CONNECTIONS WITHOUT
BOUNDARIES

Introduction to Digital DAS and CPRI

CONNECTIONS WITHOUT BOUNDARIES

Dali Wireless
Overview

- Founded in 2006
- Headquartered in Menlo Park, USA, with Research and Development in Vancouver, Canada
- Global Sales and Customer Service team (North & Latin America, Europe, APAC)
- Developed and patented an all digital DAS system for commercial and public safety bands
- Over 200 patents globally

BEST OF TOWER & SMALL CELL SUMMIT

eTECH AWARDS 2014

2014 MobileVillage Mobile Star Awards SUPERSTAR

telecoms.com AWARDS 2015 SHORTLISTED

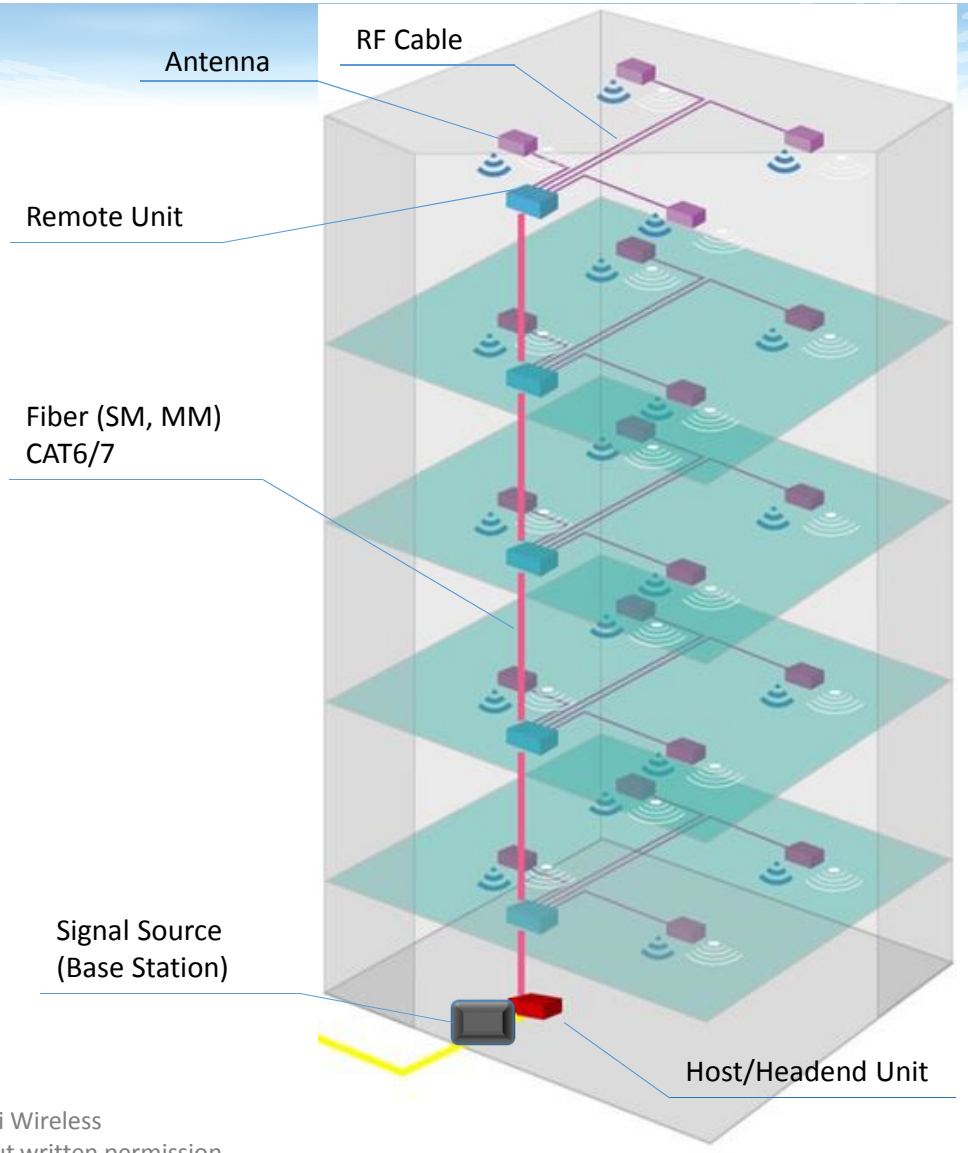
ABIresearch Top Technology Disruptor

ABIresearch No. 1 in Innovation In-building Wireless

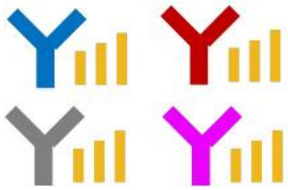
What is DAS?

