Adapting/Bridging 64-bit MACs with 48-bit MACs

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64-bit MACs vs 48-bit MACs

- In a Personal Area Network, there are nodes connected to two IEEE 802 technologies like 802.15.4 with 64-bit MACs and 802.3 with 48-bit MACs, PAN coordinator and intermediate bridges and routers
- This document presents use cases for adapting or bridging64-bit MACs with 48-bit MACs
- We will also present technical issues in the adaptation/bridging solution

Use Case: Monitor SOHO Traffic

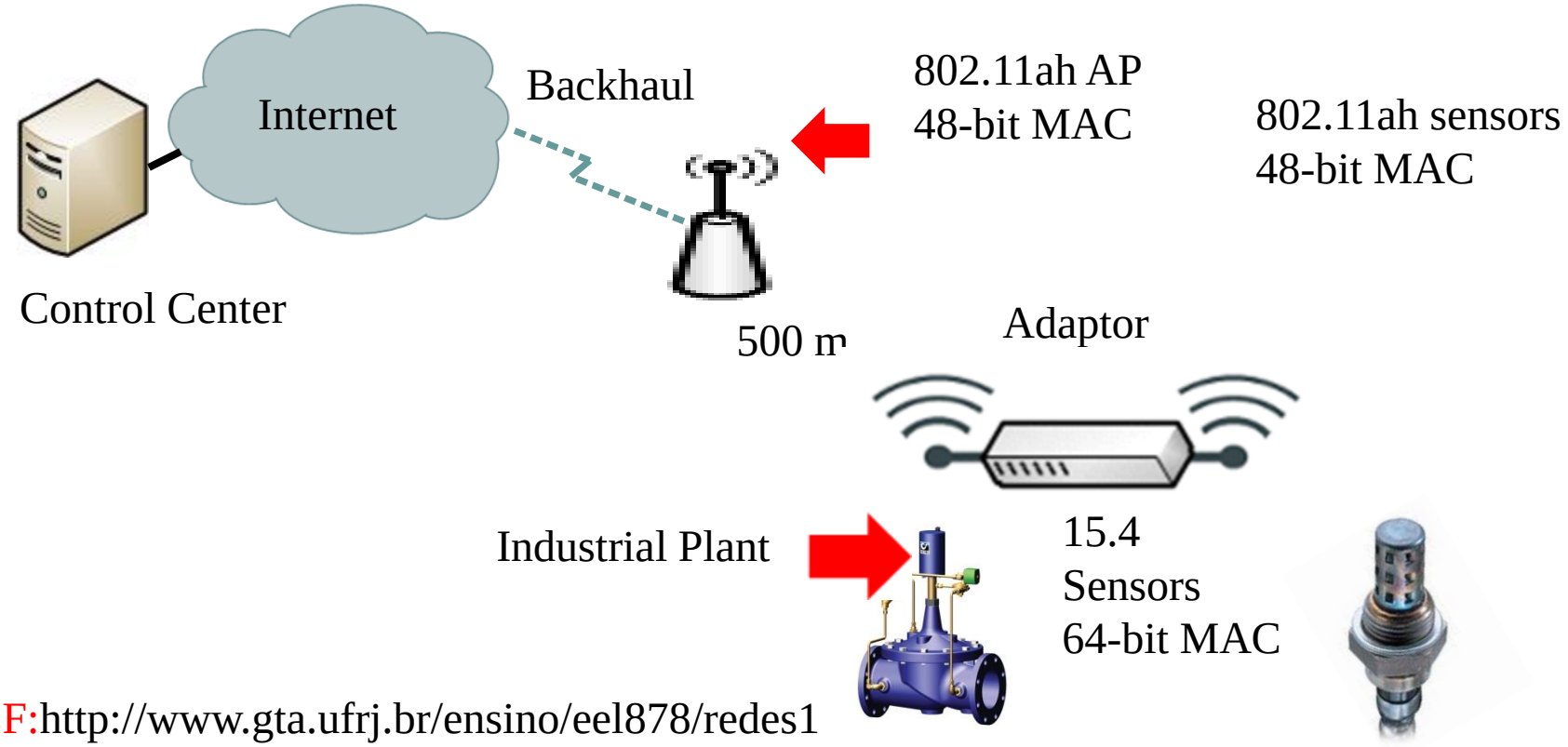
- Smart Home/Office
- Monitor smart home/office traffic using a laptop
- Laptop is connected to the LAN
- Laptop is connected to WPAN
- In order to adapt 64-bit MACs to 48-bit MACs, in the current solution, the laptop has to be a router, run routing software
- There is already another router in the home network complicating the routing

