Lesson 4
RPL and 6LoWPAN Protocols

RPL [Ipv6 Routing Protocol For Low Power Lossy Networks (LLNs)]

LLN

- A constrained nodes network
- Low data transfer rate
- Low packet delivery rate in comparison to IP network
- Unstable links (disconnections in between)

IETF ROLL

- RPL non-storing mode
- The data flow directs downwards in an RPL instance
- Flow from root at transport layer to child nodes
- From child node to leaf node at physical layer device node

RPL data flow directed upwards

- From a leaf or child node to other child node and then to the root In an RPL instance

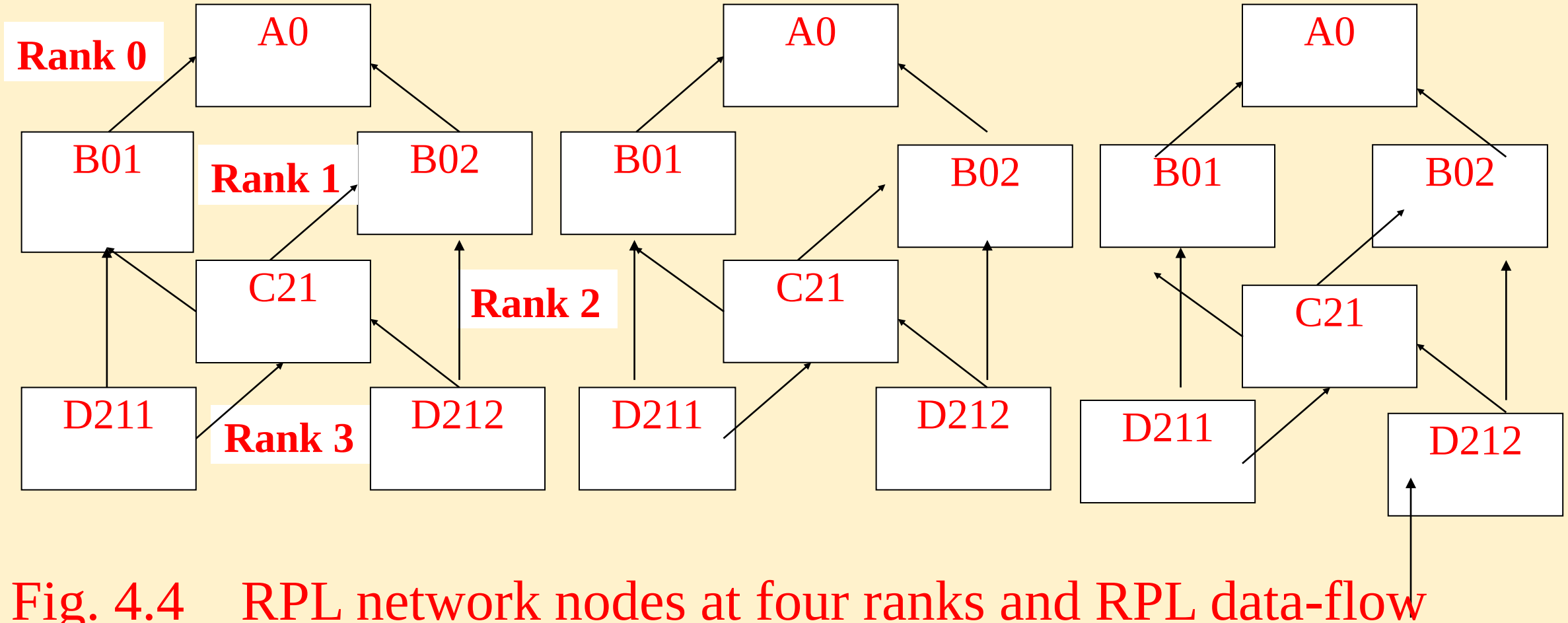

Fig. 4.4 RPL network nodes at four ranks and RPL data-flow instances for upwards and downwards flow

RPL data flow Feature

- DODAG (Destination Oriented Directed Acrylic Graph) data flow model
- DODAGs: No share nodes (disjoint).

Acrylic Data Flow Graph (ADFG)

- A DFG where only one set of inputs generate only one set of outputs for the given input set
- All inputs are instantaneously available in APDFG, (no delay between various inputs) at each stage

Directed Acrylic Graph

- A data flow model between the nodes
- Destination orientation means either upwards directed (for transport) or downward directed (for device layer end node) in a tree like structure of the DODAGs
- Acrylic graph means one end input and oe ned output

RPL Features

- A routing protocol for the LLNs,
- RPL message exchanges use Trickle algorithm, a standard RFC 6206

RPL Control Messages

1. DAO (Destination Advertisement Object)
2. DIO (DODAG Information Object)
3. IO (DAG Information Object),

Transfer of Data at an RPL instance

1. data point to point (one device nodes to one receiver node)
2. Point to multipoint (one to many device nodes) or
3. Multipoint to point (many device nodes to one receiver node)

2. 6LoWPAN (Ipv6 Over Low Power Wireless Personal Area Networks)

6LoWPAN Features

- IETF recommended methods for reassembly of fragments
- IPv6 and UDP (or ICMP) headers compression (6LoWPAN-hc adaptation layer)

6LoWPAN Features

- Neighbour discovery (6LoWPAN-nd adaptation layer) and
- supports mesh routing

Data Stack

- Uses 6LoWPAN protocol at adaptation layer
- Adaptation layer data stack transmits to IPv6 Internet layer

Devices Network

- Nodes having low speed and low power
- For example, Wireless Personal Area Network (WPAN) nodes.

