

XCamLab Hardware Description

1. Hardware Platform Overview

This hardware platform is designed for the installation of XCamLab software, enabling teaching interaction via wireless networks. The hardware platform mainly consists of:

- ✓ Wireless Network Configuration
- ✓ Teacher-Side Configuration
- ✓ Student-Side Configuration

2. Wireless Network Configuration

The wireless network setup uses a Wi-Fi 6 router architecture. Tiered configuration balances deployment cost and system stability per the school's teaching terminal quantity and concurrent bandwidth requirements, categorized into three types by performance specs.

Note: Permitted frequencies and transmit power for Wi-Fi differ by country; customers can select products for purchase accordingly.

2.1 Standard Configuration (Up to 30 Terminals)



Figure 1 XCamLab Placeable Router (China Version)



Figure 2 XCamLab Placeable Router (EU Version)

XCamLab Hardware Description

This configuration is simple to deploy and cost-effective, meeting the basic microscopic image transmission and interactive teaching needs of small classes. However, its concurrent processing capability is relatively limited; multiple terminals transmitting high-bitrate images simultaneously may cause performance bottlenecks.

Key specifications are as follows:

Item	Configuration / Description
Core Device	WiFi6 router × 1
Suitable Scale	China Version: up to 30 terminals EU Version: up to 25 terminals
Wireless Standard	WiFi6 (802.11ax)
Frequency Bands	Dual-band (2.4GHz + 5GHz)
Theoretical Wireless Rate	China Version: up to 3000 Mbps; EU Version: up to 5400 Mbps
Antenna Configuration	Multi-antenna design (basic coverage)

2.2 High-Performance Configuration (Up to 50 Terminals)



Figure 3 XCamLab Ceiling-mounted Router (China Version)

This configuration offers stronger concurrent access and higher data throughput, supporting stable HD image transmission in medium to large classrooms. It has higher costs and requires proper signal planning and interference control. In high-density scenarios, further network expansion should be evaluated based on actual conditions. Key specifications are as follows:

Item	Configuration / Description
Core Device	WiFi6 router × 1(quad-band concurrent performance-grade)
Suitable Scale	Up to 50 terminal devices
Wireless Standard	WiFi6 (802.11ax)
Frequency Bands	Quad-band (dual 2.4GHz + dual 5GHz)
Theoretical Wireless Rate	AX6000 class, maximum wireless rate up to 5952 Mbps

2.3 AC + AP Enterprise-Grade Networking Configuration (More than 50 Terminals, Multi-Classroom Scenarios)



Figure 4 AC + AP (China Version)

This distributed Access Controller (AC) + Access Point (AP) architecture is designed for high-density scenarios with multi-classroom deployments. It eliminates common single-router issues (dead zones, roaming stutter, limited concurrency) while offering centralized management, seamless roaming, uniform coverage, and ultra-high concurrent capacity. Though more complex and costly to deploy, it is ideal for long-term, large-scale, standardized teaching laboratories. Core parameters are as follows:

Item	Configuration / Description
Core Device	1 × router + N × wireless APs (planned according to classroom area / AP locations)
Suitable Scale	multi-classroom networking, high-density concurrent scenarios
Wireless Standard	WiFi6 (802.11ax)
Frequency Bands	Quad-band (dual 2.4GHz + dual 5GHz), supports unified channel planning via the AC
Theoretical Wireless Rate	Single AP: theoretical rate up to 6000 Mbps; overall concurrent throughput scales linearly with the number of APs
Concurrent Access Capability	Enterprise-grade high-density optimization
Deployment Features	Centralized management of all APs via the AC; supports seamless roaming and automatic channel planning

3. Teacher-Side Configuration



Figure 5 Teacher-Side

3.1 Teacher-Side Components

Device	Quantity	Description
Teacher-Side Computer	1 Unit	Used for image acquisition, teaching demonstration, and data distribution
Teacher-Side Camera	1 Unit	Connected to the teacher microscope
Teacher-Side Microscope	1 Unit	Used for teaching demonstrations and microscopic image acquisition

3.2 Teacher-Side Computer System Requirements

The teacher's computer is connected to the LAN port of the wireless router via a wired network cable. The recommended configuration for the teacher's computer is as follows:

Item	Specification
Motherboard / CPU	Intel Core i7 12th Generation or equivalent-performance processor
RAM	16 GB or above
Graphics	Dedicated GPU
Storage	1 TB or above
Operating System	Windows 11 Professional (64-bit) or higher
Wired Network Adapter	1000 Mbps or above
Wireless Network Adapter	WiFi6 or above

3.3 Teacher-Side Camera

Any compatible camera model from our product portfolio may be selected for the teacher-side configuration, including but not limited to the E3ISPM Series, E10ISPM Series, and MTR3CMOS Series.

