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Corporate Technology

Status of IEEE 802.11s

WLAN Mesh Networking Task Group

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ITG 5.2.4 Workshop „Wireless Mesh and Relay Networks“
27. October 2008, Munich

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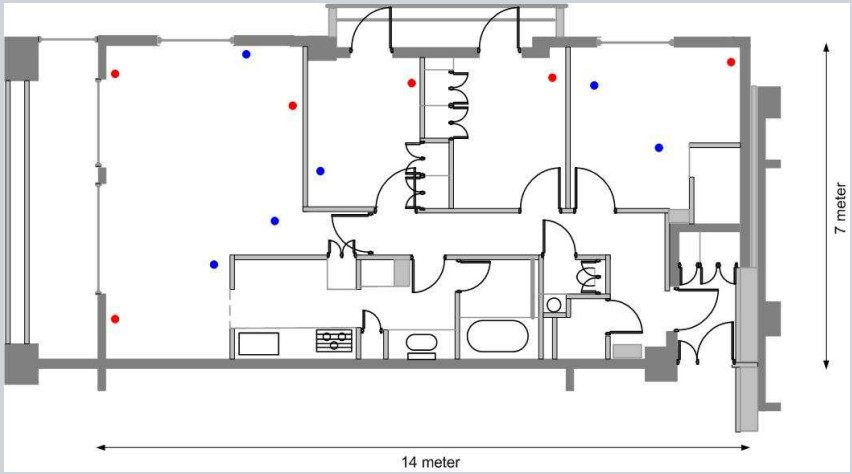
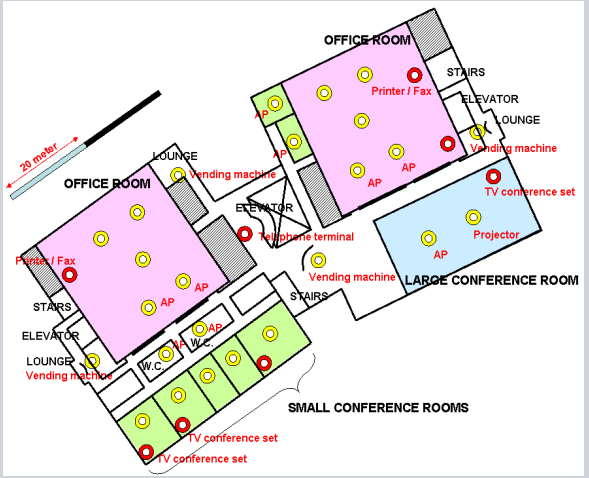
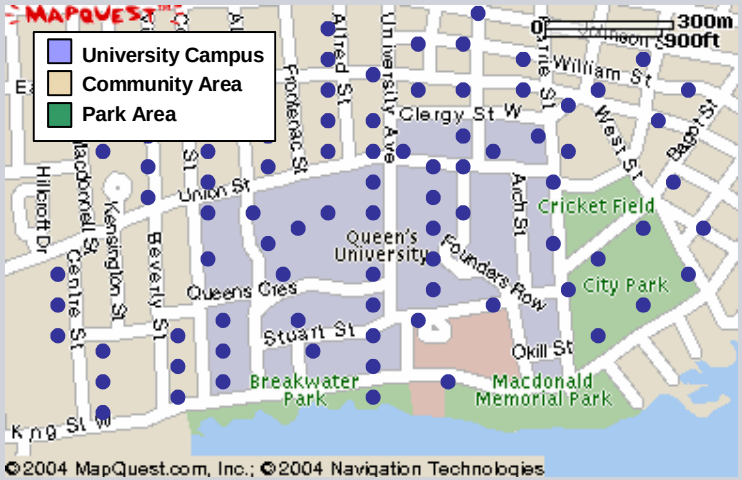
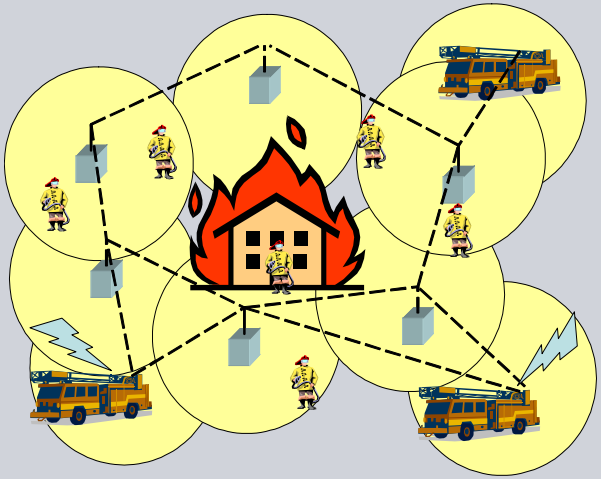
IEEE 802.11s Usage Scenarios









