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QUALCOMM® MSM™ Interface (QMI)

QUALCOMM CDMA Technologies

80-VA615-1 B

QUALCOMM® Proprietary

QUALCOMM Incorporated
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San Diego, CA 92121-1714
U.S.A.

Revision History

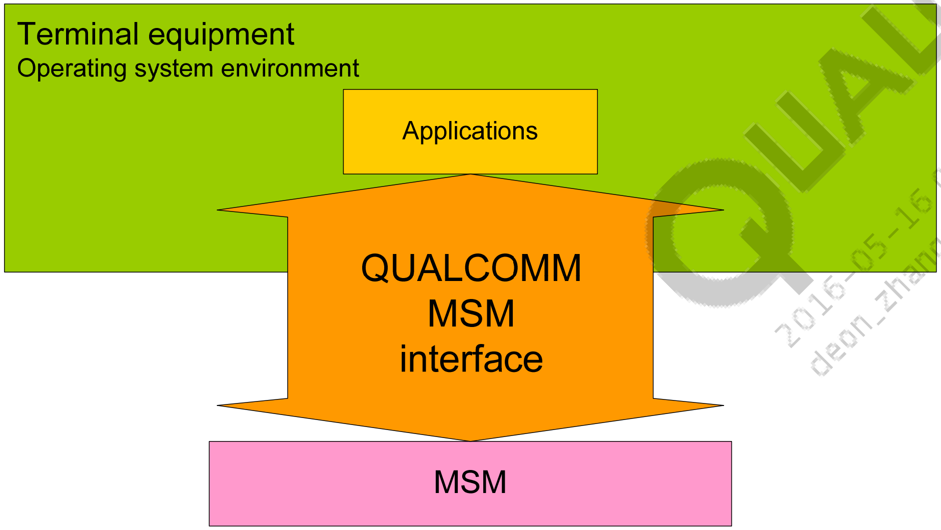
Version	Date	Description
A	Nov 2005	Initial release
B	Apr 2006	Minor clarifications and changed title

Contents

- Introduction
- QMI Architecture
- R_m Network Interface (R_m Net) QMI Logical Device
- Questions?

Introduction

QMI Overview



- QMI
  - Defines the interface between MSM™ and attached Terminal Equipment (TE)
  - A framework to export multitude of services from MSM to TE including:
    - » Interconnection guidelines
    - » Logical device enumeration
    - » QMI service protocol message definitions
  - Fully extensible, scalable, and portable architecture

    Note: R_m network interface is a new logical device in the QMI framework

QMI Design Goals

- Hardware form factor independent
  - Supports any TE form factor
    - » Example – PC, notebook, laptop, PDA, SmartPhone, etc.
  - Supports any MSM form factor
    - » Example – Embedded module, removable data card, tethered phone, etc.
- Interconnect independent framework
  - Portable to various MSM-TE interconnects
    - » Example – USB, Bluetooth® (BT), serial bus, shared memory, IPC, etc.
- Operating system independent
  - Extensible to any OS environment on TE

QMI Usage Scenarios

- PC users
  - TE
    - Laptops/desktops running third-party OS
      - Example – Windows® XP, Longhorn, Linux, MacOS
  - MSM
    - Phone tethered via USB
    - Data card via USB (PCI express)
    - Phone connected via BT
- PDAs and SmartPhone
  - Various combinations of TE and MSM
    - Standalone MSM with external applications processor (TE)
    - Standalone MSM with no applications processor (tethered data service)
    - Combined MSM and applications processor
      - Apps processor running AMSS or third-party OS

QMI Architecture

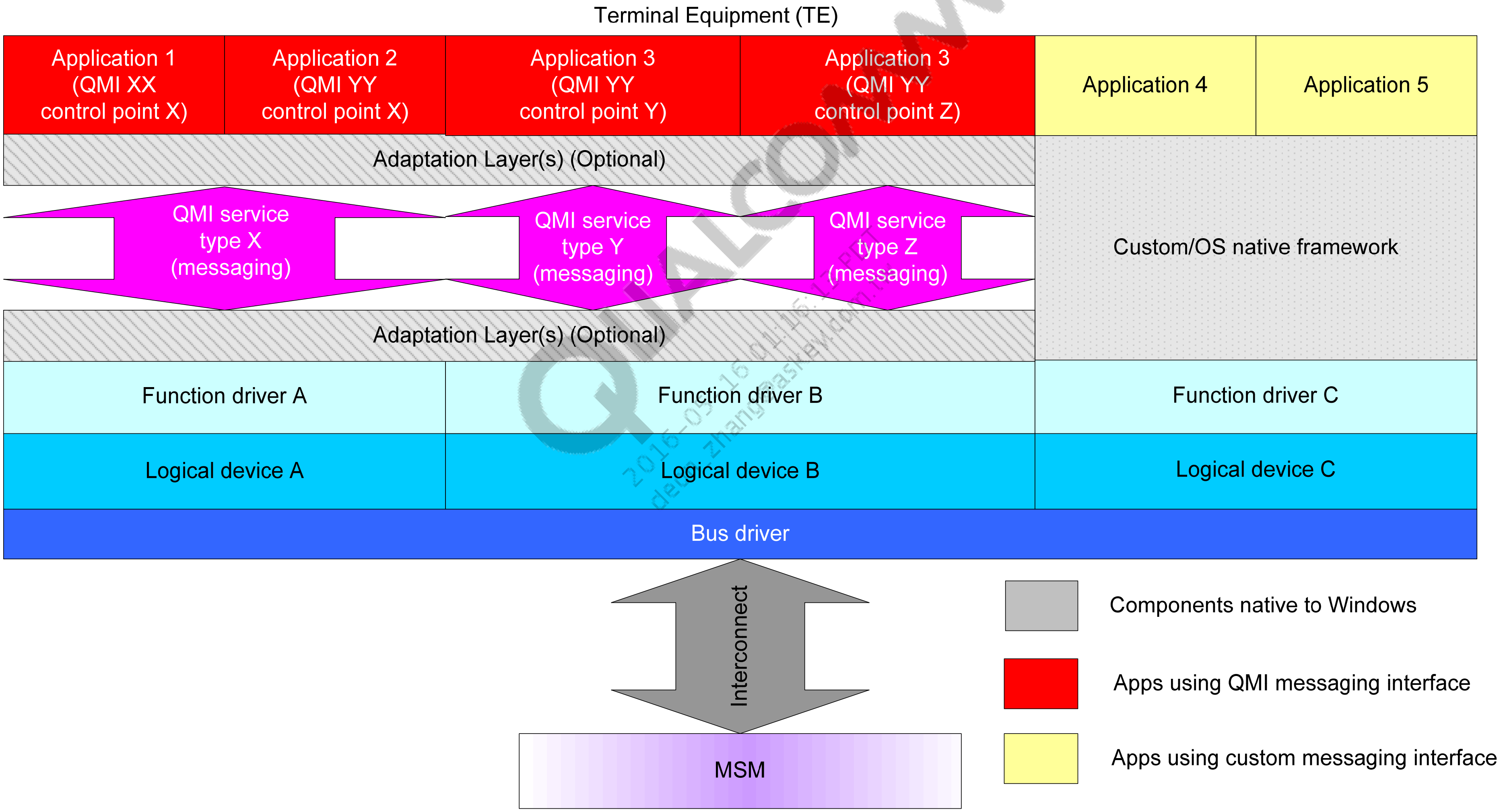
QMI Architecture

- QMI architecture defines three components
  - QMI device connectivity framework
    - MSM-TE connectivity and logical device configuration
  - QMI service model
    - Client server architecture
  - QMI control messaging interface
    - Communication endpoints and protocol stack