Distributed Antenna System

- Radio signals from one or more base stations are transported to multiple antennas
- Delivers signals with pinpoint accuracy where they are needed
- Provides indoor and/or outdoor coverage and capacity



DAS Features



Supports multiple operators on a single system

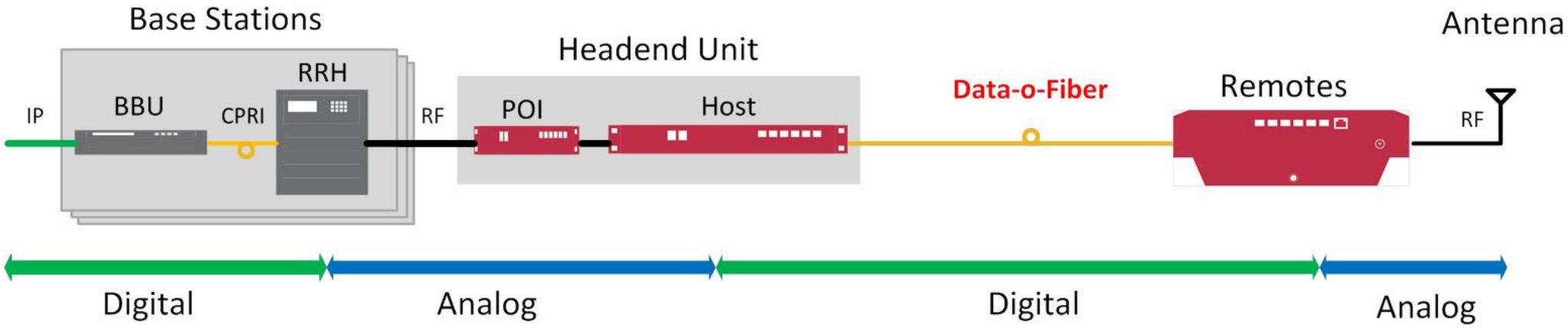
Supports multiple technologies on a single system