Residential (top), Campus / Community / Public Access (bottom)
pictures from: IEEE document 11-04/0662r16

Office (top), Public Safety (bottom)

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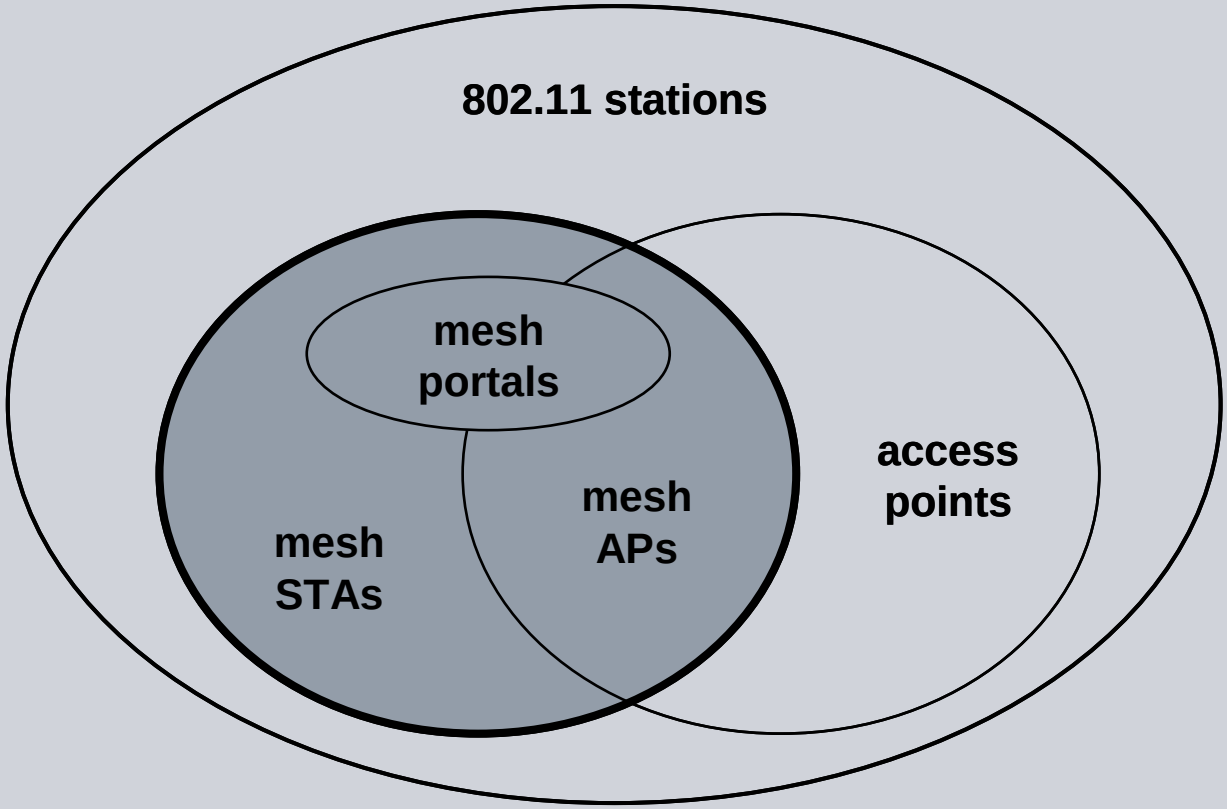
Terms and Definitions

Terminology for mesh networking

- *path selection*
- *mesh BSS*
- *mesh station (mesh STA, MSTA)*
- *mesh AP: mesh STA co-located with an AP*