QMI Interconnect Requirements

- Supports one or more logical devices
  - Each has control and/or data channel
- Control channel
  - Bidirectional
  - Reliable
  - Optional for custom logical devices
  - Provides packet framing function
- Data channel
  - Bidirectional
  - Best effort
  - Provides packet framing function

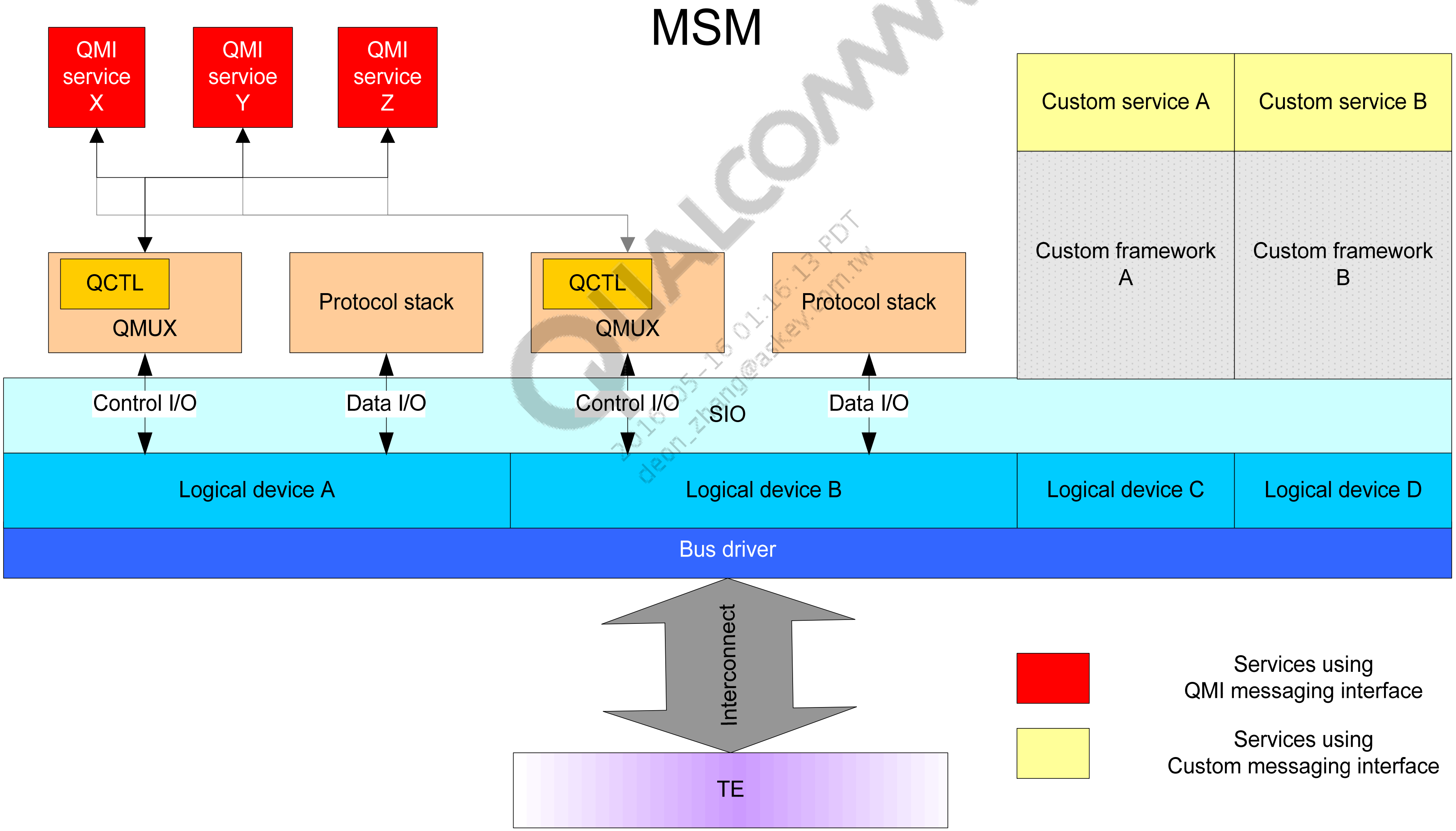
QMI Connectivity Framework – TE


Terminal Equipment (TE)
Application 1 (QMI XX control point X)
Application 2 (QMI YY control point X)
Application 3 (QMI YY control point Y)
Application 3 (QMI YY control point Z)
Application 4
Application 5
Adaptation Layer(s) (Optional)
QMI service type X (messaging)
QMI service type Y (messaging)
QMI service type Z (messaging)
Custom/OS native framework
Adaptation Layer(s) (Optional)
Function driver A
Function driver B
Function driver C
Logical device A
Logical device B
Logical device C
Bus driver
Interconnect
MSM
Components native to Windows
Apps using QMI messaging interface
Apps using custom messaging interface

QMI Framework Components

- Bus driver
  - Driver for the bus controller
  - Mostly provided natively by OS vendor
- Logical devices
  - Exposed through bus enumeration
    - » With plug-and-play, logical device enumeration may be dynamic
    - » Without plug-and-play, device enumeration is statically defined
  - QMI framework defines logical devices that are exposed
- Function drivers
  - Exports specific functionality to applications
  - Upper layer exposes OS native and/or custom API to applications
  - Lower layer interfaces to MSM via QMI messaging
    - » Uses one or more QMI services
    - » May expose zero or more QMI service APIs directly to applications