Signal strength optimized for coverage and capacity

Mobile phones are closer to the antennas thereby extending battery life

Digital Distribution System

Introduction

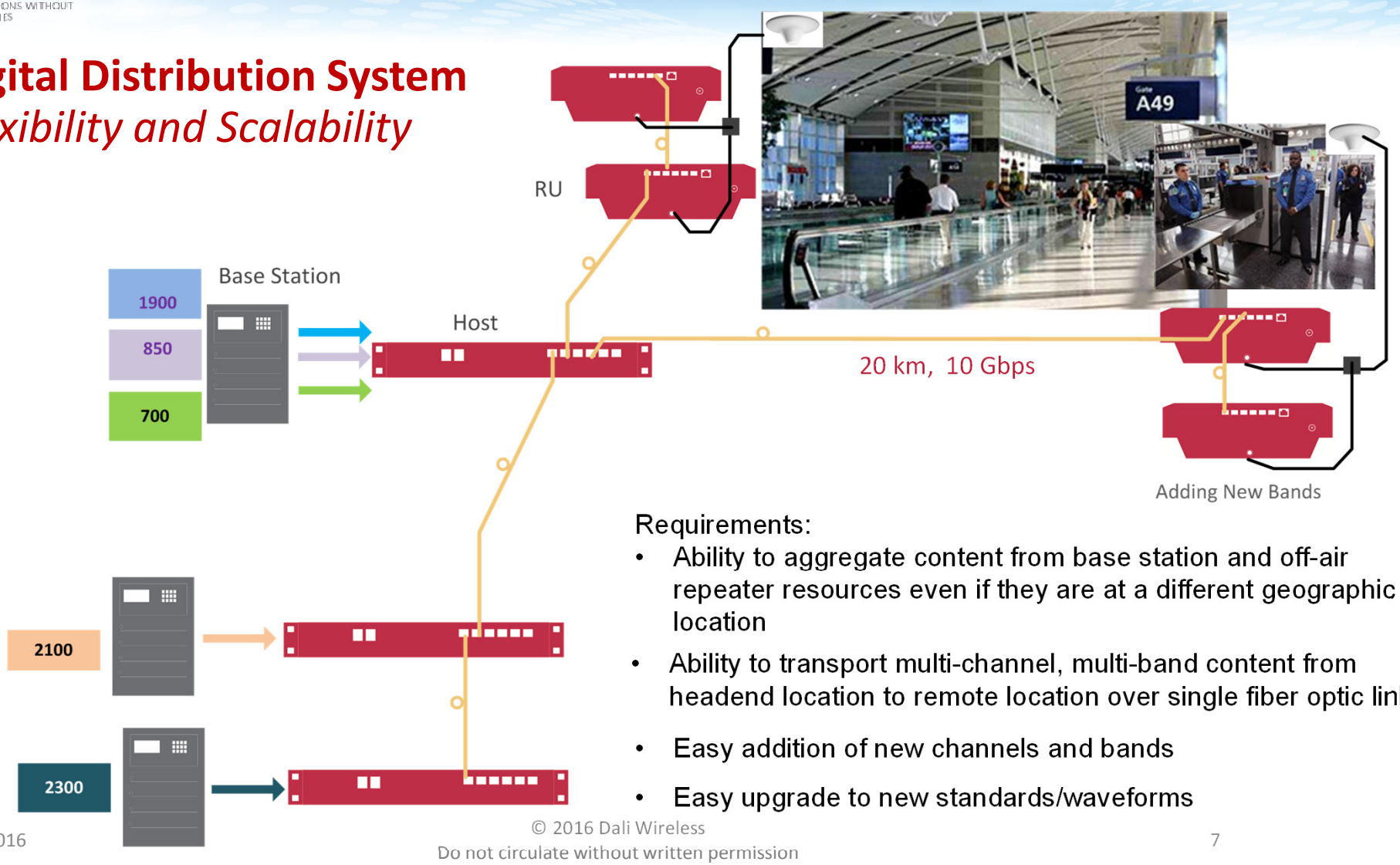


Digital Distribution System
Reach

- Commercial off-the-shelf Small Form Factor (SFP) pluggable optical transceivers are used tor transport serial data stream from the Host/central location to remote location, and back , over optical fiber link.
- Digital signals (1s and 0s) turn SFP laser diode on and off
- No performance degradation while link budget is positive
- Reach – distance between host and remote, depends on:
  - SFP optical budget - type of SFP used: from 14 dBo (“10 km”) to 31 dBo (“70 km”)
  - Link loss : fiber 0.4 dB/km, connector 0.3 dB, splice 0.1 dB
- Bi-directional SFP optical transceivers with WDM (Wavelength Division Multiplex) enable symmetrical/bidirectional transport over single fiber.

Digital Distribution System

Flexibility and Scalability



Requirements:

- Ability to aggregate content from base station and off-air repeater resources even if they are at a different geographic location
- Ability to transport multi-channel, multi-band content from headend location to remote location over single fiber optic link
- Easy addition of new channels and bands
- Easy upgrade to new standards/waveforms