For detailed product specifications, please refer to the official website:

<https://www.touptekphotonics.com/download/>

4. Student-Side Configuration

Two optional deployment solutions are available for the student side:

- AIOCAMW series All-in-One camera
- UCAM series, CXCAM series or WUCAM8MPA cameras with External PAD Device

4.1 AIOCAMW All-in-One Camera



Figure 6 AIOCAMW All-in-One Camera

The AIOCAMW is a multifunctional all-in-one camera that integrates a 13.3-inch display and an image acquisition system. It is portable and can be used for microscopic video and image acquisition and processing. AIOCAMW is the abbreviation of All-in-One Camera with Windows System. Its main features are as follows:

- The camera and display screen are integrated together, eliminating wiring and facilitating installation.
- Built-in Intel® N150 processor with a maximum turbo frequency of up to 3.6 GHz.
- Pre-installed Windows operating system with touch support, Optional with a wireless keyboard and mouse.
- Uses a Sony CMOS sensor, supports large-format high-resolution sensors, and allows customized model development.
- Supports synchronous 4K60Hz video output via HDMI 2.0 or USB Type-C interfaces.
- Supports Gigabit Ethernet and WiFi 6 wireless networking.
- Comes with advanced video and image processing software applications, ToupView and ToupLite.
- Provides a Windows SDK supporting native C/C++, C#/VB.NET, DirectShow, and Twain API.

AIOCAMW Series All-in-One Camera datasheet and functions are as follow:

Model	Sensor & Size(mm)	Pixel(μm)	G Sensitivity Dark Signal	Sensor Output (FPS/Resolution)	Binning	Exposure
AIOCAMW8MPA	IMX678(C) 1/1.8"(7.68x4.32)	2.0x2.0	3541mv with 1/30s 0.15mv with 1/30s	45@3840x2160 60@1920x1080	1x1 2x2	0.02ms~15s
AIOCAMW12MPA	IMX676(C) 1/1.6"(7.07x7.07)	2.0x2.0	3637mv with 12 bit converted value(HCG) 0.15mv with 1/30s	27@3536x3536 60@1768x1768	1x1 2x2	0.013ms~15s
AIOCAMW20MPA	IMX283(C) 1"(13.06x8.76)	2.4x2.4	462mv with 1/30s 0.21mv with 1/30s	15@5440x3648 50@2736x1824 60@1824x1216	1x1 2x2 3x3	0.1ms~15s

4.2 Type-C Interface Camera + Tablet PC (PAD)

This configuration supports two installation methods. The PAD may either be independently placed on the desktop or fixed directly onto the microscope body for integrated operation.



Figure 7 External PAD Connection Mode



Figure 8 Integrated PAD Mounting Mode

4.2.1 UCAM Series Camera

The dimension drawing of the UCAM series cameras is shown below:

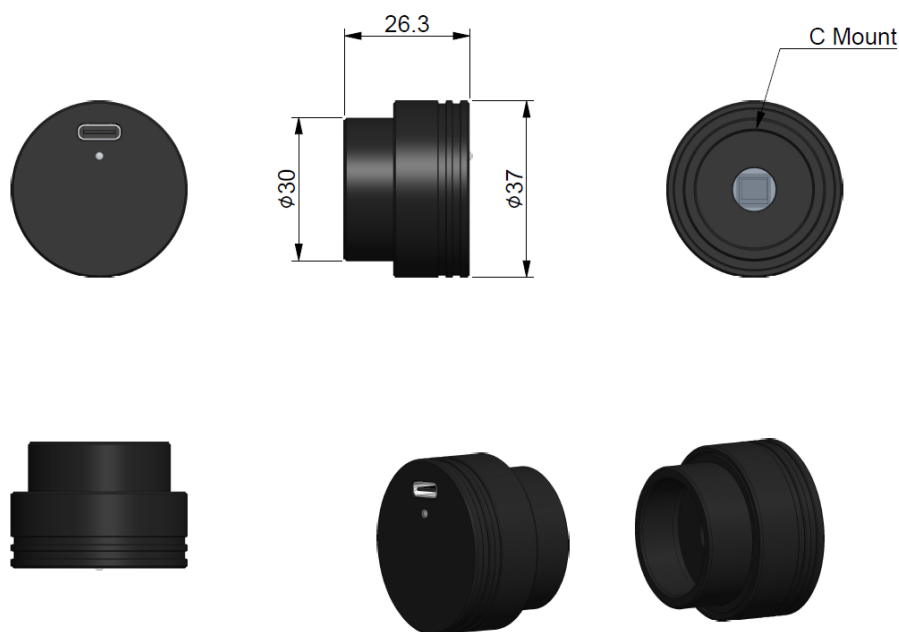


Figure 9 UCAM Camera Dimensional Drawing

XCamLab Hardware Description

The main functions are as follows:

