10Mbps Visible Light Transmission System

Tom Matsumura

Secretary General

VLCC (Visible Light Communications Consortium)

President

Nakagawa Laboratories, Inc.

Special thanks for
TAMURA CORPORATION

Visible Light Communications Consortium

Contents

Features

- **10Mbps-Transmission Speed is realized by using White LEDs(RGB+W).**
- **Bi-directional & Full-duplex Communication is available.**
- **Enable 1 to N Connection**
- **Compliance of a Japanese Standard (ARIB STD-T50)**
- **Enable Direct Connection to Ethernet (IEEE802.3) Devices.**

System Looking & Presentation

Presentation at IT Pro Expo 2008

Poster Display

ARIB STD-T50

STD-T50 is designed to fundamentally meet the ISO/IEC 8802-3:2000. So, Optical Wireless LAN System complying with this standard is able to connect the Ethernet devices.

Trans. Speed / feature, type	10Mbps	100Mbps	1000Mbps
Transmission Topology	1 to 1, or 1 to N		
Access Control	support CSMA/CD method network configuration		
Data Rate	10Mbps	100Mbps	1000Mbps
Type of Trans. Signal	10BASE－T (Manchester encoding)	100BASE－FX (4B/5B encoding)	100BASE－X (8B/10B encoding)
Transmitting Function	In case of available on signal data, transmit predefined signal type. Other case, hold idling signal or similar signal.		
Receiving Function	Predefined trans. signal is received, idling signal is sent back when no reception. Sensitivity is shown by μW／cm or dBm		
Others	Loop back, collision detection and link confirmation function		