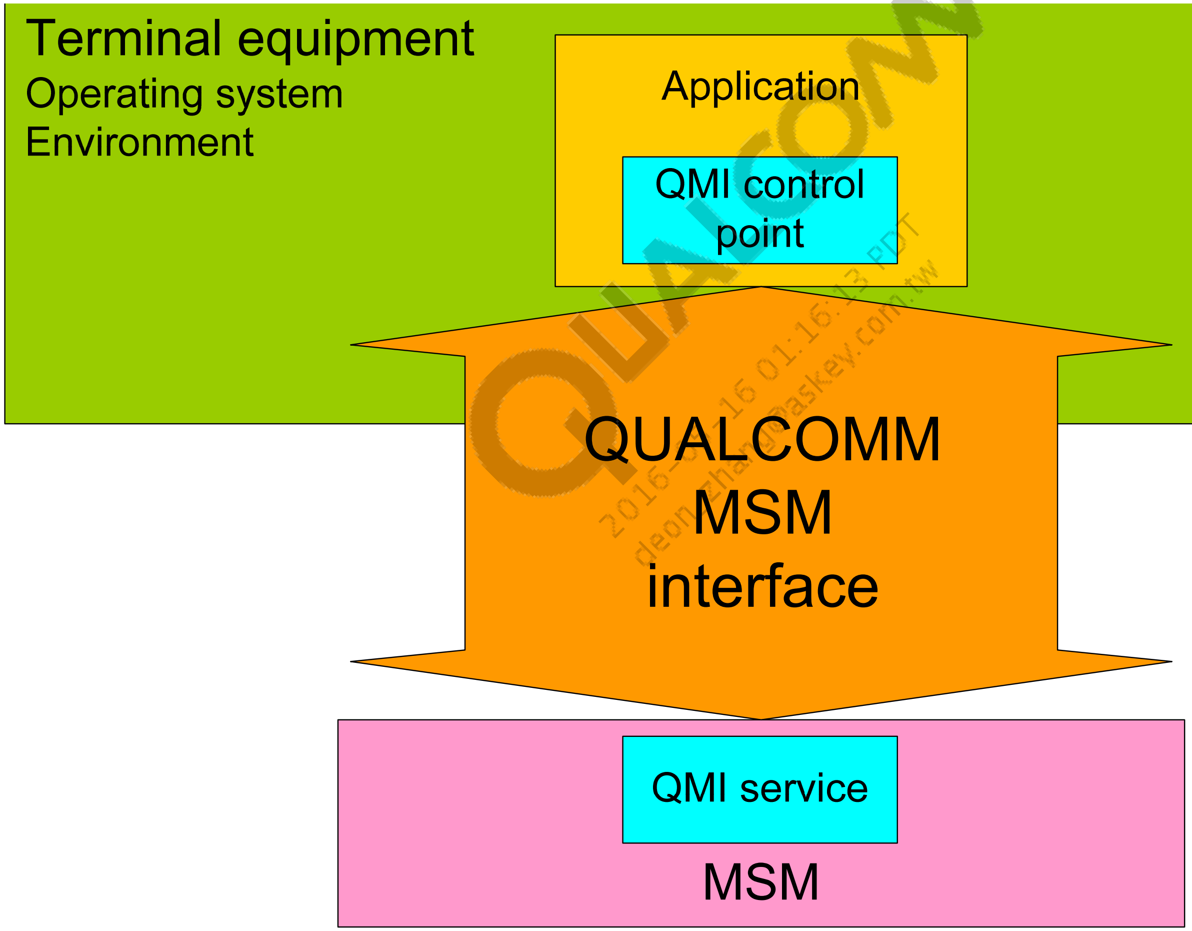
QMI Connectivity Framework – MSM



🟥 Services using QMI messaging interface

🟨 Services using Custom messaging interface

QMI Service Model



QMI Service Model (cont.)

- QMI supports two types of services
  - QMI (native) service
    - » Uses QMI messaging via control I/O path of one or more logical devices
    - » Addressed by a unique identifier (QMI service type)
    - » Service-specific protocol defined in associated QMI service ISOD
      - QMI vendor-defined services are allowed
  - Custom service
    - » Does not use QMI messaging interface
    - » Uses custom data format on control and/or data channels
    - » Includes legacy services, e.g., MSM Diag
    - » Suitable when data format is already defined, e.g., MSM Diag, SyncML

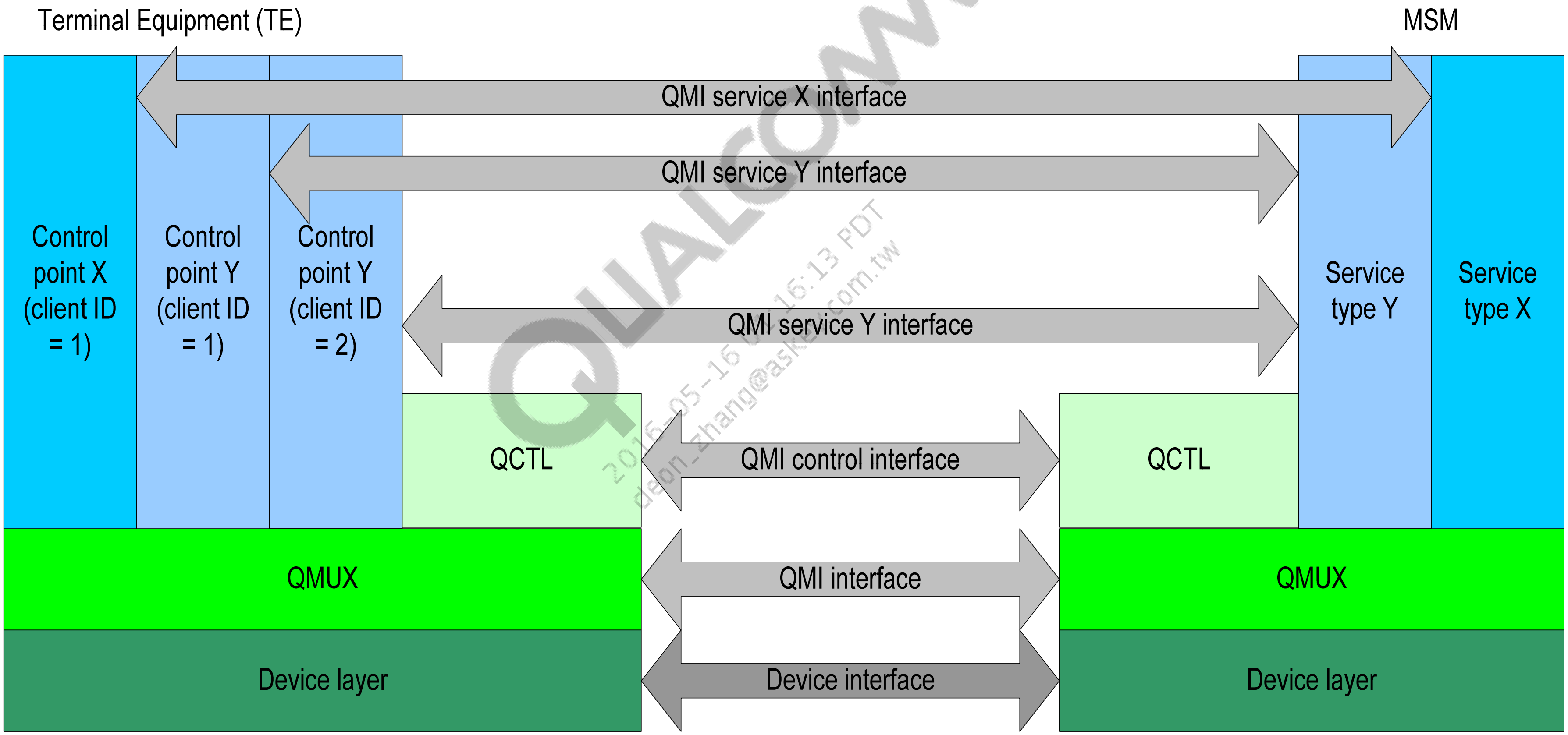
QMI Service Model (cont.)