Model	Sensor & Size(mm)	Pixel(μm)	G Sensitivity Dark Signal	Sensor Output (FPS/Resolution)	Binning	Exposure(ms)
UCAM2MPA	OS02C10(C) 1/2.8"(5.57x3.13)	2.9x2.9	32000 $\text{e}^-/\text{lux} \cdot \text{s}$	60@1920x1080(USB)	1x1	0.107~874
UCAM5MPA	IMX335(C) 1/2.8"(5.18x3.89)	2.0x2.0	2020mv with 1/30s 0.52mv with 1/30s	30@2592x1944(USB)	1x1	0.066~1000

4.2.2 WUCAM8MPA Camera

The dimension drawing of the WUCAM series cameras is shown below:

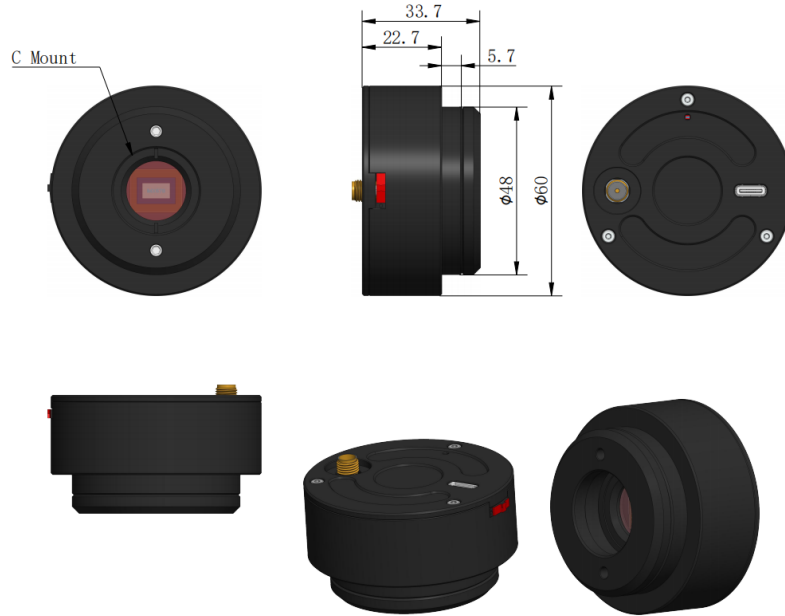


Figure 10 WUCAM Camera Dimensional Drawing

The main functions are as follows:

Model	Sensor & Size(mm)	Pixel(μm)	G Sensitivity Dark Signal	Sensor Output (FPS/Resolution)	USB Type-c (Max FPS/Resolution)	Binning	Exposure(ms)
WUCAM8MPA	Sony IMX678(C) 1/1.8"(7.68x4.32)	2.0x2.0	1364mv with 1/30s 0.15mv with 1/30s	30@3840*2160	30@3840*2160 30@2688*1512 30@1920*1080	1x1	0.04~1000

NOTE: This student camera supports wired image transmission by connecting to student-side PAD via Type-C. Its built-in WiFi is incompatible with the interactive teaching system.

4.2.3 CXCAM Series Camera

The dimension drawing of the CXCAM series cameras is shown below:

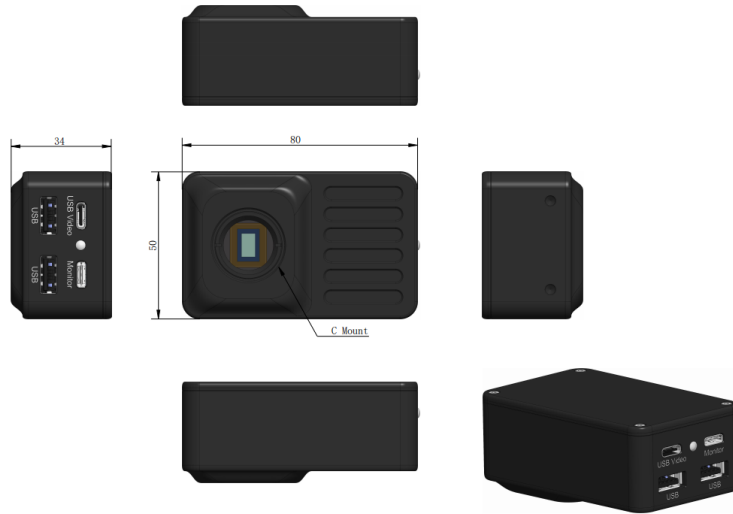


Figure 11 CXCAM Camera Dimensional Drawing

The main functions are as follows:

Model	Sensor & Size(mm)	Pixel (μm)	G Sensitivity Dark Signal	Sensor Output (FPS/Resolution)	USB Video (Max FPS/Resolution)	Binning	Exposure
CXCAM1080P8MPA (TBD)	Sony IMX334(C) 1/1.8"(7.68x4.32)	2.0x2.0	505mv with 1/30s 0.1mv with 1/30s	45@3840*2160	30@3840*2160 45@1920*1080	1x1	0.04~1000
CXCAM1080P8MPB	Sony IMX585(C) 1/1.2"(11.14x6.26)	2.9x2.9	5970mv with 1/30s 0.39mv with 1/30s	45@3840*2160	30@3840*2160 45@1920*1080	1x1	0.04~1000
CXCAM1080P8MPC	Sony IMX678(C) 1/1.8"(7.68x4.32)	2.0x2.0	1364mv with 1/30s 0.15mv with 1/30s	45@3840*2160	30@3840*2160 45@1920*1080	1x1	0.04~1000
CXCAM1080P2MPA	Sony IMX385(C) 1/2"(7.2x4.05)	3.75x3.7 5	1175mv with 1/30s 0.15mv with 1/30s	120@1920*1080	80@1920*1080	1x1	0.04~1000

NOTE: This student camera supports wired image transmission by connecting to student-side PAD via USB Video.

4.2.4 Tablet PC Configuration

Taking **HUAWEI MatePad SE (China Version)** Used for Testing as an Example:

Item	Specification
Model	HUAWEI MatePad SE (China Version)
CPU	Qualcomm Snapdragon 680
RAM	6 GB or above
Graphics	Integrated GPU
Wireless Protocols	802.11a/b/g/n/ac (WiFi5)
Storage	128 GB or above
Operating System	HarmonyOS 3.0 (HarmonyOS 5.0 not supported temporarily)
Resolution	2000 × 1200

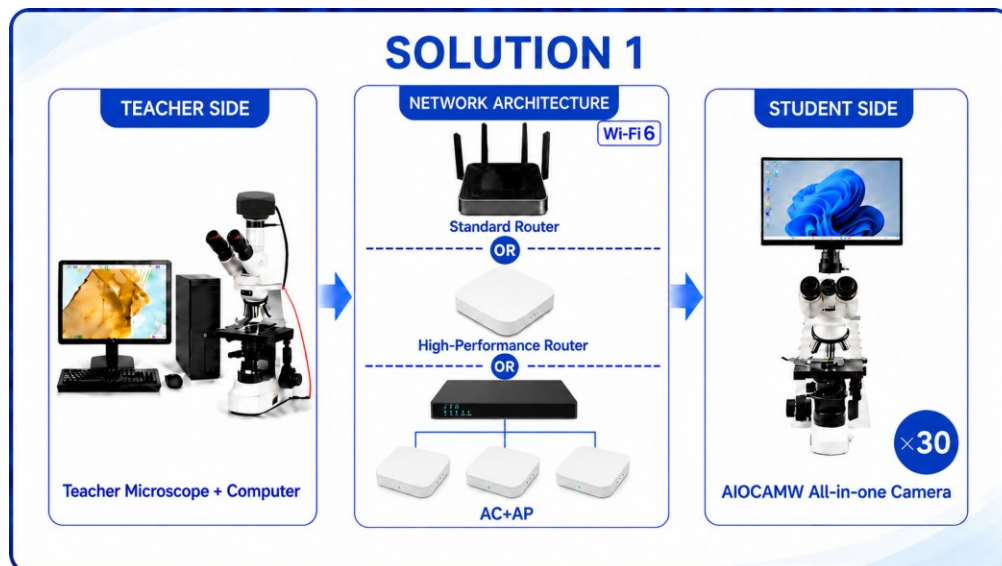
Taking **Galaxy Tab S10 Lite (Overseas Version)** Used for Testing as an Example:

Item	Specification
Model	Galaxy Tab S10 Lite (Overseas Version)
CPU	Exynos 1380
RAM	6 GB or above
Graphics	Integrated GPU
Wireless Protocols	802.11a/b/g/n/ac/ax (WiFi6)
Storage	128 GB or above
Operating System	Android 16.0 or higher
Resolution	2112 x 1320