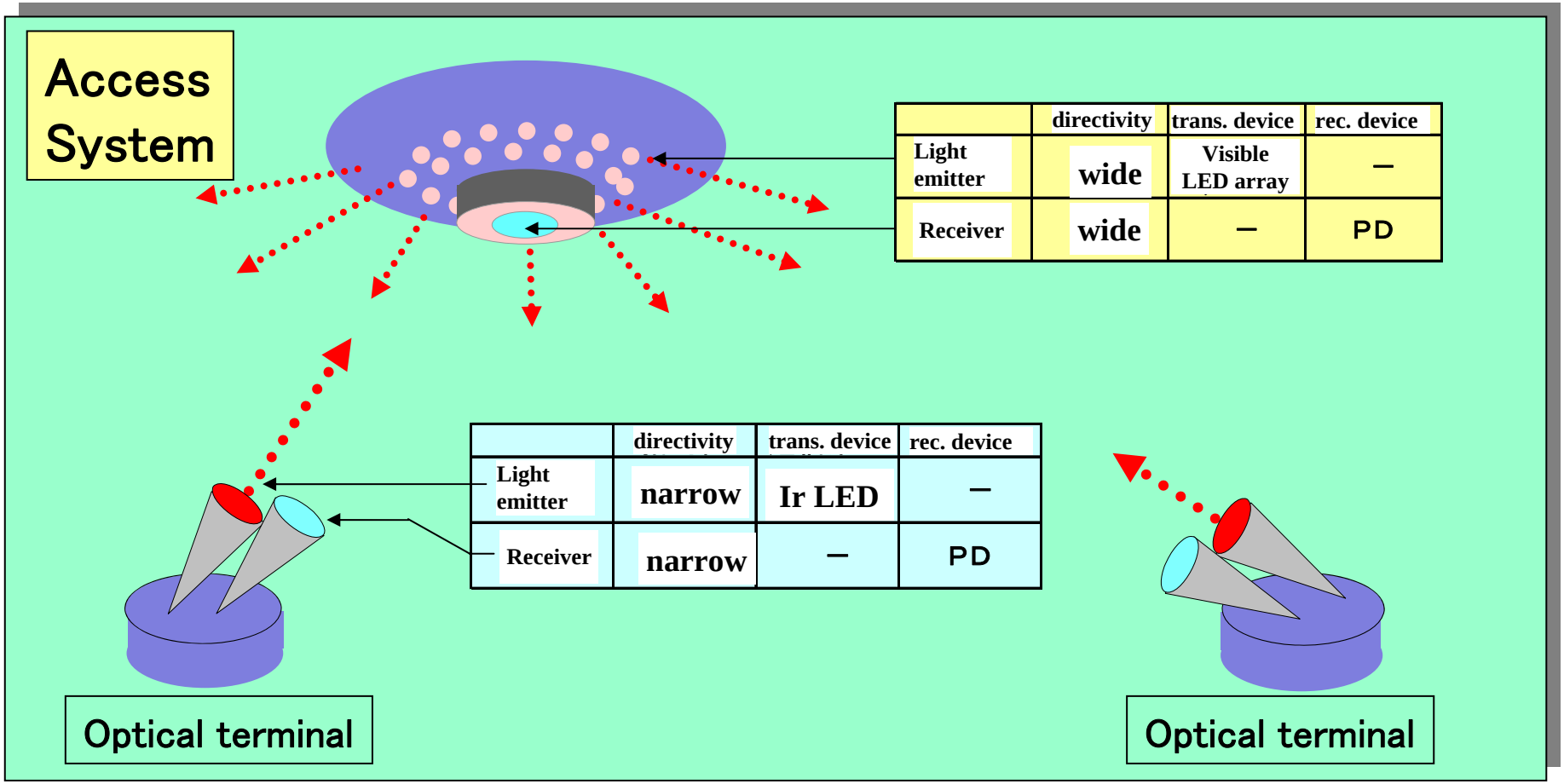
Specification of STD-T50 PHY Layer

Trans. Speed / item	10Mbps	100Mbps	1000Mbps
Optical media	assuming 680～1600nm, or other W.L. is available		
Optical device	LED or LD for trans. Device, PD or APD for receiving device		
Safety Regulation	Indoor : Class 1, defined by IEC60825-1Edition1.2		
	Outdoor: recommending Class 1 or Class 1M		

Specification of STD-T50 Optical Transmission System

Topology on Optical PHY Layer

This System can be establishd 1toN Multi-Channel Access between the Access System on the ceiling /wall and Several Optical terminal located inside the System Covering Area.



Specification (VLC Wireless LAN System)

	item		elements
1	Trans. Distance		＜2m
	Trans. Area		Vertical: 9.5 ～50° Horizontal: +/−60° from underneath
2	Base Station	W.L. for Transmitter	400～750 nm White(745nm/680nm) 620～630 nm Red 525～530 nm Green 460～470 nm Blue
		W.L. for Receiver	680～1600 nm(Ir)
		Logical I/F	ARIB STD-T50 compliance
		Data Rate	10Mbit/s Max
		Encoding	Manchester encoding
		Lighting Intensity	14 lx (2m)
		Trans. Power	～2W(Red), ～12W(RGB+W)
		Power Supply	100Vac
		Power Consumption	15W
		Operation Temp.	0～40℃
		Operation Humidity	20～85%(no condensation)
		Dimensions	W222 x H185 x D129 mm

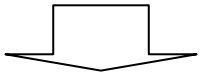
Specification (OpticalTerminal)

	item		elements
3	Optical Terminal	W.L. for Transmitter	680～1600 nm(Ir)
		W.L. for Receiver	350～750 nm
		Logical I/F	ARIB STD-T50 compliance
		Data Rate	10Mbit/s Max
		Encoding	Manchester encoding
		Power Supply	5Vdc
		Consumption Current	720mA
		Operation Temp.	0～40℃
		Operation Humidity	20～85%(no condensation)
		Dimensions	W60 x H70 x D120 mm
		Weight	150g