IPv6 over IEEE 802.15.4 standard network nodes

- Headers, security and Application data in a frame
- Total device node frame size = 127B .
- IPv6 header = 40B;
- UDP header = 8B;

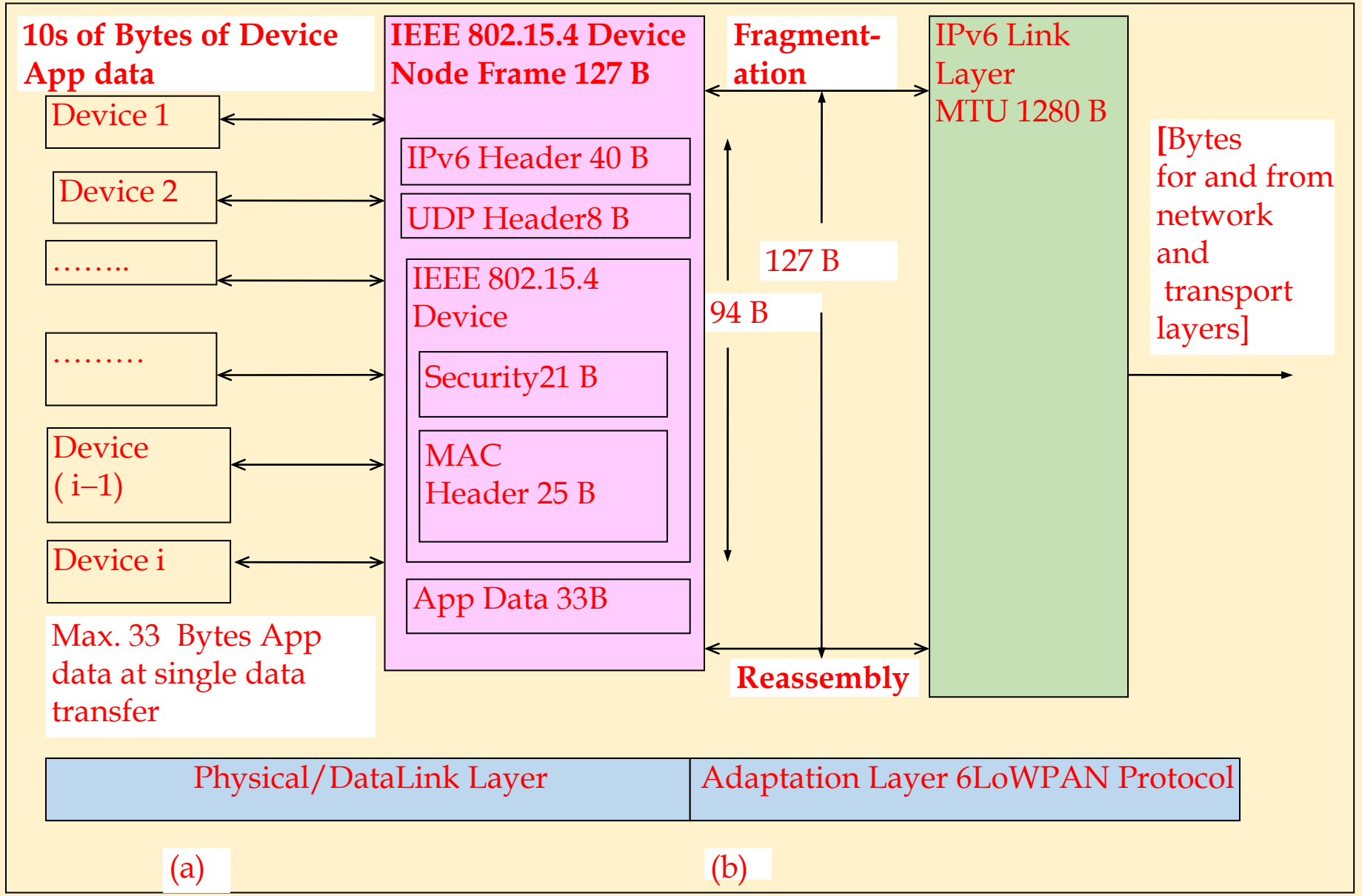

Fig. 4.5(a) Physical layer IEEE 802.15.4 network devices (b) Adaptation layer 6LoWPAN protocol 127 B fragmented frames reassembly into IPv6 maximum 1280 B or fragmentation of IPv6 MTU 1280B into 127 B frames for transfer to a device.

IPv6 over IEEE 802.15.4 standard network nodes

- Device node MAC (Media Access Control) = 25 B;
- AES-128 security = 21 B;
- Remaining Application data

IPv6 MTU at data link layer

- 1280 B fragments into frame of 127 B each for single transfer to a device node

IPv6 MTU (maximum transmission unit)

- Link layer = 1280 B
- Link layer frame fragmentation needed in order to communicate frame of 127 B over IEEE 802.15.4 nodes (device).

The frame MTU

- 1280 B for transmission to network layer
- Fragments from frames from the device of 127 B each reassemble into IPv6 frame

Summary

We learnt

- Routing protocol for the LLNs
- RPL
- Neighbour discovery (6LoWPAN-nd adaptation layer) and support to mesh routing
- 6LoWPAN

SUMMARY

- We learnt
- The data stack uses 6LoWPAN protocol at adaptation layer before data stack transmits to IPv6 Internet layer.

End of Lesson 4 on
RPL and 6LoWPAN Protocols