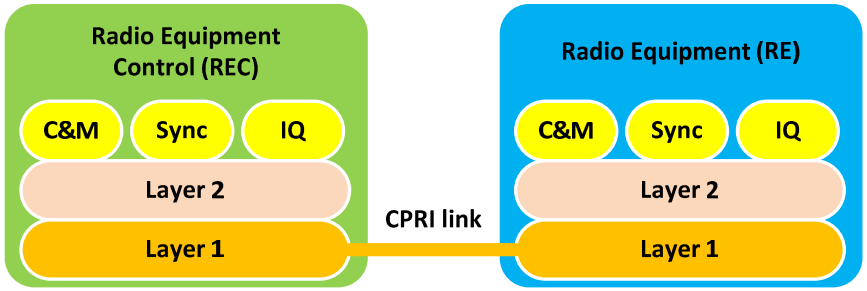
Digital Distribution System
Security

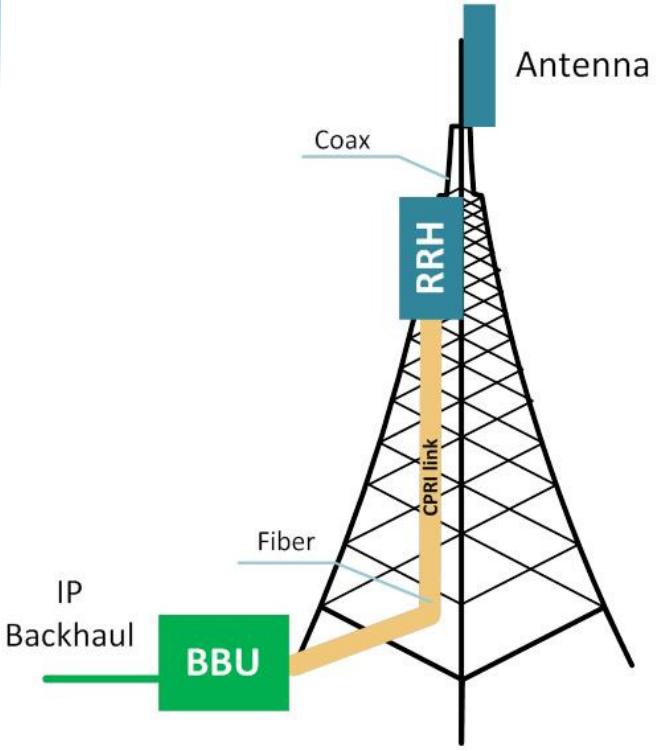
- Payload data scrambled – information protected if intercepted during data transport
- Access to network Control & Monitoring functions password protected and encrypted
- HTTPS (HTTP over SSL/TSL) protocol used to enable secure communication

Common Public Radio Interface

Introduction

- The CPRI specification has been jointly developed by:
  - Ericsson
  - Huawei
  - NEC
  - Alcatel Lucent
  - Nokia Siemens Networks
- Specification for the key internal interface of radio base stations between the Radio Equipment Control (REC) and the Radio Equipment (RE) . V1.0 published in 2003



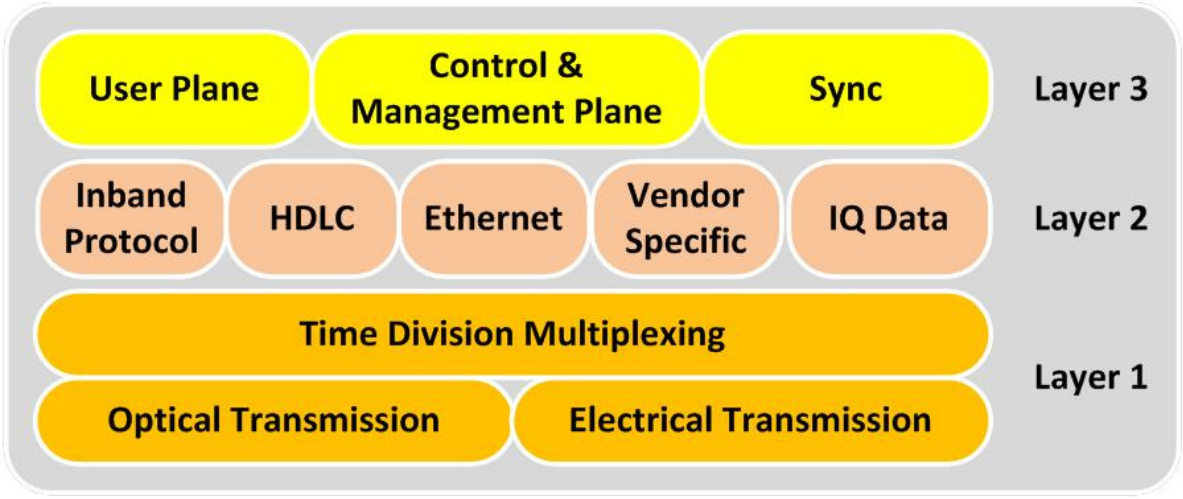


- Goal of CPRI is to allow base stations manufacturers to share a common protocol to easily adapt platforms from one customer to the other
- Being used in two areas:
  - Key internal interface of radio base stations
  - From the BBU to the RRH units

Common Public Radio Interface

Description

Protocol Stack



- Layer 1 – Physical interface - TDM and clock rate fully defined
- Layer 2 – well defined
- Layer 3 – C&M vendor specific