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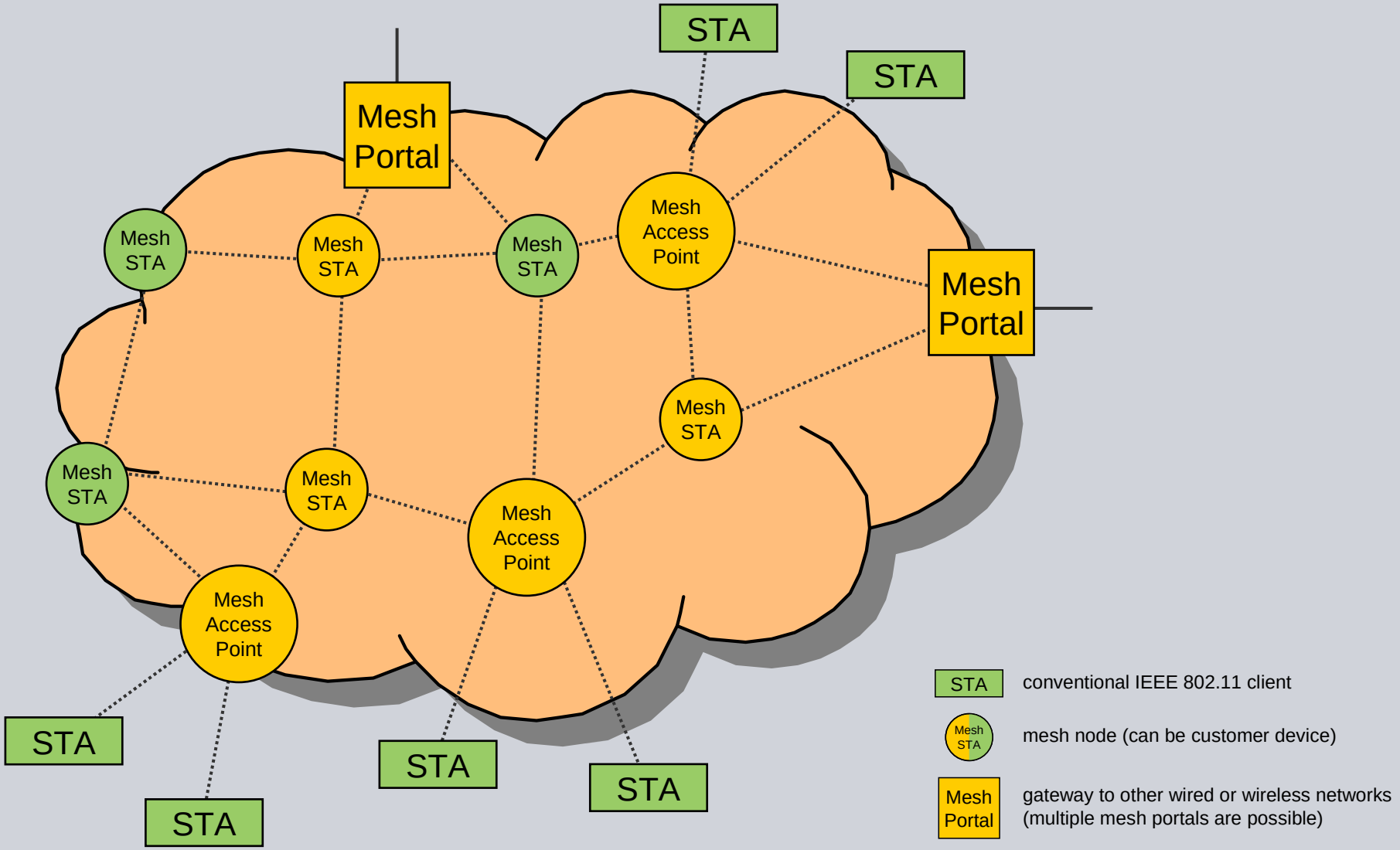
WLAN Mesh – A General Example



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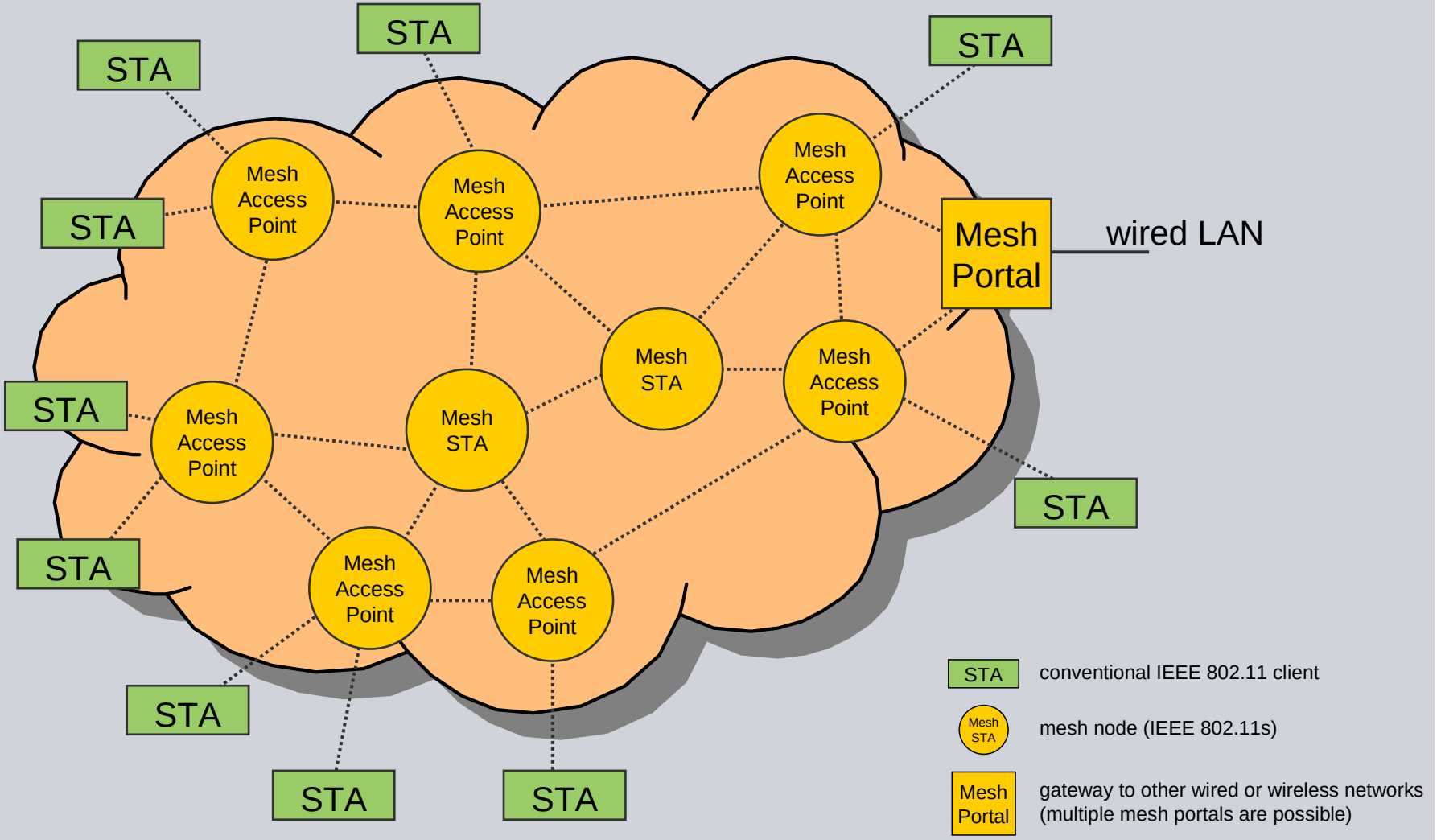
WLAN Mesh – Backhaul Mesh with Legacy Stations