Establishment of 1toN Transmission

CSMA/CD(Carrier Sense･Multi Channel Access / Collision Detect) system is a MUST

Conventional wireless system hard to make CD



Issue of receiving signal masking by transmission to be leared

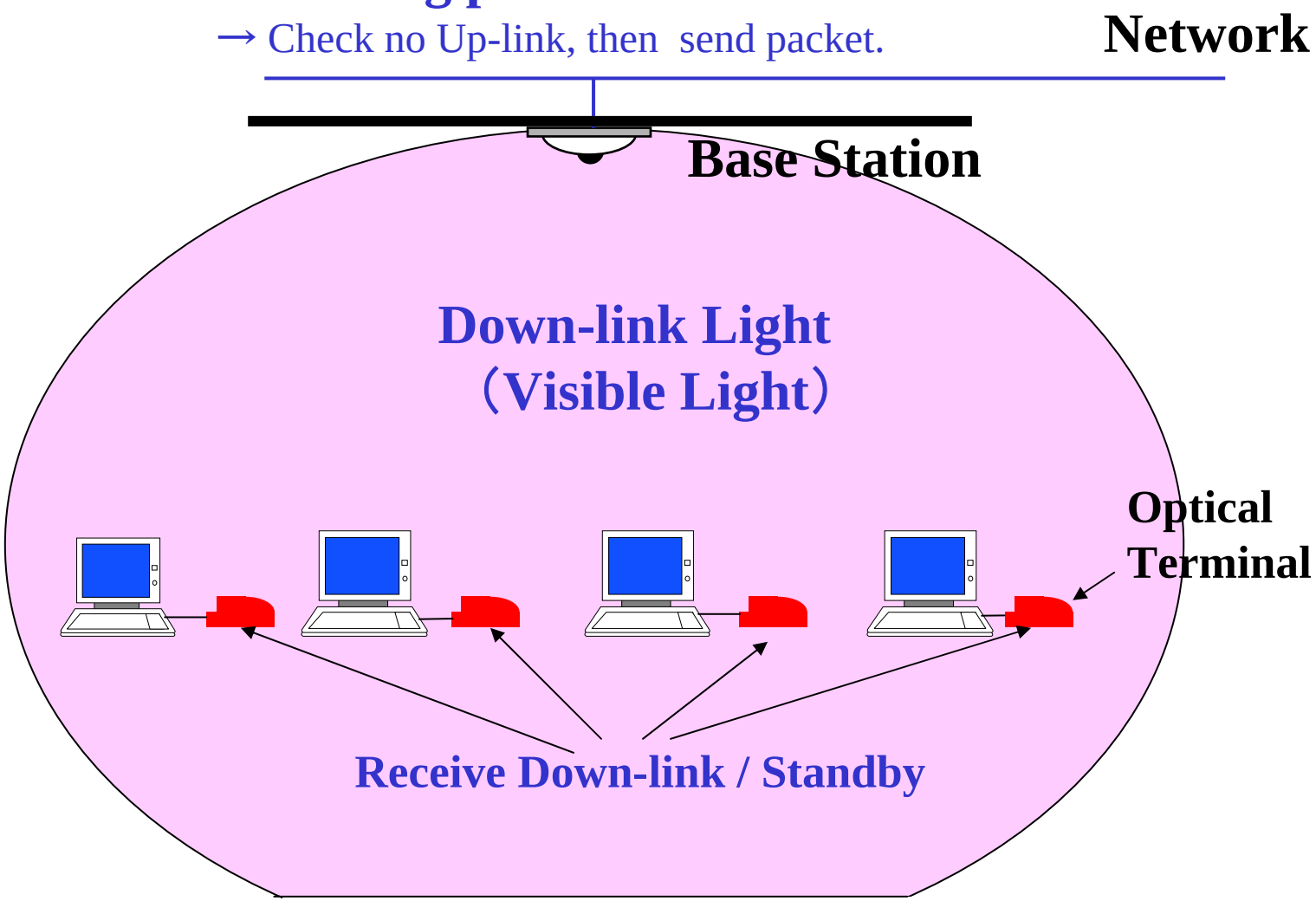
Break through the issue by employment of Visible light for down-link and Ir-light for up-link