- Synchronous, symmetrical data link - slave port recovers the reference/clock signal from incoming bit stream
- CPRI Frame structure:
  - Basic Frame: Tc =1/3.84 MHz ~260.4 ns; 16 words, 1 control word, rest I&Q
  - Hyperframe 66.67 us; synchronization information in control word of basic frame 0
  - CPRI Frame 10 ms
- In-phase (I) and Quadrature (Q) digital baseband data transported using Time Division Multiplexing (TDM)
- Embedded C&M data (HDLC)
- Embedded Ethernet traffic
- Defined delay measurement and calibration

Common Public Radio Interface

Line Bit Rate

- All CPRI line bit rates have been chosen in such a way that the basic UMTS chip rate of 3.84 Mbit/s can be recovered in a cost efficient way
- Line coding implemented to support detection/ synchronization

CPRI Line Bit Rate Options	Line Bit Rate	Line Coding
Option 1	**614.4 Mbit/s**	8B/10B
Option 2	**1228.8 Mbit/s**	8B/10B
Option 3	**2457.6 Mbit/s**	8B/10B
Option 4	**3072.0 Mbit/s**	8B/10B
Option 5	**4915.2 Mbit/s**	8B/10B
Option 6	**6144.0 Mbit/s**	8B/10B
Option 7	**830.4 Mbit/s**	8B/10B
Option 7A	**8110.08 Mbit/s**	64B/66B
Option 8	**10137.6 Mbit/s**	64B/66B
Option 9	**12165.12 Mbit/s**	64B/66B

OBSAI, ORI

- There are other options beside CPRI

OBSAI: Open Base Station Architecture Initiative

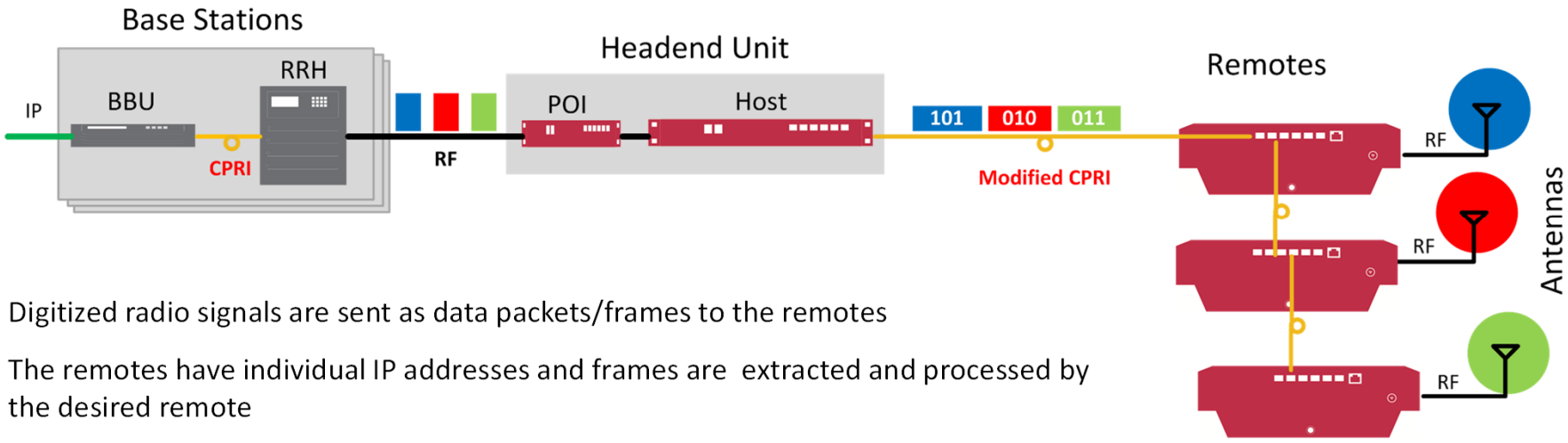
- Similar to CPRI
- Created with the aim of creating an open market for cellular network base stations

ORI: Open Radio Interface

- ETSI ISG released v4.1.1 of Open Radio Equipment Interface (ORI) in October 2014.
- Notable participants in the ISG include AT&T Global Network Services and Ericsson.
- ORI is for use between the BBU and remote radio head or integrated active antenna.
- **Defines the control and management portion for operation with CPRI**
- Supports discovery of nodes and enable monitoring the state of the node
- Provides the control protocol to route a signal path through many ORI links in the network

