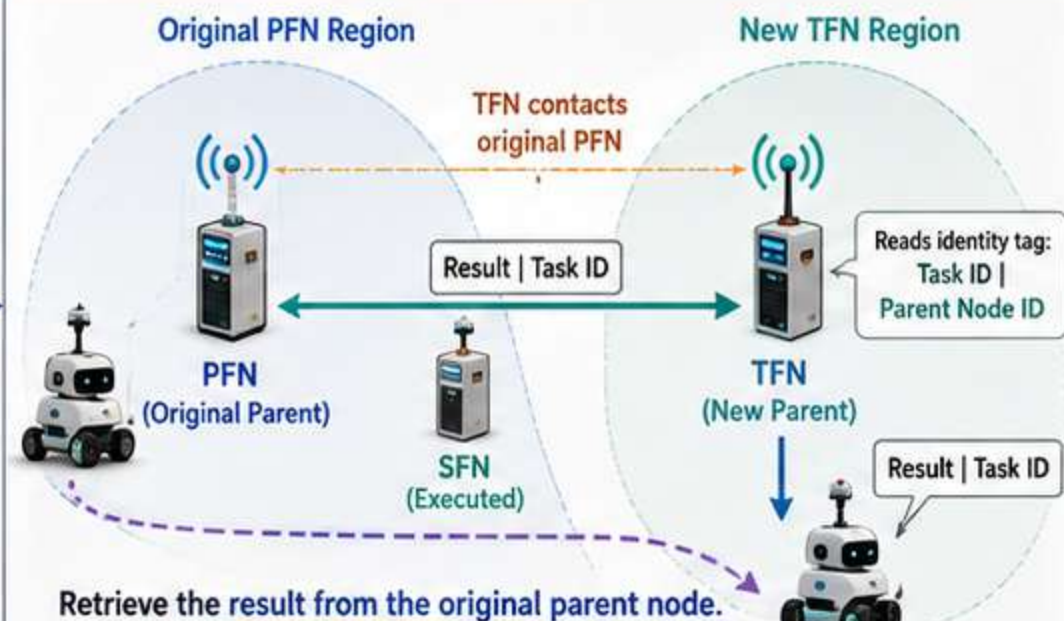
Fastest path

2 CASE 2 — IN RANGE, PFN OVERUTILIZED



Cooperative offloading

3 CASE 3 — DEVICE OUT OF RANGE



No task migration

Task upload (S | C | X)

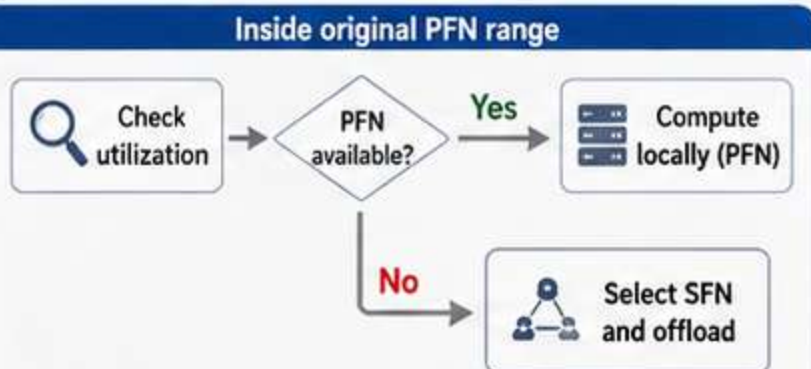
Result delivery (Result | Task ID)

Device movement

Migration overhead (avoided)

Cloud fallback (if needed)

Algorithm Flow
(No Central Controller)



The method follows the result, not the device trajectory.

This is result forwarding, not task migration.



Mobility is managed through identity and cooperation rather than location prediction.

What the Mobility Experiments Show

Comparison with iFogSim2 and MobFogSim

1 NETWORK USAGE

Eliminating migration avoids state-transfer traffic.

68.4%

lower than iFogSim2

31%

lower than MobFogSim

2 EXECUTION TIME

Utilization-based SFN selection and zero migration overhead shorten task completion.

Up to 44.4%

lower execution time

3 DOWNTIME

Baseline migration procedures introduce downtime through migration phases.

No migration downtime

in the proposed simulation

4 CLOUD COST AND TASKS IN CLOUD

More tasks remain inside the cooperative fog layer.

62.8%

lower cloud cost than iFogSim2

10.5%

lower cloud cost than MobFogSim

The proposed scheme executes the lowest percentage of tasks in the cloud.