- QMI messaging defines two communication endpoints
  - Service entity
    - » Exports a specific QMI native service from the MSM
    - » Separate service entities for each defined QMI service
    - » Supports a certain number of control points, e.g., one if service only wants one controller to avoid contention
  - Control point
    - » Customer of a QMI native service
    - » Identified by a 1 byte client_id assigned by service entity
    - » Typically resides in TE as part of a User mode application/module
      - May exist in function driver
    - » Application may own multiple control points
      - Associated with different services

QMI Service Model (cont.)

- QMI services defined today
  - QMI Control Service (QMI_CTL)
  - QMI Wireless Data Service (QMI_WDS)
  - QMI Device Management Service (QMI_DMS)
  - QMI Network Access Service (QMI_NAS)
- Future services
  - QMI Quality of Service (QMI_QOS)
  - QMI Location-Based Services (QMI_LBS)

QMI Messaging Interface



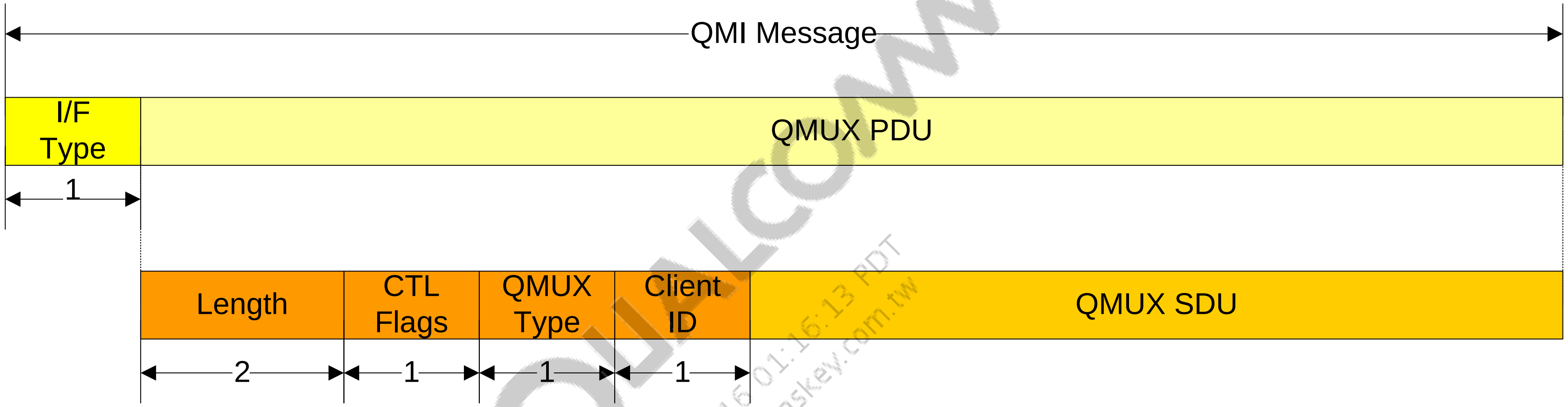
QMI Messaging Interface (cont.)

- QMUX
  - QMI control channel multiplexing and routing layer
  - All QMI messages are transported via this layer
  - Routes QMI messages to appropriate service/control point entities
  - One QMUX instance per logical device
  - For each logical device, allows:
    - » Multiple services to be exported
    - » Multiple control points per service

QMI Messaging Interface (cont.)

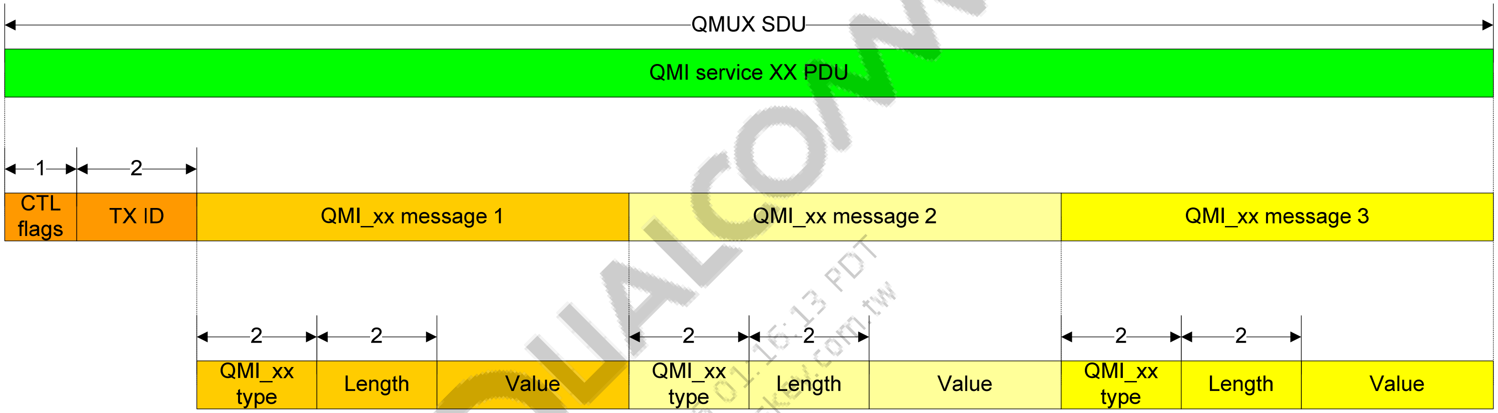
- QCTL – QMI control service
  - Internal QMI service with a single control point – QMUX layer on TE
    - Client ID of 0 reserved for QCTL control point
    - One QCTL instance per QMUX
  - Purpose
    - Client ID management for control points (applications)
    - Assigning QMUX instance identifier for associated QMUX layer
    - May be extended in future for other administrative/control tasks