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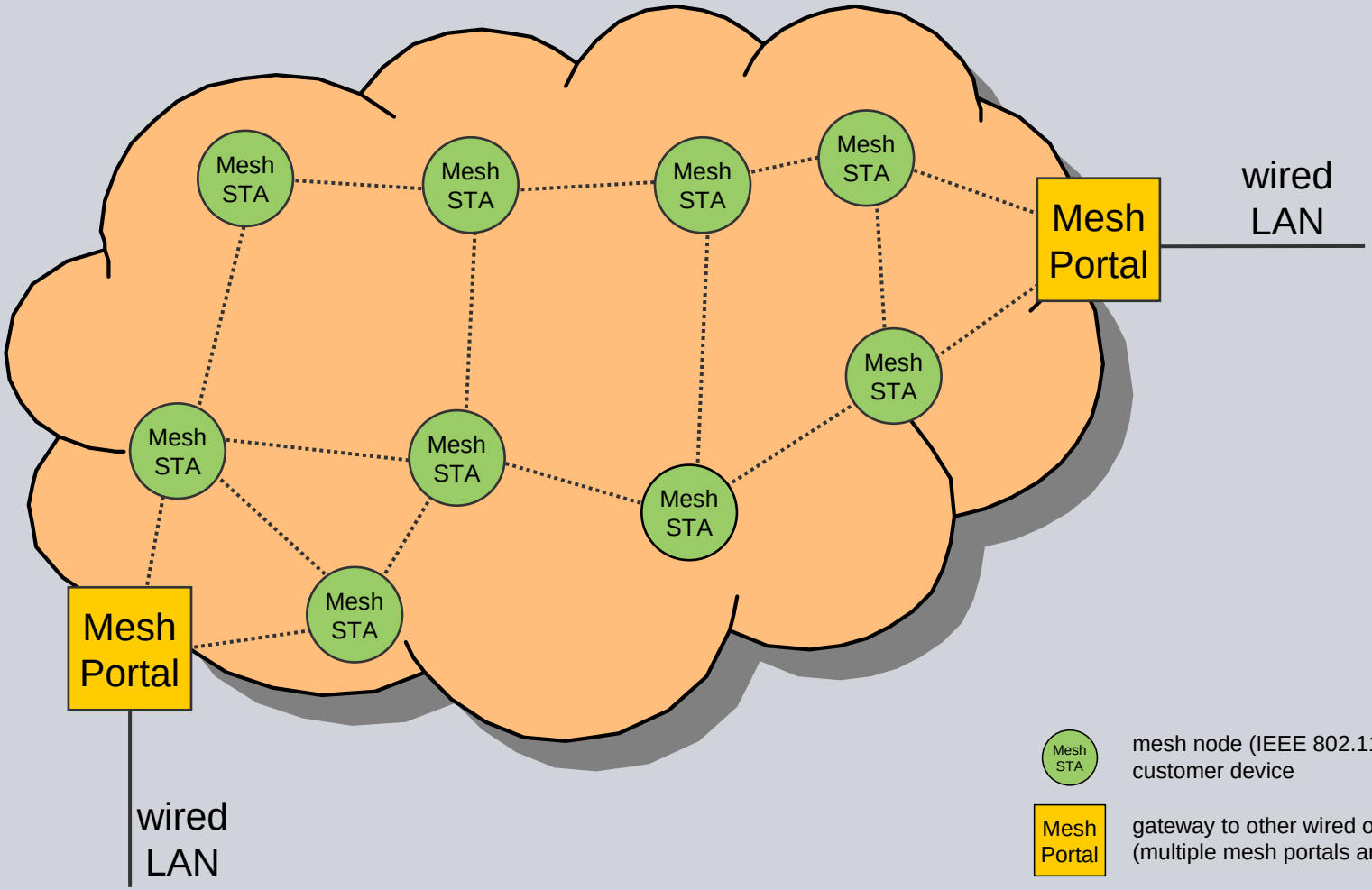
WLAN Mesh – Client Mesh