SIMULATION SETUP

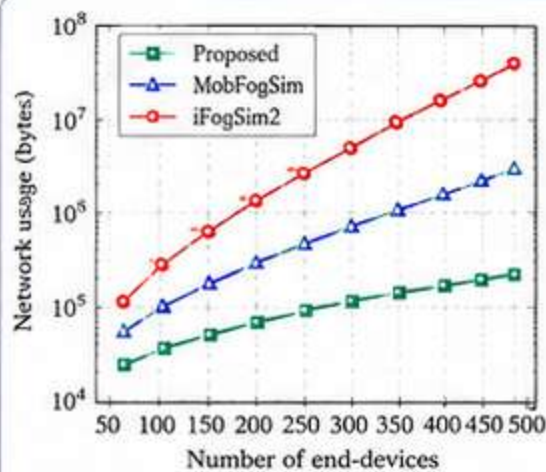
Simulator	: iFogSim2
Compared with	: iFogSim2 and MobFogSim
1 Cloud node	
50 Fog nodes	
50 – 500 Mobile end-devices	
Task size	: 420 KB
End-device	: 500 MIPS RAM : 1000 MB
Fog node	: 2800 MIPS RAM : 4000 MB
Cloud	: 44,800 MIPS
Host machine	: Intel Core i5 8th Gen, 1.6 GHz, 8 GB RAM

LIMITATIONS

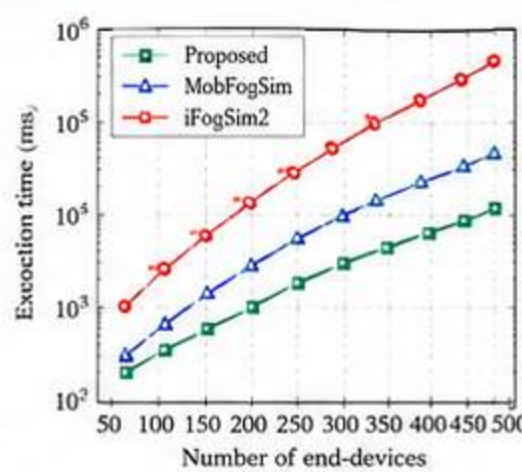
The method assumes that the computed result is a small signal. Completely avoiding migration may be unsuitable for long-running or highly interactive tasks.

FUTURE WORK

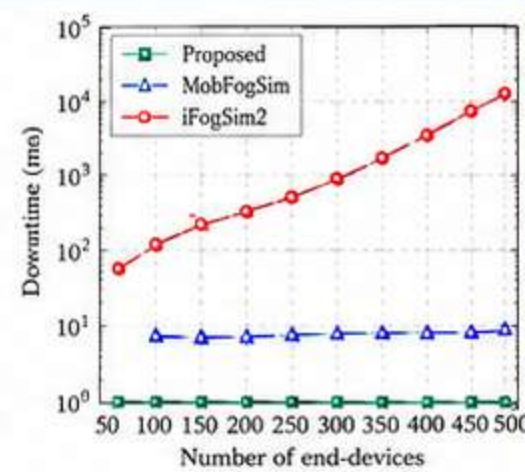
Combine cooperative offloading with selective migration.



(a) Network usage

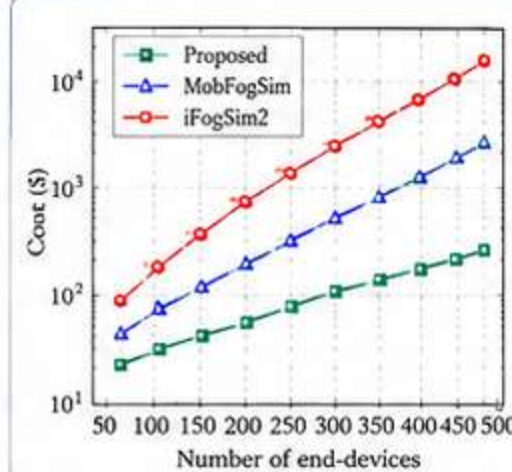


(b) Execution time

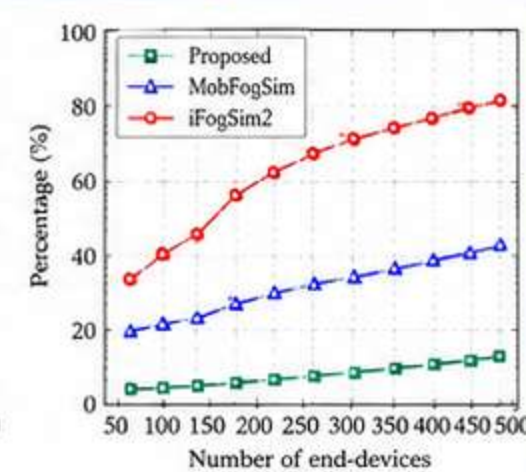


(c) Downtime

Fig. 3: Different performance metrics



(a) Cost of execution in cloud



(b) Percentage of tasks executed in cloud

Fig. 4: Cloud cost and percentage of tasks executed in cloud

HOW IT WORKS (CONCLUSION CHAIN)



FINAL RESEARCH CONCLUSION

The proposed scheme supports mobile end-devices by keeping execution within cooperative fog nodes and forwarding completed results across changing service regions.

KEY ASSUMPTIONS



Cooperative fog nodes



High-speed inter-fog links (Ethernet)



Computed result is a small signal (delay negligible)

Let the device move. Keep the task stable. Deliver the result through the fog.