Use Case: Monitor SOHO Traffic

- Monitor smart home/office traffic using a laptop connected to both LAN and WPAN
- The laptop running routing software requires so much configuration, so it can not readily be used for monitoring
- 64 bit MAC to 48 bit MAC Adaptor/Bridge is the only solution to provide immediate monitoring capability

Use Case:11ah to 15.4

- Industrial Automation System involving 802.15.4 sensors and 802.11ah sensors/AP



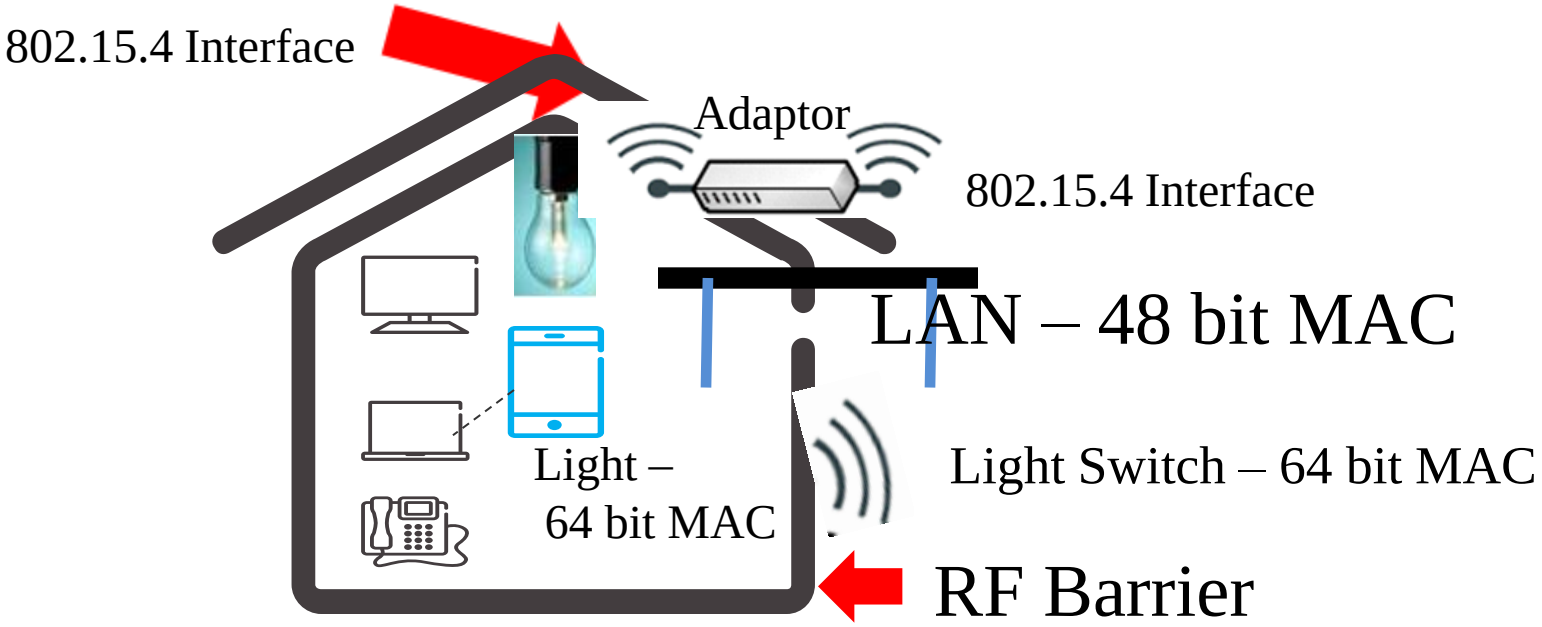
REF:http://www.gta.ufrj.br/ensino/eel878/redes1-2015-1/15_1/802.11ah/aplicacao.html

Use Case:11ah to 15.4

- 11ah to 15.4 bridge/adaptor helps connect 15.4 sensors (15.4e, 15.4g, etc.) to the control center
- 11ah to 15.4 bridge/adaptor has 11ah interface so it can connect to 11ah AP over long range (500m)
- 11ah AP backhauls the traffic eventually to the control center
- Need to consider only outgoing traffic from 15.4 network in the plant, i.e. data frames