Major Properties of IEEE 802.11s WLAN Mesh Networking (I)

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MAC address based mesh routing protocol
⇒Hybrid Wireless Mesh Protocol (HWMP)

HWMP

Layer 2 routing protocol extensible mesh path selection architecture

Extensible Path Selection Framework

radio-aware routing metric
⇒airtime link metric

use of WDS 4-address frame or extension
- extension of 4 addresss frame format
- 6-address scheme for IEEE 802.11 mesh data frames

6 Address Scheme

mesh unicast / multicast / broadcast data delivery
- unicast:
  - via paths established with path selection protocol (HWMP)
  - PTK for unicast transmission
- multicast / broadcast:
  - flooding of broadcast frames in mesh network
  - GTK for security

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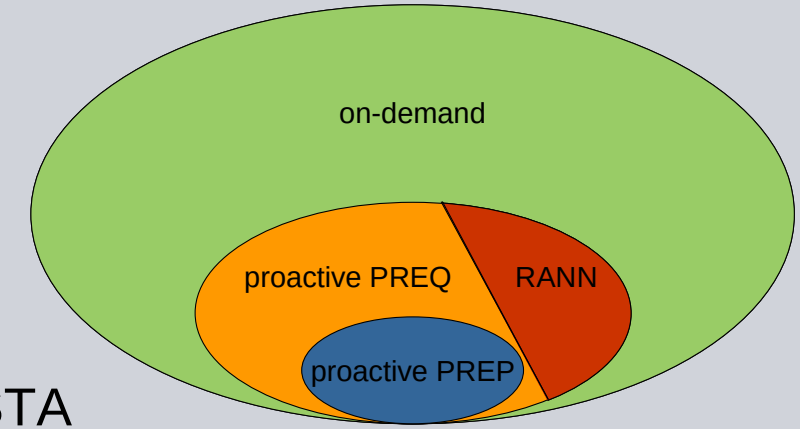
Hybrid Wireless Mesh Protocol

- Ad hoc On-demand Distance Vector Routing Protocol (AODV) as basis
  - uses MAC addresses
  - works with arbitrary link metrics
  - handles proxy MSTAs
  - always available



- Proactive tree to designated MSTAs
  - requires MSTA configured as root MSTA
  - periodic flooding of proactive PREQs or RANNs by root MSTA
  - 3 modes:
    - proactive PREQs – on-demand PREP (no proactive PREP)
    - proactive PREQs – proactive PREP (configured at root MSTA)
    - root announcement (RANNs)