QMI Message Format



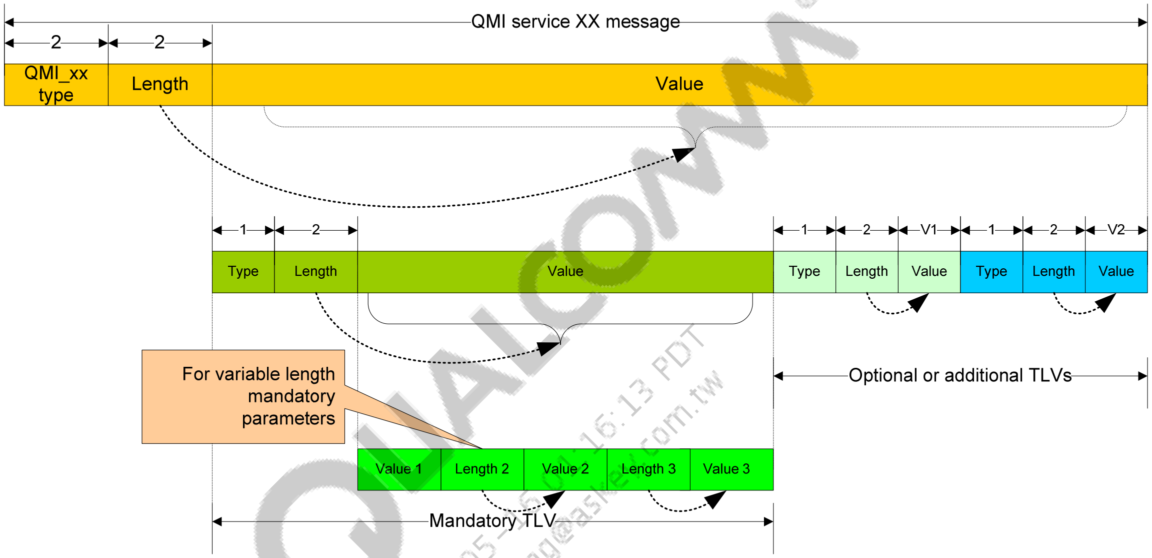
- I/F Type – Identifies the type of interface (1 = QMUX Ver 1.0)
- Length – Total length of QMUX PDU (including length itself)
- CTL – Flags specify sender type (control point or QMI service)
- QMUX Type – Identifies the QMI service to which this message belongs
- Client ID – Identifies the control point to which the message pertains
  - 0xFF = broadcast → to all Control Points
- QMUX SDU – Actual message content; these are defined by the appropriate QMI service specification

QMUX SDU Format



- Control flags
  - Compound message bit – Set if multiple messages are contained in this service PDU
  - OpCode bits – Indicate the message(s) type (command, response, or indication)
- Transaction ID
  - Identifier to correlate a response with a command
  - May be used as a sequence number in the case of indications (not required)
- Message bundling
  - Messages may be bundled in a single service PDU, indicated by compound message bit
  - All messages must belong to same QMI service
  - All messages must be of same OpCode (command, response, or indication)

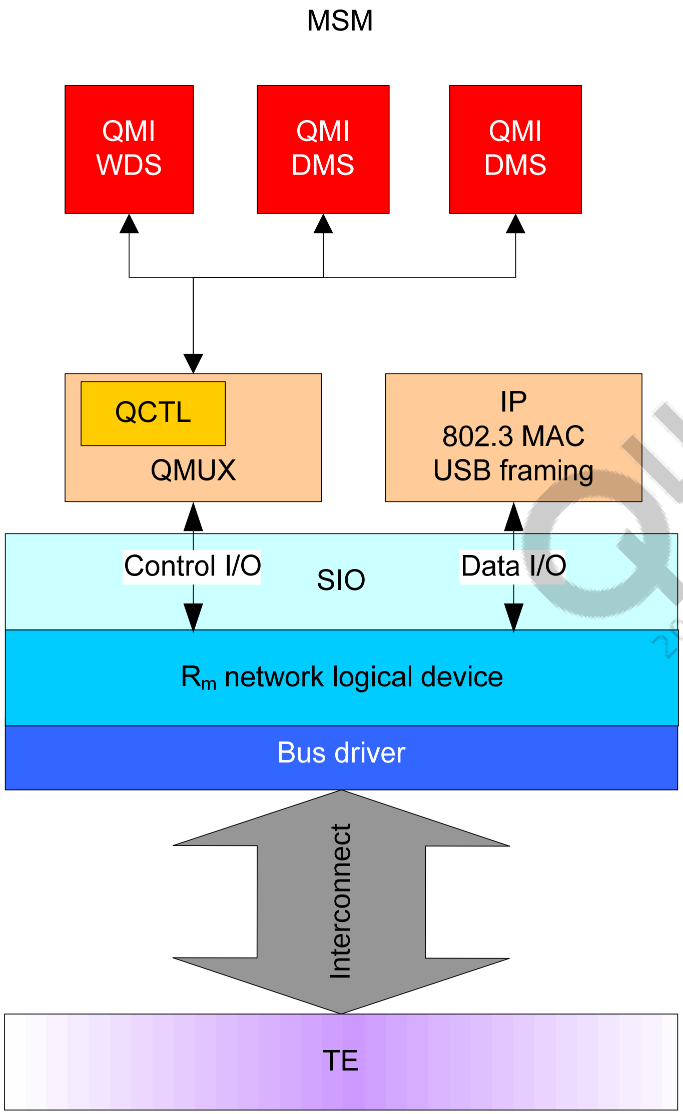
QMI Service Message Format



- Each service message consists of one or more TLVs
  - One mandatory TLV placed at the beginning of the message payload
  - Zero or more optional TLVs
  - Optional TLVs support backward compatibility within a major version
- QMI_xx type identifies the message type
  - Unique within the service type
- Overall message format itself is a TLV

R_m Network Interface (R_m Net) QMI Logical Device

R_m Network Interface



- A new QMI logical device for data service
- In accordance with QMI architecture uses:
  - Data I/O channel for IP data transfer
  - Control I/O channel for QMI messaging
    - Messaging supports functionality similar to AT commands
- May be used in place of legacy USB (PPP) modem interface
  - Legacy modem (AT/PPP) device still enumerated alongside R_m Net device