In addition, to support STD-T50, then established CSMA/CD system

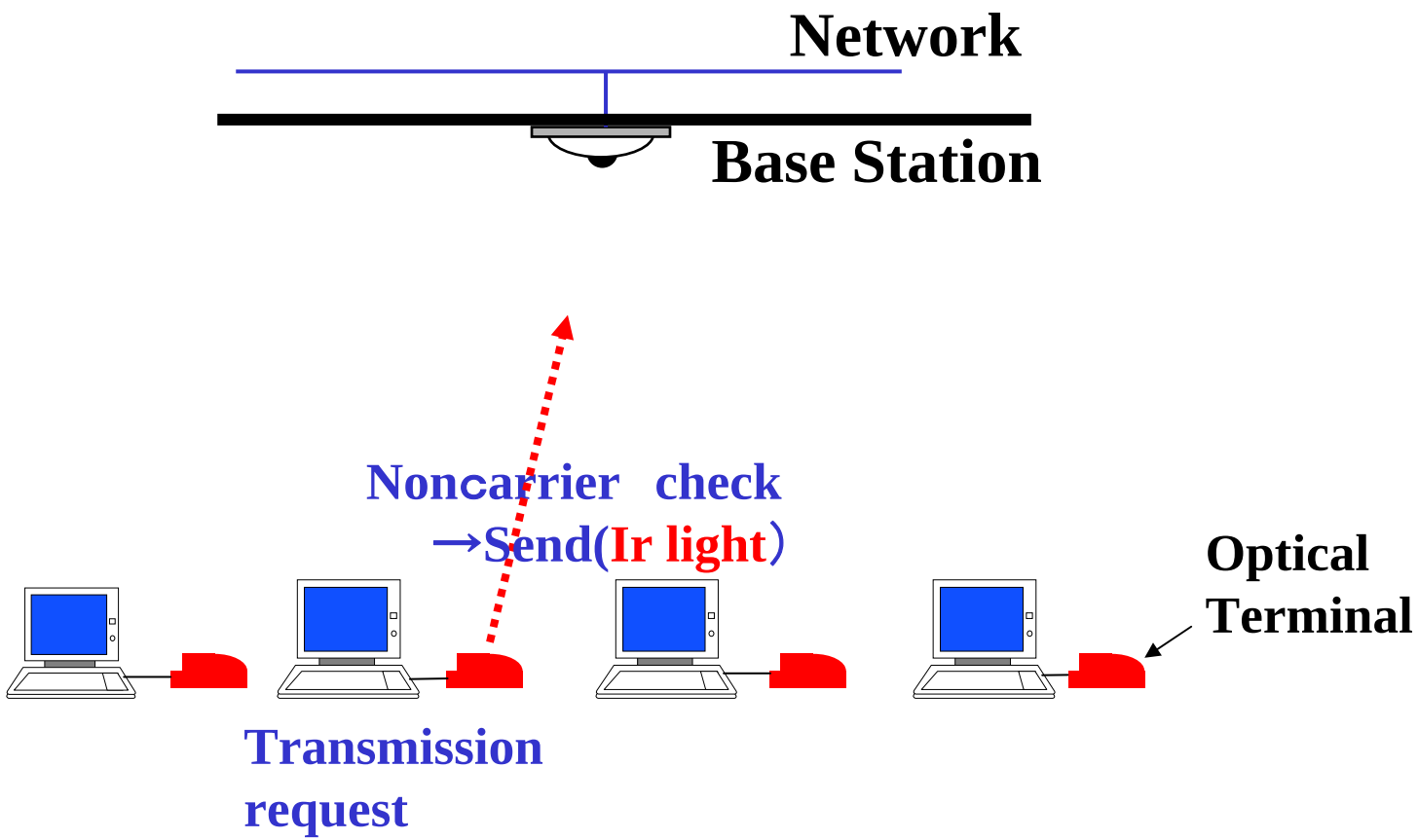
Down-link