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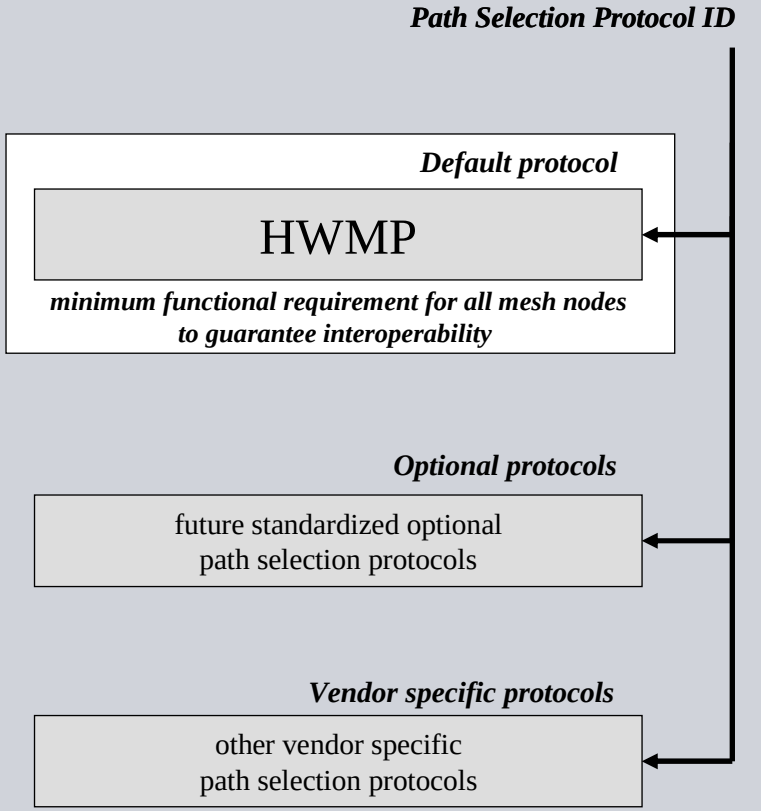
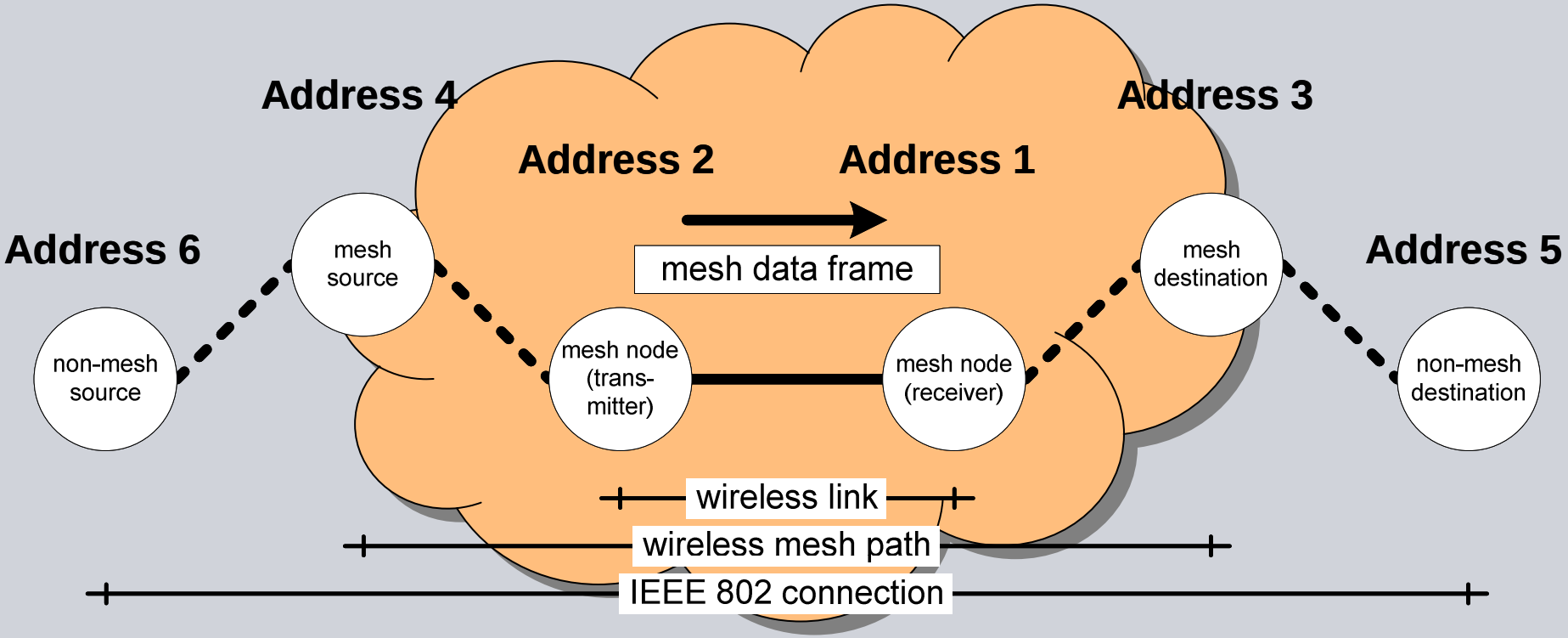
Extensibility in IEEE 802.11s

- make IEEE 802.11s adaptable to different usage scenarios
- allow the use of vendor specific solutions for routing and routing metrics
- choice of default routing protocol, optional standardized routing protocols, or vendor specific routing protocols
- choice of default routing metric or vendor specific routing metrics
- works over any IEEE 802.11 PHY/MAC (e.g. 802.11n)
- used protocol and metrics announced in mesh identifier



6-Address Scheme for Mesh Data Frames



existence of addresses 5 & 6 indicated by address extension mode setting in mesh data frame

Major Properties of IEEE 802.11s WLAN Mesh Networking (II)