CPRI and Digital Distribution System

Description 1



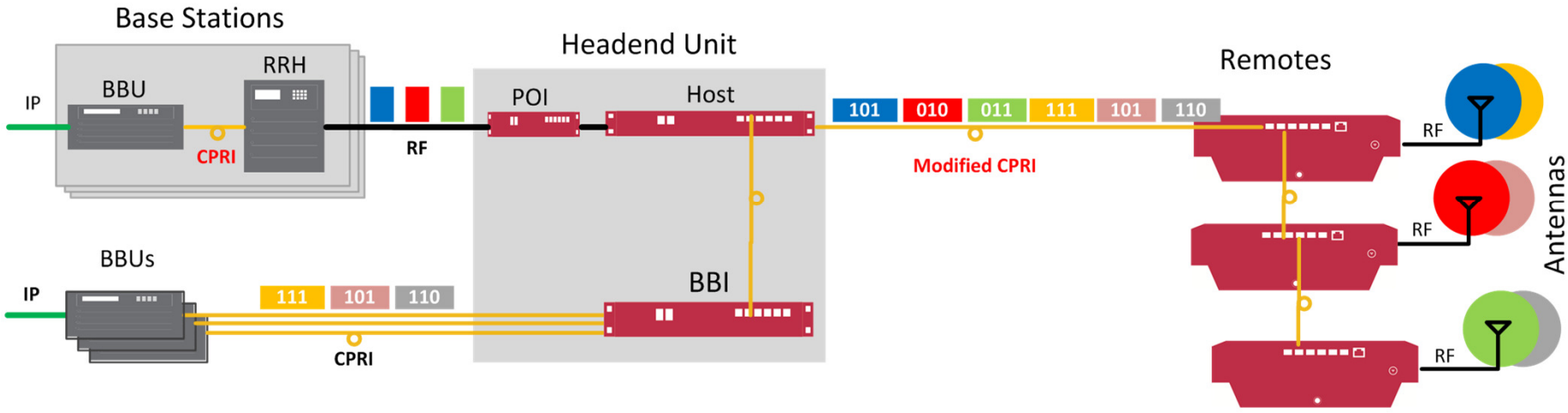
- Digitized radio signals are sent as data packets/frames to the remotes
- The remotes have individual IP addresses and frames are extracted and processed by the desired remote
- True flexibility in sending signals to any remote with ability to re-sectorize the system
- Host and remotes are software configurable units
- Can optimize the delay meeting 3GPP requirements with a single click on the GUI

HOW?

- Dali's patented implementation of CPRI in a DAS environment

CPRI and Digital Distribution System

Description 2



RF + Direct Data Interface

- Direct CPRI interface to BBUs

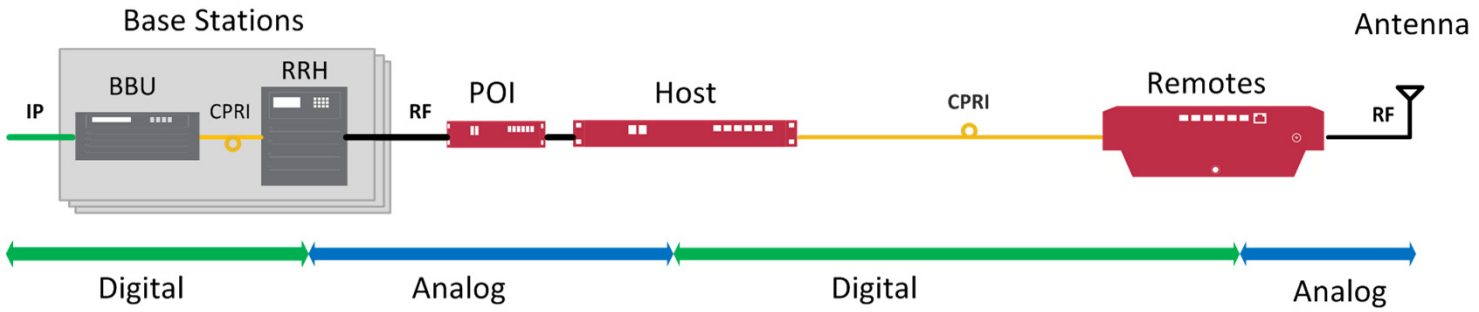
Why modified ?