Initiating packet on Network

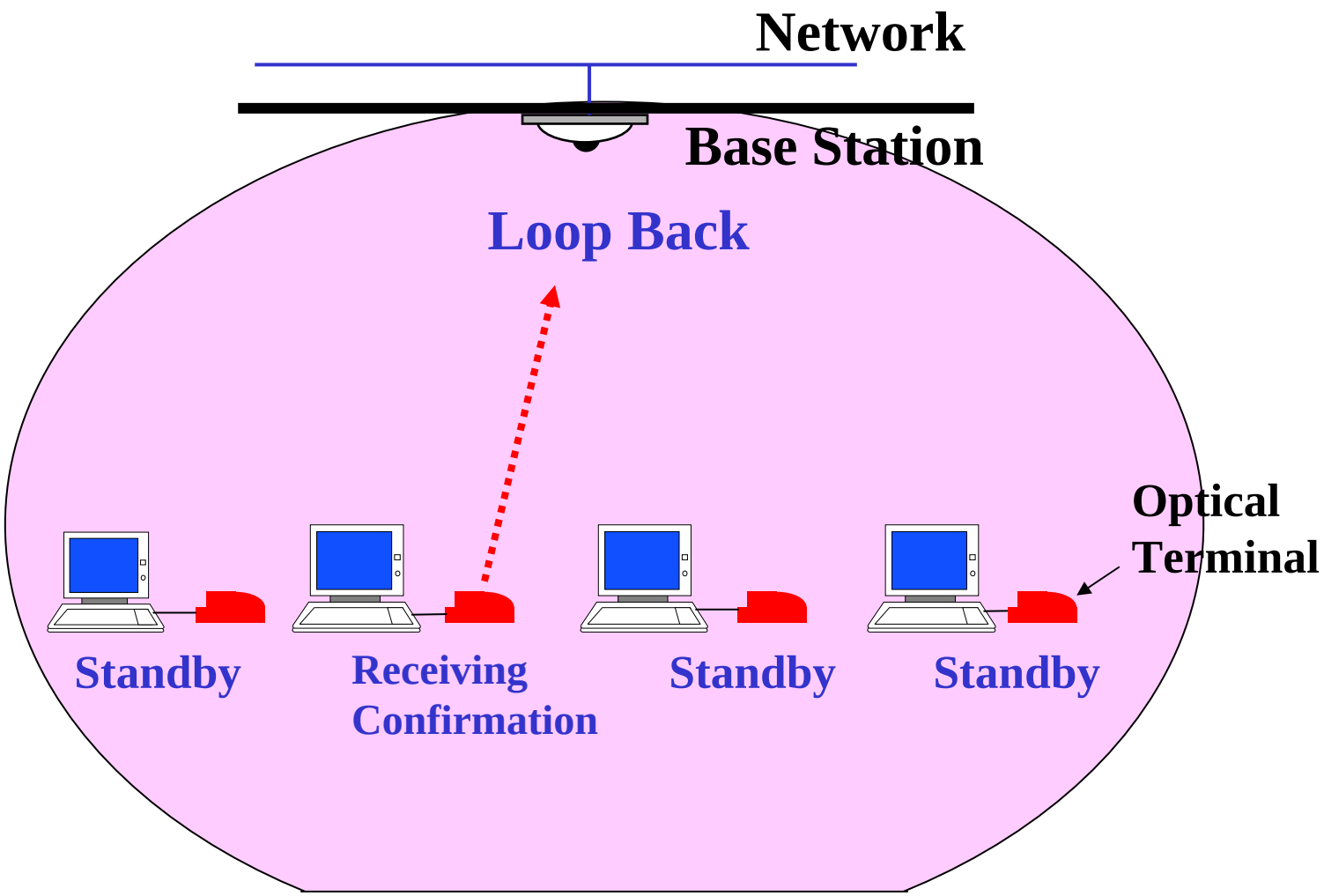
→ Check no Up-link, then send packet.