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support for single and multiple radios
- recommendations for multiple interfaces
- specific solutions are implementation topic

mesh network size: ca. 32 mesh nodes (up to 50 mesh nodes)
- all mechanisms will scale to up to 50 mesh nodes

mesh security: IEEE 802.11i as basis
- IEEE 802.11i for link security
- adaptations for security over mesh backhaul
- Mesh Security Architecture (MSA) with concepts from IEEE 802.11r
- MSA-PSK for client meshes

backwards compatibility with legacy BSS and STA
- separation between mesh functionality and AP functionality

no PHY changes required
- done

Major Properties of IEEE 802.11s WLAN Mesh Networking (III)

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time synchronization
- needed for power save and mesh deterministic access
- link-local time synchronization

power save
- needed for battery-powered customer devices, GreenIT
- light sleep and deep sleep modes for different degrees of power save

mesh deterministic access (MDA)
- needed for applications with strict delay requirements
- distributed reservation of MDA opportunities (MDAOP)

compatibility with higher-layer protocols (transparent to higher layers)
- transparent to IP, IEEE 802.1

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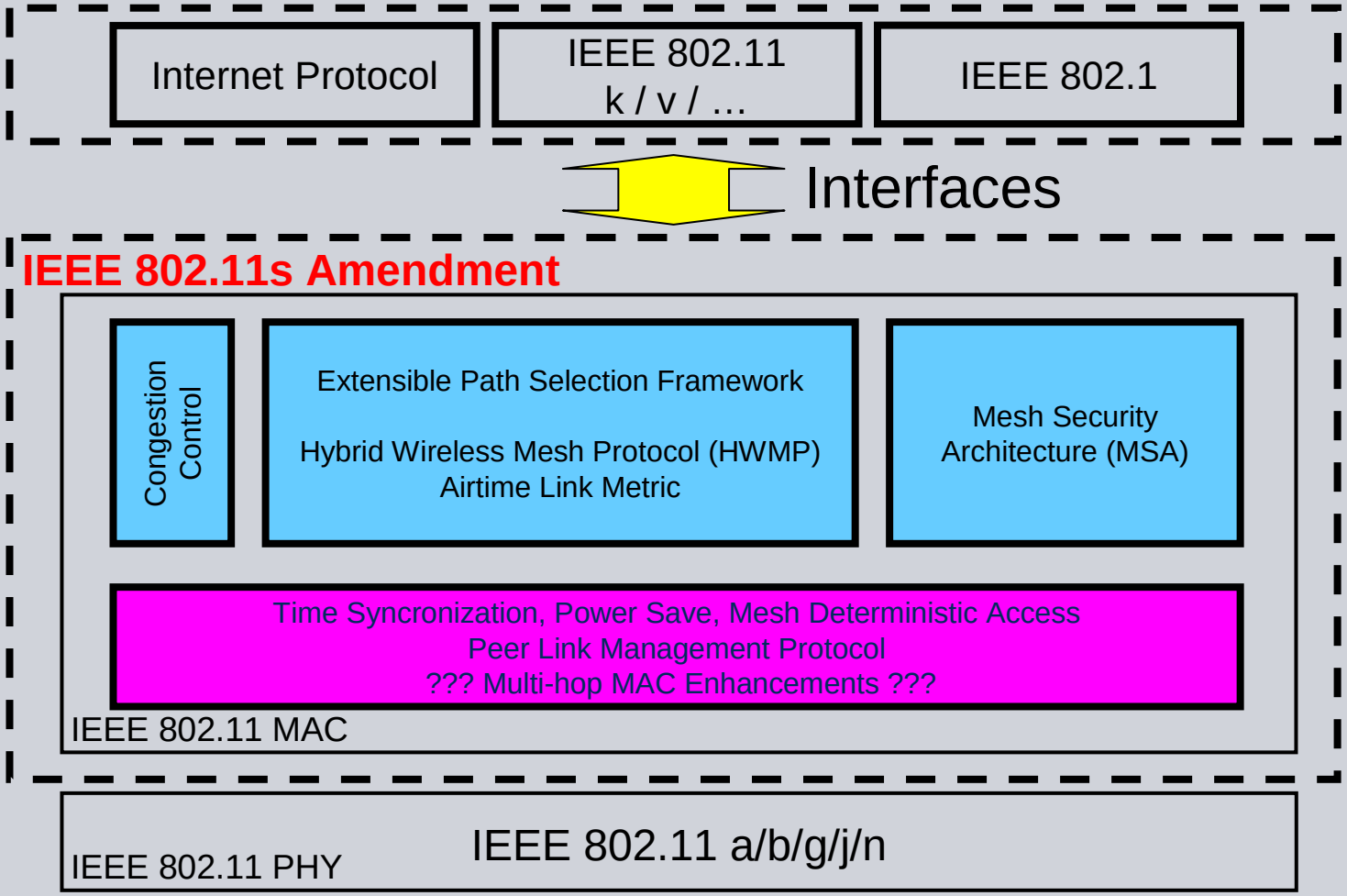
Major Functional Components for 802.11s Mesh STAs