- Higher efficiency of the transport than standard CPRI (more RF bandwidth per gigabit of data)
- Dali 6 G can transport 164 MHz of mixed RF BW per wavelength , new 10 G system - up to 320 MHz of mixed RF BW

CPRI and Digital Distribution System

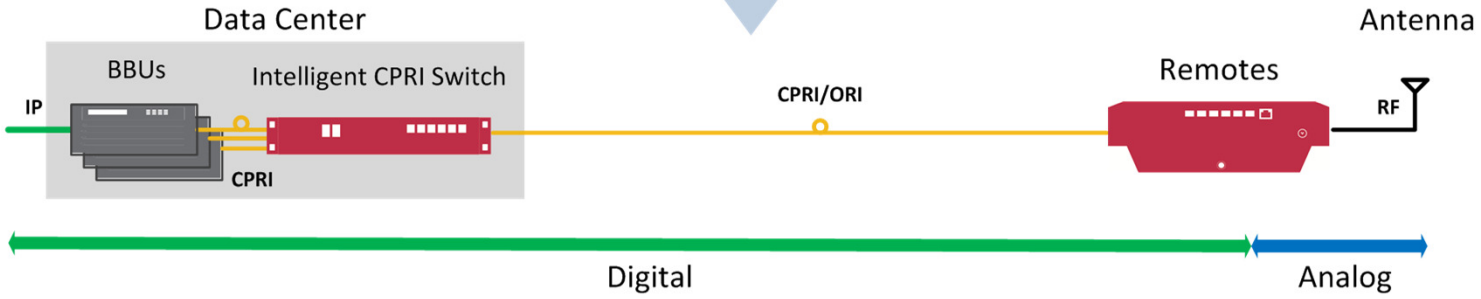
Evolution

On-site Base Station(s) with RF Interface to Distribution System



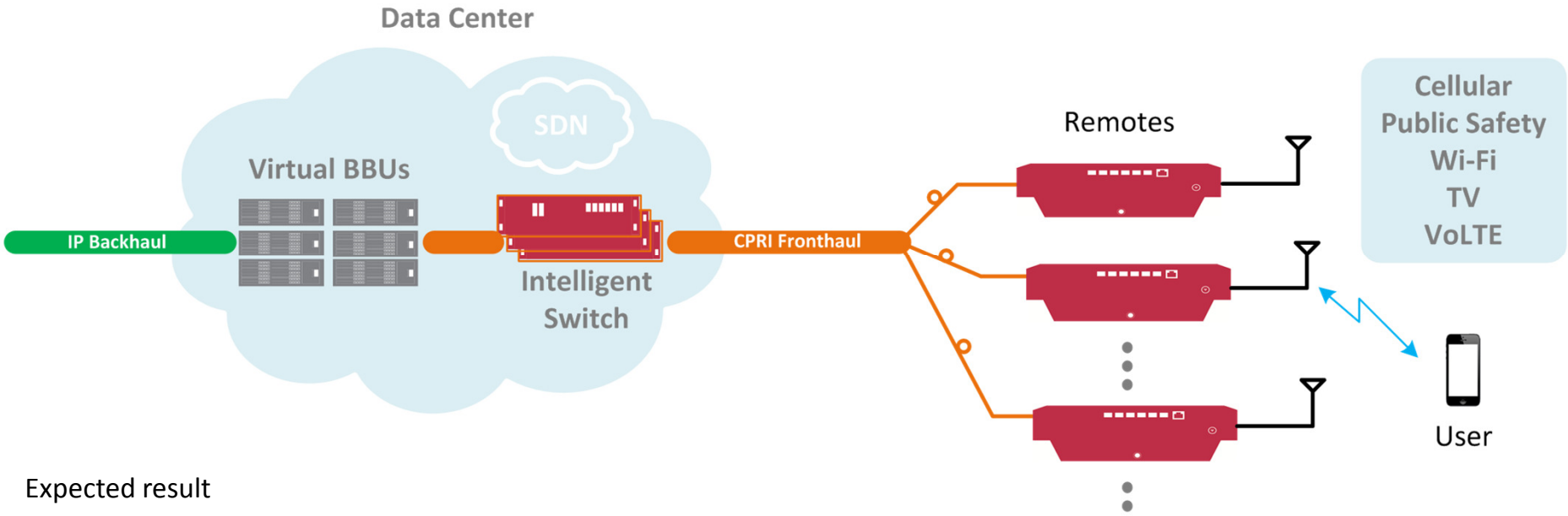
Centralized BBU resources

Access and Distribution System comprised of Intelligent CPRI Switch and SW configurable Remote