Use Case: RF Barrier

Lights & Light Switch with RF Barrier



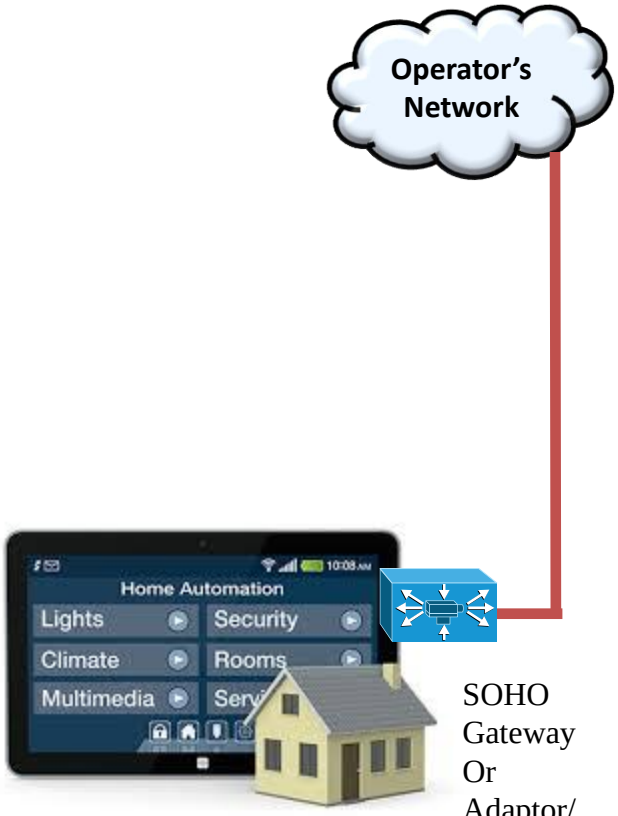
- 64 bit MAC to 48 bit MAC Adaptor/Bridge is the only solution to provide switch control to the lights in this scenario

Use Case: RF Barrier

- In this use case, the adaptor adapts from 15.4 to 802.3 and then 802.3 to 15.4
- All traffic has to be adapted, data and control frames
- 64 bit long addresses as well as 16 bit short addresses need to be considered

Use Case: Home Gateway

- Making case for smart home/office gateway (SOHO) to do bridging not routing
- Additional overhead IP imposes on a system compared to layer 2 especially if its IPv6 could reach 50%, we'll show how:
- The packet size on 802.15.4 is about a tenth of that of non-jumbo frame Ethernet.
- IPv6 header alone is 40 bytes so if the frame size is 127 bytes the IPv6 overhead is about 30% of the frame
- Add the MAC headers and that's another 12 bytes or more
- So overhead of an 802.15.4 packet carried over Ethernet on IPv6 is close to 50% of the frame.



Why Adapting/Bridging?

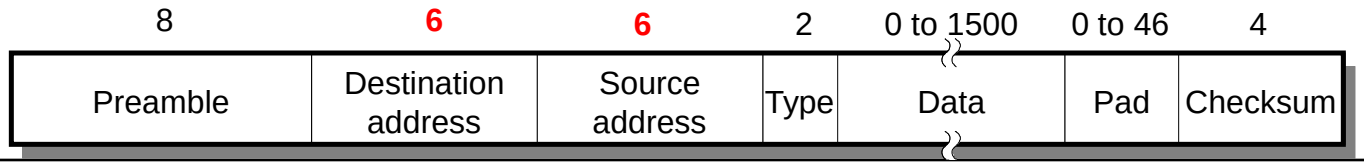
- Why adapting/bridging? if any communications equipment has a 64 bit MAC on it unless we say it can only be routed and cannot be attached to a bridged network then there is the case for bridging.
- IEEE 802 architecture (IEEE Std 802-2014) states on page 26 that bridging for an IEEE 802 network with 64-bit MAC addresses is currently not specified

Frame Formats

- 802.15.4 MAC Data Frame

Octets:2	1	4 to 20	variable	2
Frame control	Data sequence number	Address information	Data payload	Frame check sequence
MAC header			**MAC Payload**	**MAC footer**

- Only 802.15.4 MAC has 64 bit MAC addresses, others like Bluetooth or 802.15.1 are 48 bit
- 802.3 MAC Data Frame