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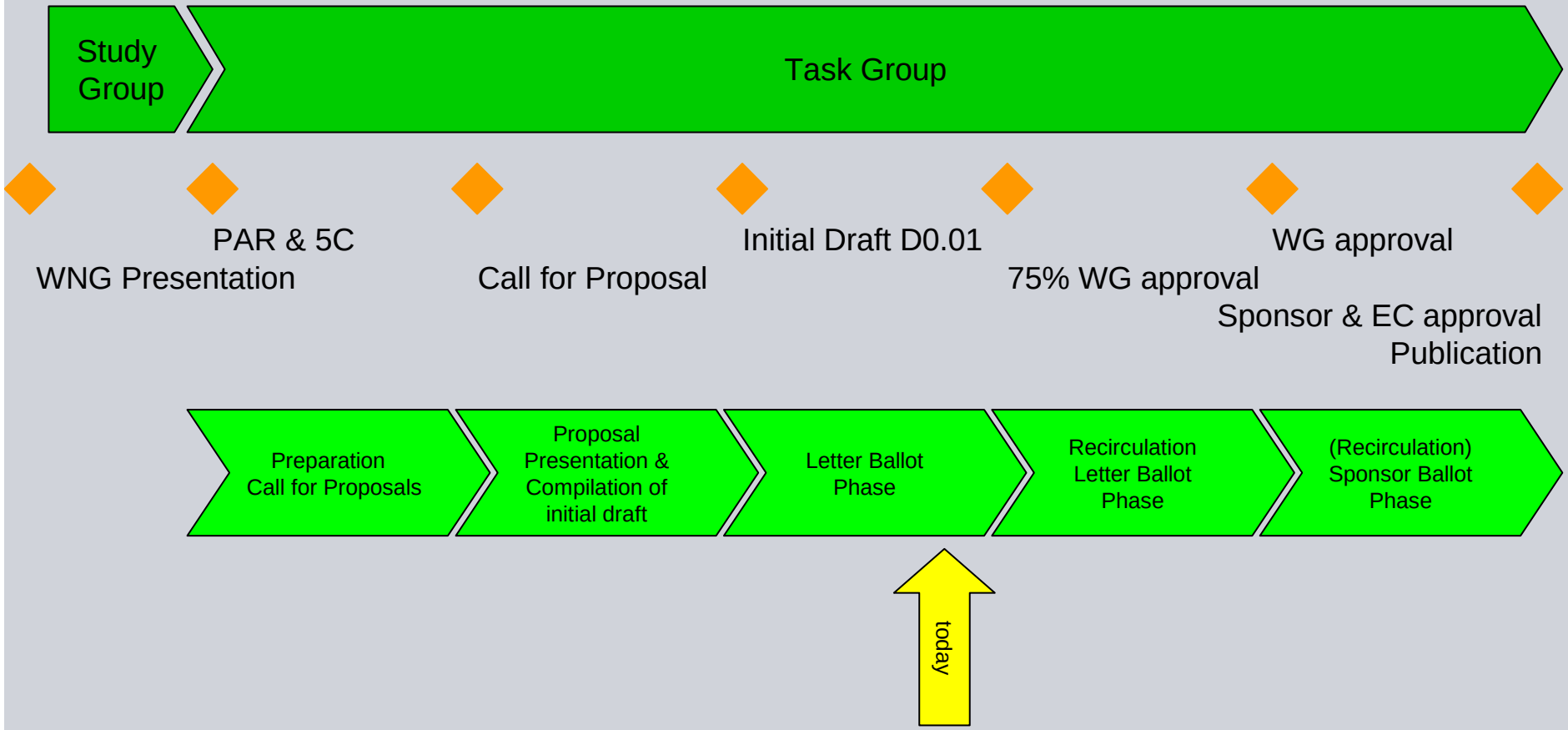
IEEE 802.11 Standardization Process



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Status of IEEE 802.11s (WLAN Mesh Networking)

Proposals

- 15 proposals to IEEE 802.11s in July 2005, includes a proposal by Siemens
- Draft D0.01 in March 2006

Reviews / Letter Ballots

- Internal Review during April 2006 by Task Group s
- 1st Letter Ballot in December 2006 / January 2007
  - failed with 48% yes votes, 5714 comments
- 2nd Letter Ballot in April / May 2008
  - failed with 61% yes votes, 1964 comments, ca. 600 still open

Technical Content

- AODV + configurable tree to root mesh STA with radio-aware metric based on MAC addresses (layer 2 routing protocol)
- extensible routing architecture
- security for transport functionality and authentication with access points (based on 802.11i)

Next Steps

- resolution of comments from letter ballot in Task Group s
- third letter ballot (Draft D3.0) in January 2009
- 2010 standard approved

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Comment Resolution Progress in IEEE 802.11s