Motivation:

IoT->LLNs->WSNs

Limitations:

1.processing power;
2.memory;
3.energy (battery power);

RPL —— Routing Protocol for LLNs;

RPL doesn’t provide the optimal routing but is the most suitable one for LLNs, considering the energy and communication link.

What UAV can do:

1. Provide complex computing power;
2. Provide efficient reconfiguration;
3. Larger memory with global topology;

●Routing Mode I:

1. UAV update the Objective Function :

Objective Function (OF): An OF defines how routing metrics, optimization objectives, and related functions are used to compute Rank. Furthermore, the OF dictates how parents in the DODAG are selected and, thus, the DODAG formation.

```
struct rpl_of {
  void (*reset)(struct rpl_dag *);
#if RPL_WITH_DAO_ACK
  void (*dao_ack_callback)(rpl_parent_t *, int status);
#endif
  uint16_t (*parent_link_metric)(rpl_parent_t *);
  int (*parent_has_usable_link)(rpl_parent_t *);
  uint16_t (*parent_path_cost)(rpl_parent_t *);
  rpl_rank_t (*rank_via_parent)(rpl_parent_t *);
  rpl_parent_t *(*best_parent)(rpl_parent_t *, rpl_parent_t *);
  rpl_dag_t *(*best_dag)(rpl_dag_t *, rpl_dag_t *);
  void (*update_metric_container)( rpl_instance_t *);
  rpl_ocp_t ocp;
};
```

2. UAVs do the optimization :

```
rpl_dag_t *rpl_set_root(uint8_t instance_id, uip_ipaddr_t *dag_id);
int rpl_repair_root(uint8_t instance_id);
int rpl_set_default_route(rpl_instance_t *instance, uip_ipaddr_t *from);
…
```

UAVs serve as central controllers

●Routing Mode II:

When UAVs are off-line:

Sensor -> Sensor

When UAVs are on-line:

Sensor -> UAV -> UAV -> Sensor

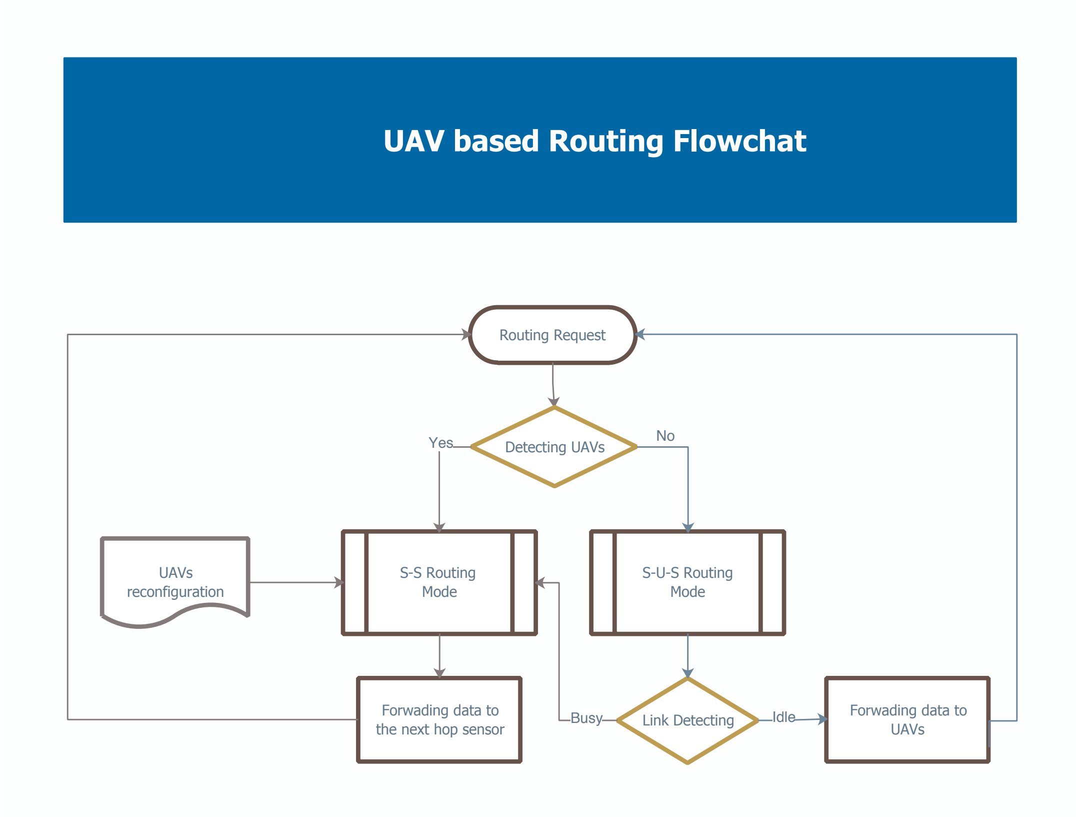
Throughput is the bottleneck and we propose a balanced routing algorithm:

Key idea: try the sensor-UAVs-sensor routing first; if the link is busy, then turn to the sensor-sensor routing.

UAVs serve as switches (somehow act like the role in Adler).

Contribution:

SDN ->Routing
->NFV -> sensor
-> application


UAV based Routing Flowchat
Routing Request
Detecting UAVs
Yes
No
UAVs reconfiguration
S-S Routing Mode
S-U-S Routing Mode
Forwading data to the next hop sensor
Busy
Link Detecting
Idle
Forwading data to UAVs