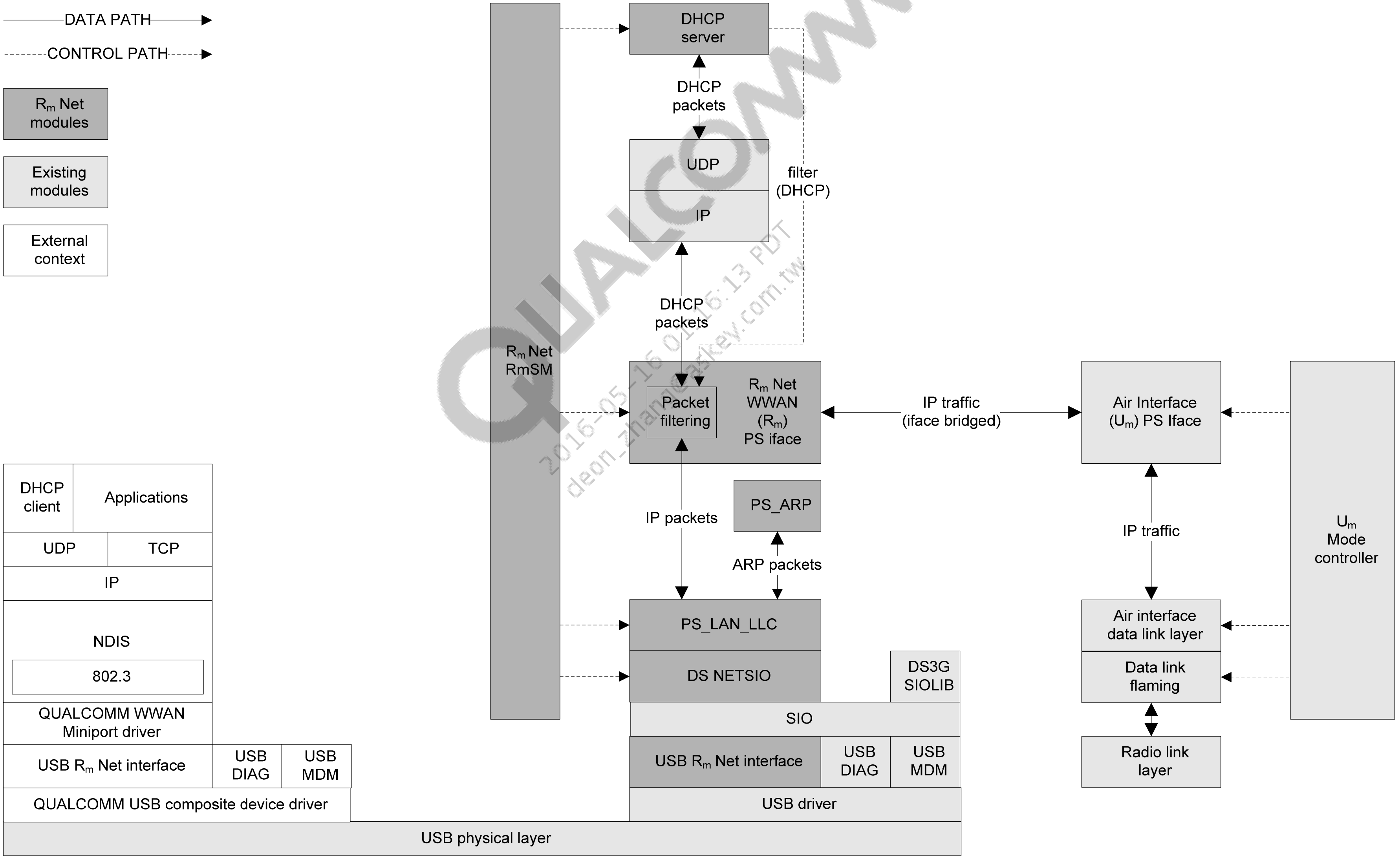
R_m Network Interface (cont.)

- Motivated by carrier demand for Connection Manager software
  - Connection Manager application controls data session on TE
  - Feature enriched – Configures and controls advanced data functionality, e.g.:
    - Authentication credentials
    - Data session profiles
    - Serving System information
    - Extensible to support new data features as they are incorporated, e.g., QoS
- Benefits
  - Asynchronous and binary control channel
  - Control interface is always available (even during data session)
  - Remove QMI control interface is always on (even during data session)
  - Eliminates R_m HDLC framing overhead
  - Will support new functionality that is not available through AT commands
  - NIC-like user experience

R_m Net Data I/O Channel

- Standard-based data link layer
  - 802.3 Ethernet data link layer (replaces PPP)
  - Address configuration via DHCP (IETF RFC 2131)
- Link layer framing implemented in USB drivers
  - End of packet delimited by short (or 0-length) USB frame
  - Reference USB drivers shipped with MSM software
- Auto-connect feature
  - Call can be established when USB cable is plugged in

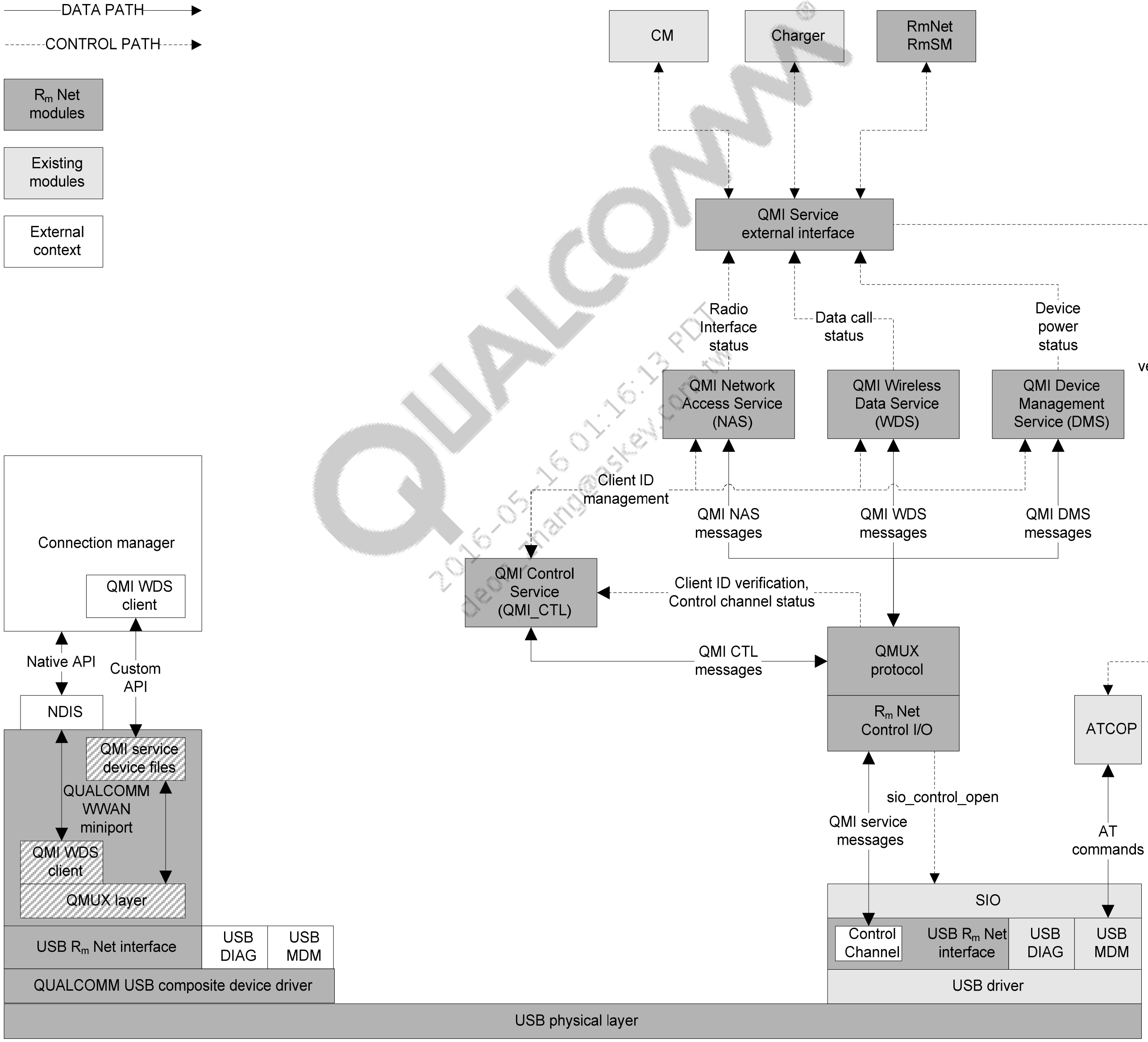
R_m Network Interface Data Path (Phase One – QMI)