802.15.4 to 802.3 Adaptation or Bridging

- Address bridging: 802.15.4 MAC address long format is 64 bits or 8 octets, 802.3 supports 48 bit MAC address, i.e. 6 octets
- MPDU bridging: Some 802.15.4 PHY limit MPDUs to 127 octets, 802.3 has 1500 octet MPDUs
- Avoiding control frame loops: Control frames need not be sent out in all cases except RF Barrier case as RF Barrier adaptor/bridge connects to the same PAN
- So no control frame loop possibility

MAC address adaptation

- Currently there is no solution for 64-bit to 48-bit MAC address conversion
- Also no solution for 48-bit MAC addresses conversion/mapping into 64-bit addresses
- New developments in this area include 802.1 TG dealing with local addresses
- Consider support for short (16-bit) addresses
- 16-bit short address to 48-bit MAC address conversion and vice versa (RF Barrier Use Case)

802.1 Local Addressing

- Local addressing is now part of 802.1 DCB Task Group
- Currently lots of 48-bit MAC address space exist but depletion possibility from heavy use of network ports on devices should be addressed early enough
- Local address TG will recommend how to use local addresses, 7th bit in Byte 1 set to 1
- Local address TG will develop protocols to acquire local addresses
- Address Bridging: 64-bit to 48-bit address adaptation work is needed in 802.1
- Local addresses can be used by the bridge during address bridging (both for 64-bit to 48-bit and vice versa)

- IEEE 802.15 Task Group 10 finished developing a new protocol on Layer 2 routing in Wireless Personal Area Network (WPAN)
- After the incoming frame if bridged to 802.15 network, L2R protocol can route it to the destination

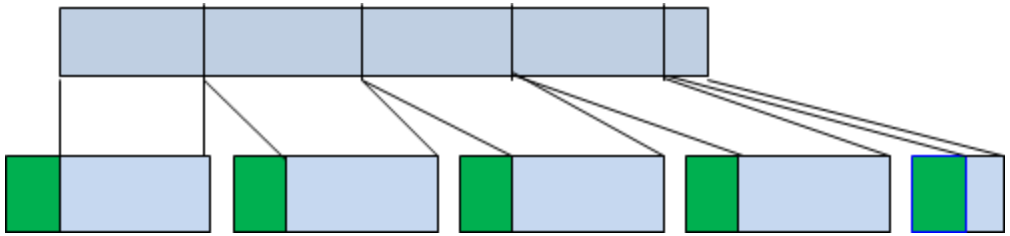
MPDU Size Adaptation

- 802.15.4 amendments that can support 1500 octets: 802.15.4g, 802.15.4m
- Other 802.15 technologies that have smaller MPDU sizes like 127 octets in 802.15.4e, 802.15.4k
- Ethernet can carry frame sizes 64 to 1500 octets
- MPDU bridging: Bridge/adaptor may receive frames longer than 802.15 can handle, fragmentation/reassembly is needed in 802.15

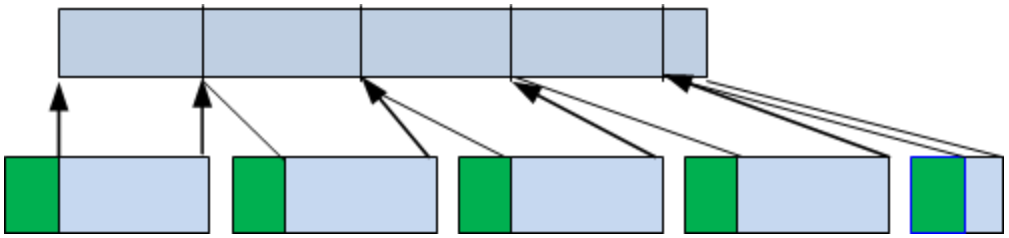
Dealing With Frame Sizes

- Segmentation and reassembly of frames
- Adaptor/Bridge does segmentation of frames
- Receiver does reassembly

Segmentation



Reassembly



Timing Considerations

- 802.15.4 MAC allows low-power/inactive mode
- Determined by superframe with inactive period
- Inactive period could be larger than 0
- Adaptor/Bridge have to stay away from transmitting the frame during inactive period
- Some 802.15.4 MAC supports sleeping mode
- Those MACs also have wakeup frames (as defined in 802.15.4e, 4k)
- Adaptor/Bridge have to wake up the node before transmitting the frame

Thank you!

Questions