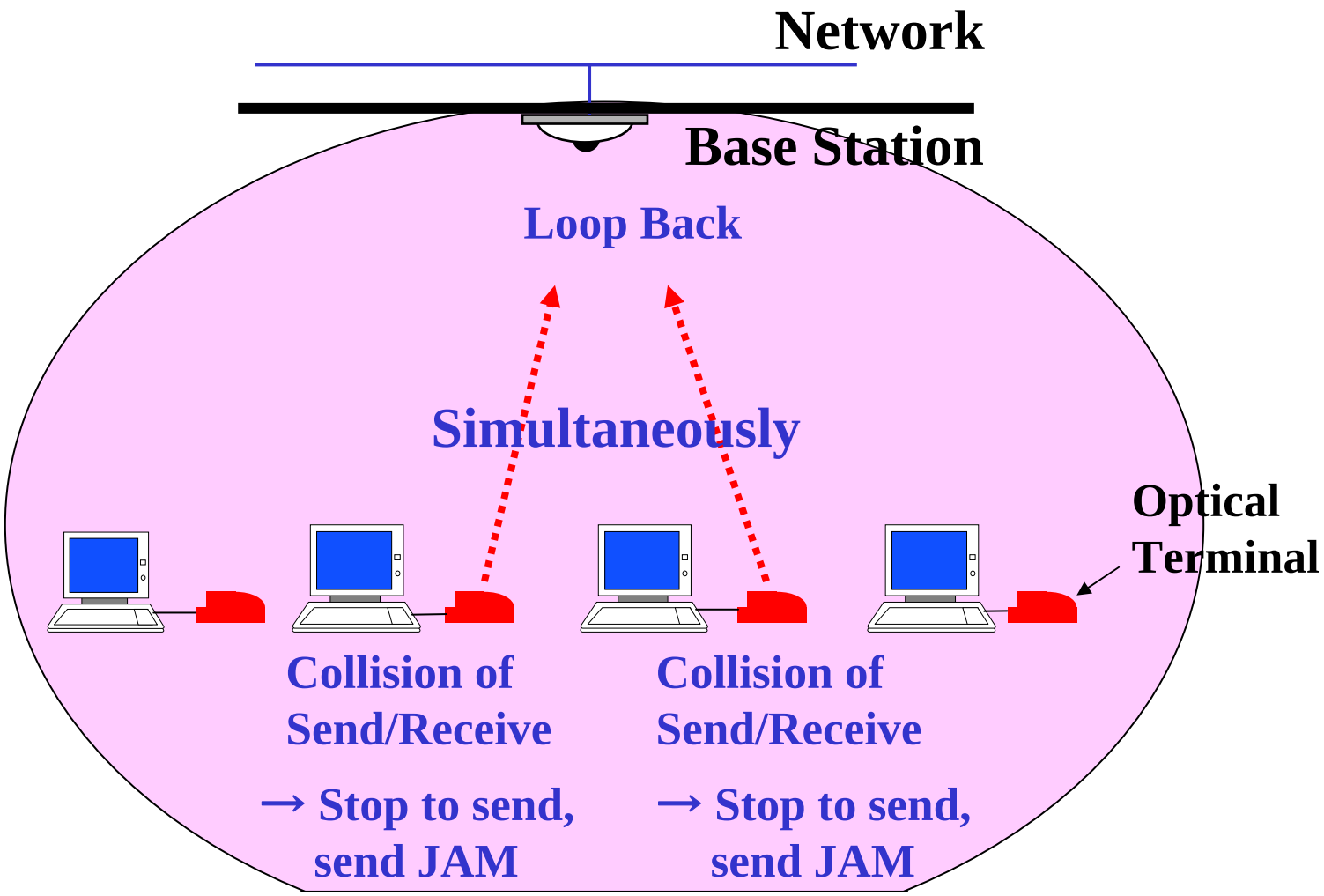
Up-link 1


Network
Base Station
Noncarrier check
→Send(Ir light)
Optical
Terminal
Transmission
request