R_m Net Control Channel

- Available during data connection (unlike AT commands)
- Exports functionality to be used by Connection Manager
  - QMI WDS
    - Start/stop network interface
    - Obtain bearer technology and data rate
    - Packet transfer statistics
    - Go active/go dormant
  - QMI NAS
    - Obtain serving system
    - Obtain signal strength
    - Perform network scan, register, attach
    - Configure home/preferred/forbidden networks
  - QMI DMS
    - Device identification
    - Device power source and charge level
- Additional services to be added based on licensee and carrier requirements

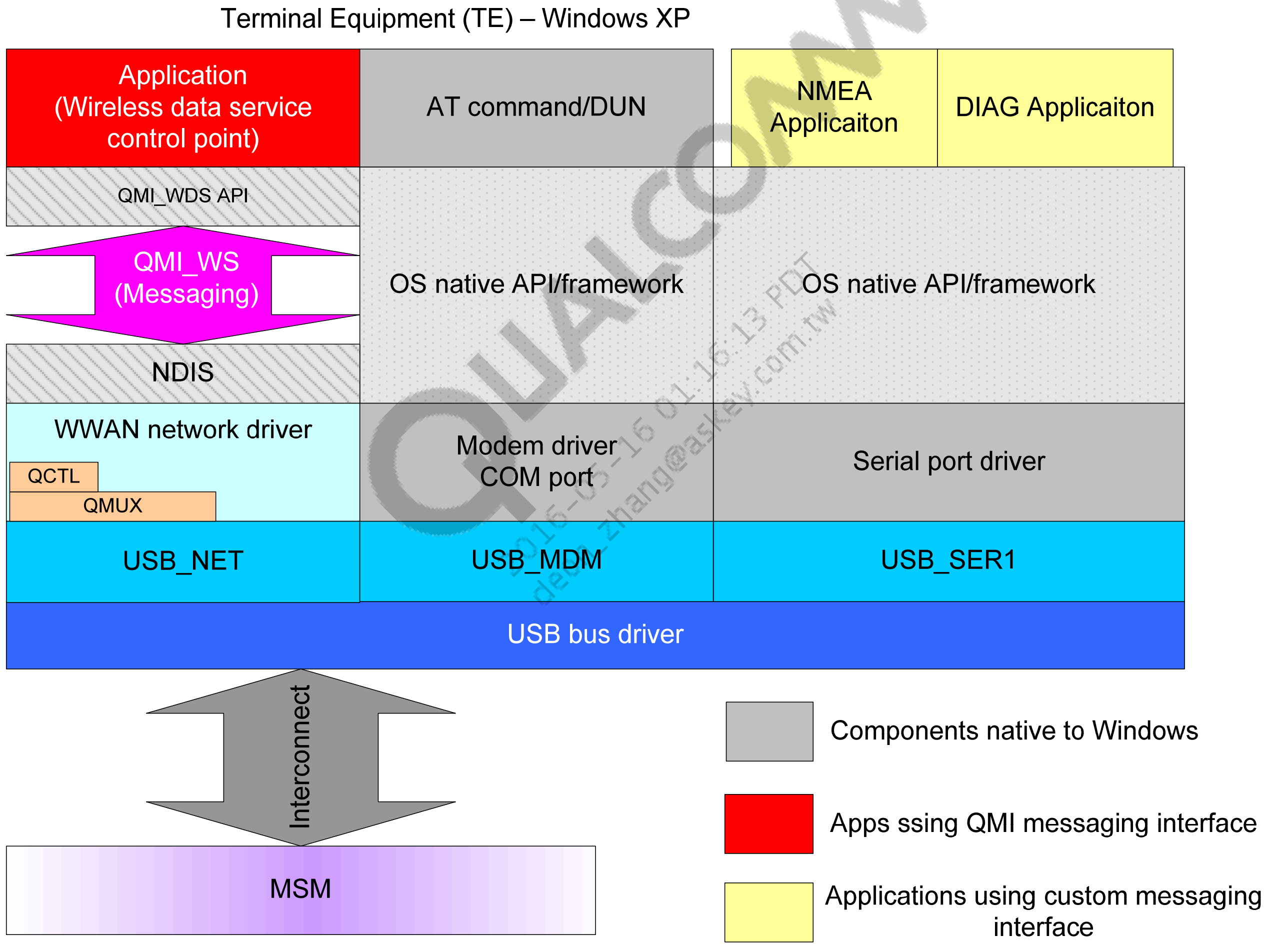
R_m Network Interface Control Path (Phase One – QMI)



R_m Net/Modem Logical Device Interaction

- Modem and R_m Net devices available simultaneously
  - PS calls supported on R_m Net logical device
  - CS/PS calls supported on modem logical device
  - AT commands continue to be supported on modem logical device
    - AT channel unavailable during CS calls
      - Only accessible to CS application (using Esc sequence/ONLINE_DATA mode)
- USB enumeration is configurable
  - R_m Net interface can be turned on/off via NV setting (2782)
    - For backward-compatibility, use legacy drivers