RAN Virtualization

- "Virtual" Base Stations (Base Band Units) run on standard /commodity HW (servers), with specialized SW applications enabling variety of services – Software Defined Network (SDN)
- Services delivered over Access-Distribution System to customer when needed, where needed

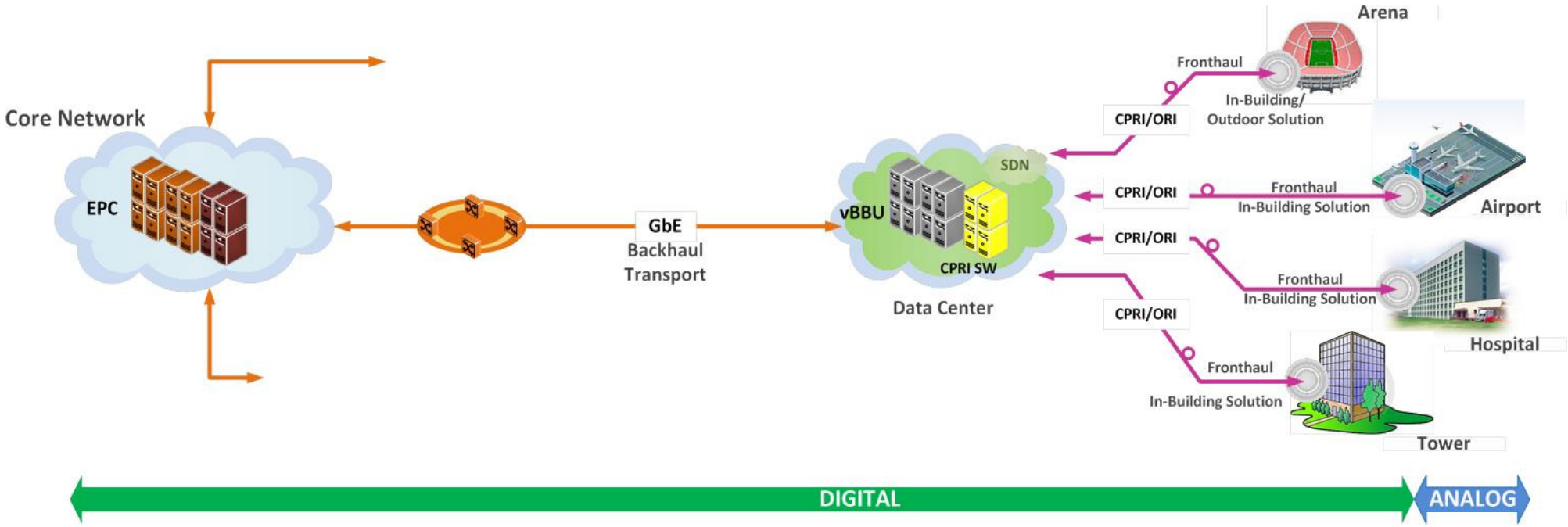


Expected result

- Reduced Total Cost of Ownership (TCO)
- Increased Quality of Service (QoS) and User Experience

Cloud RAN

- Complete digital system from Core Network, via IP backhaul, virtual BBU hotel and access –distribution system, to radiating point.
- Only conversion to/from RF conducted at the software configurable remote unit



Benefits of Digital + Software Reconfigurable

Satisfying current requirements, providing a seamless migration path to future networks, while maintaining the value of the operators installed infrastructure

Optimal users experience:

- Greater reach without signal degradation

- Maximize data throughput / capacity in the network by minimizing noise interference

Seamless migration path without rip and replace:

- Foundation for network evolution (RAN virtualization, Software-Defined Network, Self-Optimizing Network, etc.)

- Flexible and Scalable: Can easily upgrade and expand network through plug & play modules and software upgrades

- Converged solution for 2G, 3G, 4G, 5G, WiFi and GPON (Gigabit Passive Optical Network)

An all-digital and software reconfigurable platform enables operators and enterprises to maximize the usage of their existing capital investment, while providing them with a seamless migration path to the future generation of wireless networks.

CONNECTIONS WITHOUT BOUNDARIES

Thank you

www.daliwireless.com