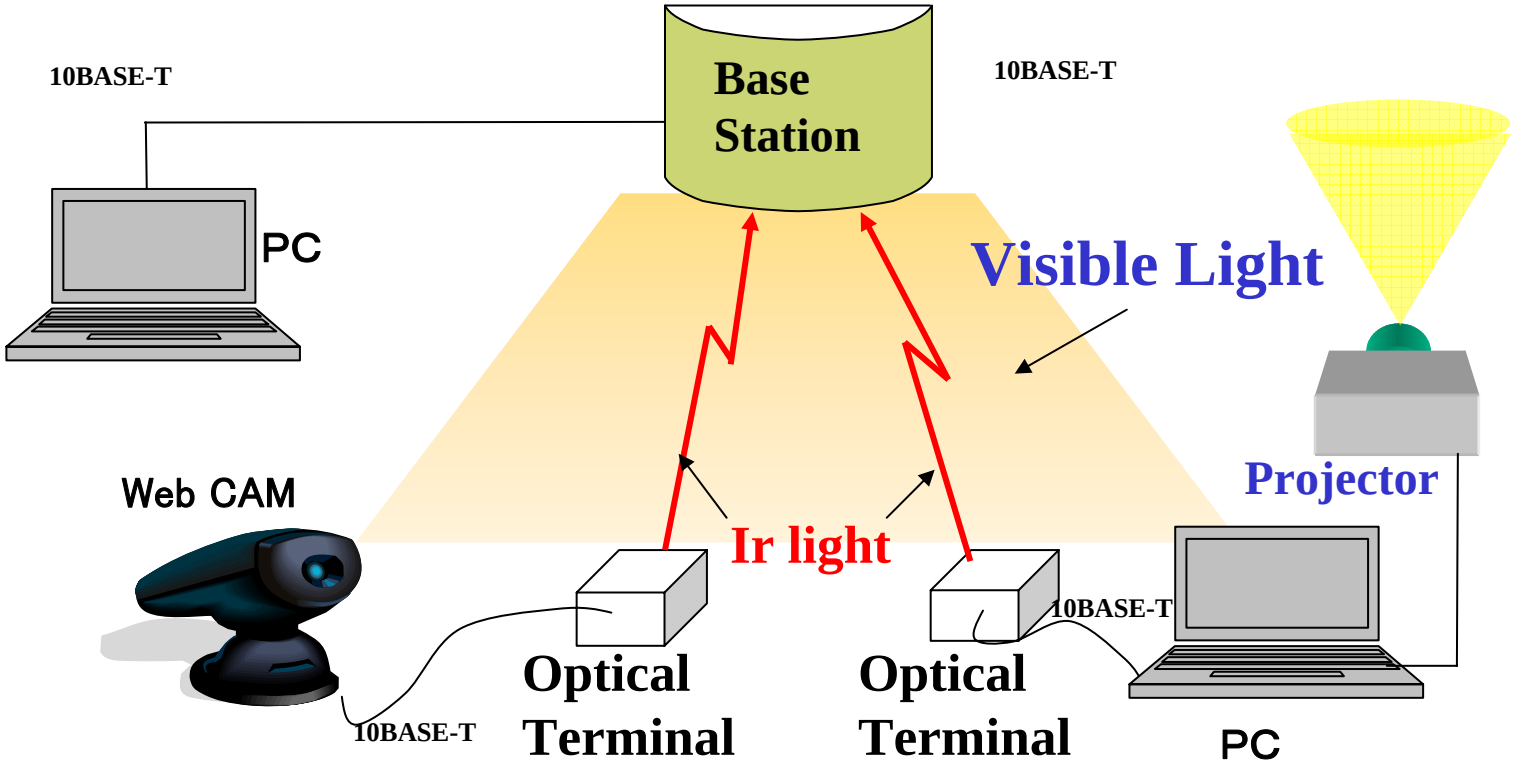
Up-link 2


Network
Base Station
Loop Back
Optical
Terminal
Standby
Receiving
Confirmation
Standby
Standby

Collision Case



Demo System


10BASE-T
Base Station
10BASE-T
PC
Visible Light
Projector
Web CAM
Ir light
10BASE-T
Optical Terminal
Optical Terminal
PC
10BASE-T

Summary

- Confirmed the capability of establishment of 10Mbps wireless LAN using White LEDs(RGB+W).

- Utilizing the lighting system for down-link and IR light for up-link makes 1toN wireless LAN configuration.

- Direct Ethernet connection is available by supporting ARIB STD-T50. That application, on conventional wireless LAN disable environment, has potential for office use, which needs care for compromise, or for medical institution, which requires high-level safety.