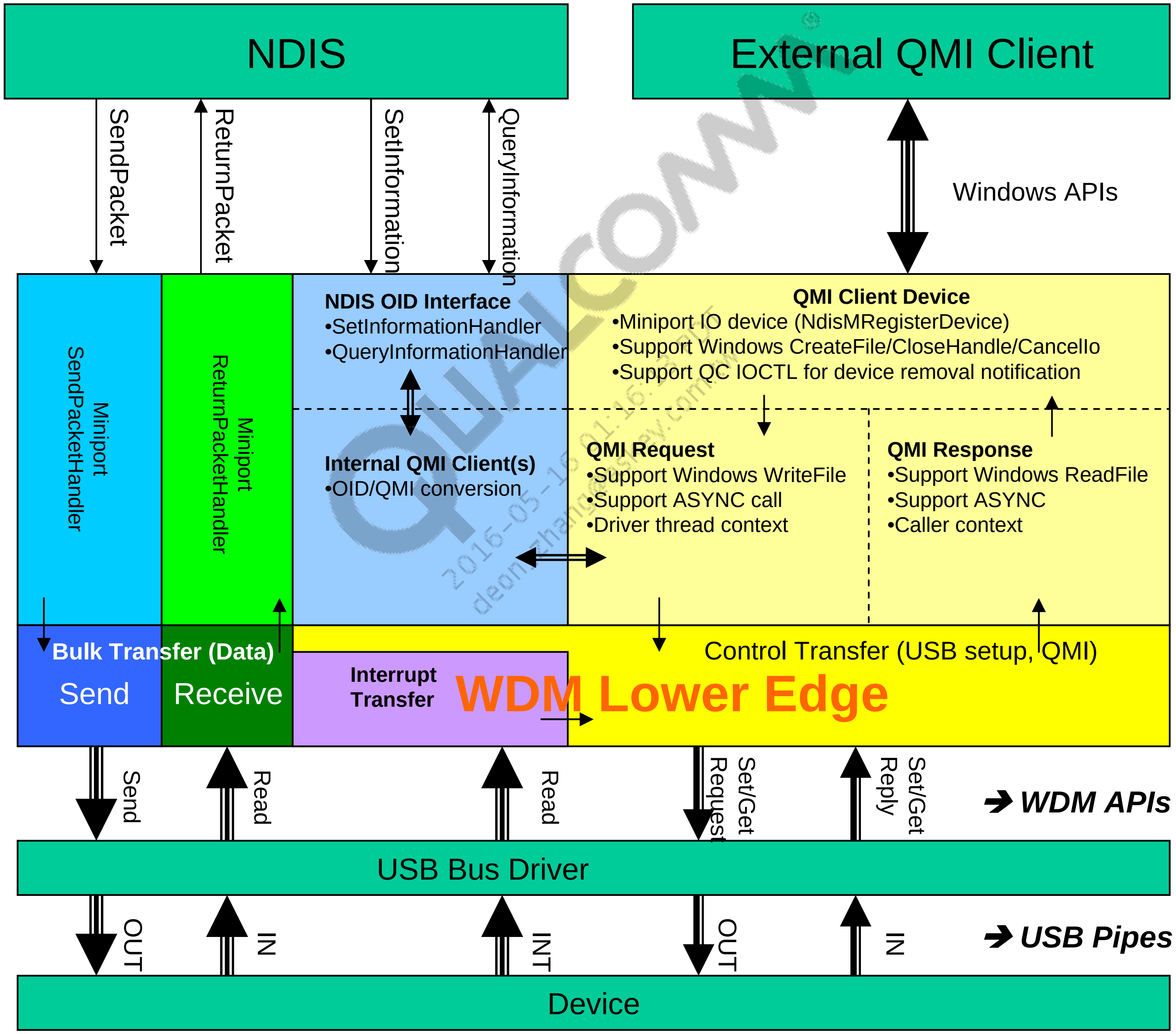
QMI TE Architecture – Windows XP



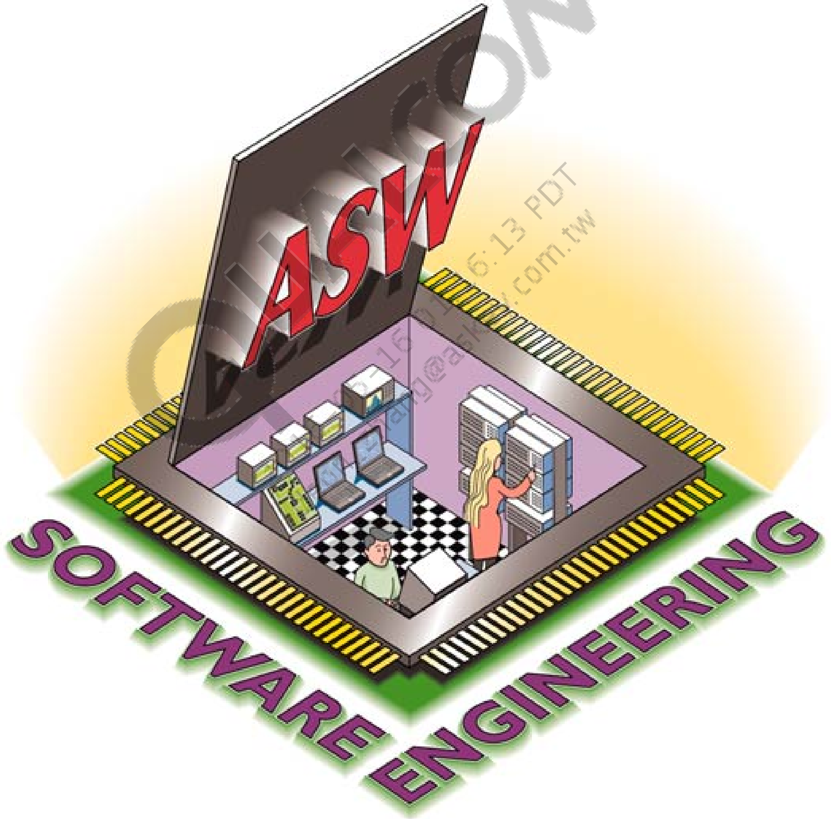
QMI Windows Reference Driver

- Supports Windows XP (NDIS 5.1)
  - Currently emulates Ethernet device
    - » 802.3 miniport
    - » Will work with Longhorn (MS claims Longhorn will be backward-compatible)
  - Portable to other Windows flavors like Windows CE, Windows 2000
- Supports USB interconnect
  - Adds a new USB interface – WWAN Network device (USB_NET)
  - Continues to enumerate legacy interfaces – Modem (USB_MDM), Serial (USB_SER
- Shipped as a reference to QUALCOMM licensees in source form only
  - Reference driver will pass WHQL tests with QC reference devices
- For commercialization, licensee:
  - Adds any proprietary customizations (if required)
  - Generates driver binaries (requires Windows DDK license)
  - WHQLs with commercial devices (if WHQL certification required)

NDIS 5.1 Miniport Driver for XP with WDM Lower Edge



Questions?



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