5. Hardware Platform Configuration Options

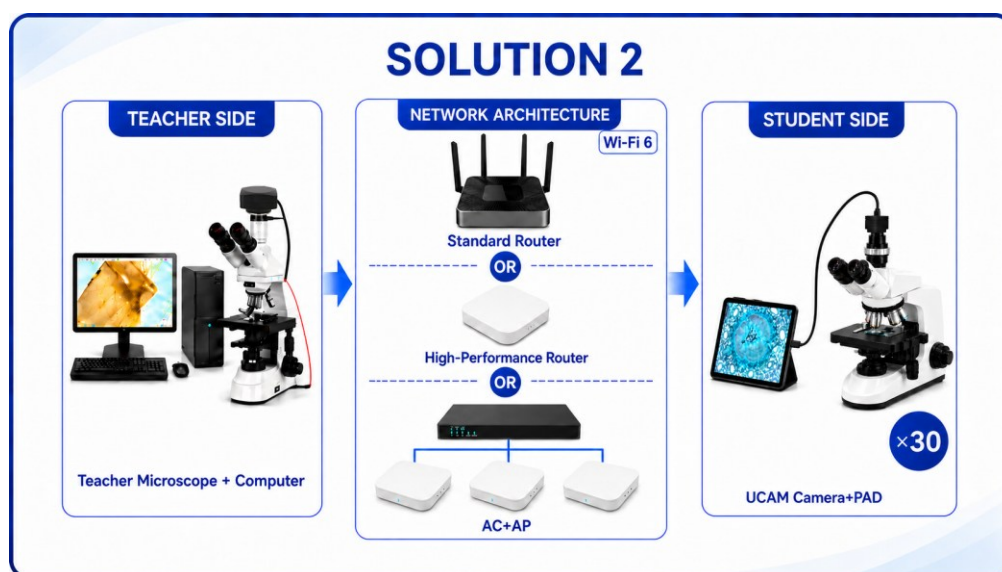
Taking 30 student terminals as an example, five differentiated configuration schemes are provided below for your reference and selection.

Solution 1: 30 Microscopes + 30 AIOCAMW All-in-One Cameras



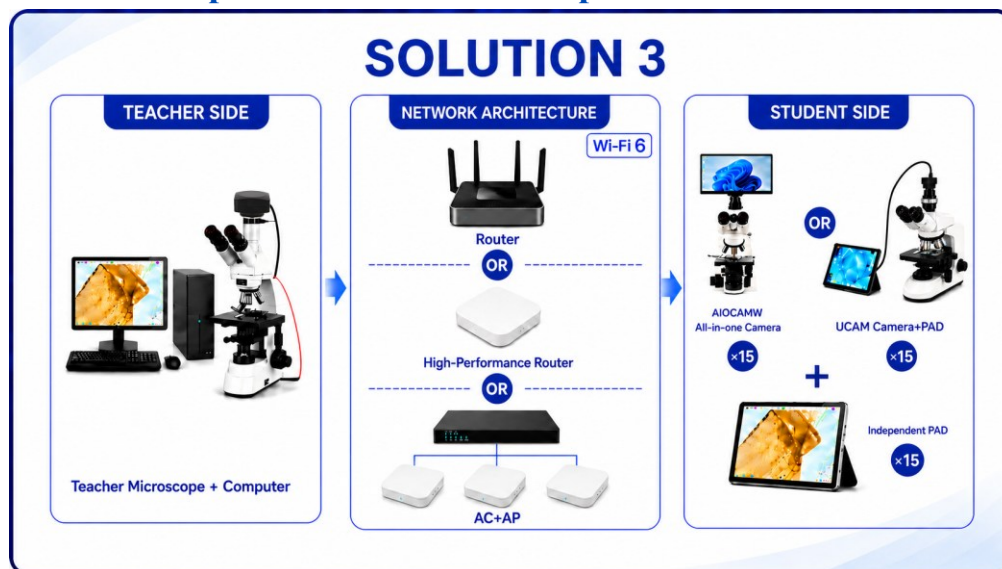
Application Scenario: The student side adopts the AIOCAMW Series all-in-one camera solution, integrating a Windows operating system and Sony image sensor within a compact device. Compared with traditional desktop-computer-based solutions, this configuration significantly reduces equipment footprint while improving laboratory organization and deployment efficiency.

Solution 2: 30 Microscopes + 30 Sets of Type-C Interface Cameras with PAD



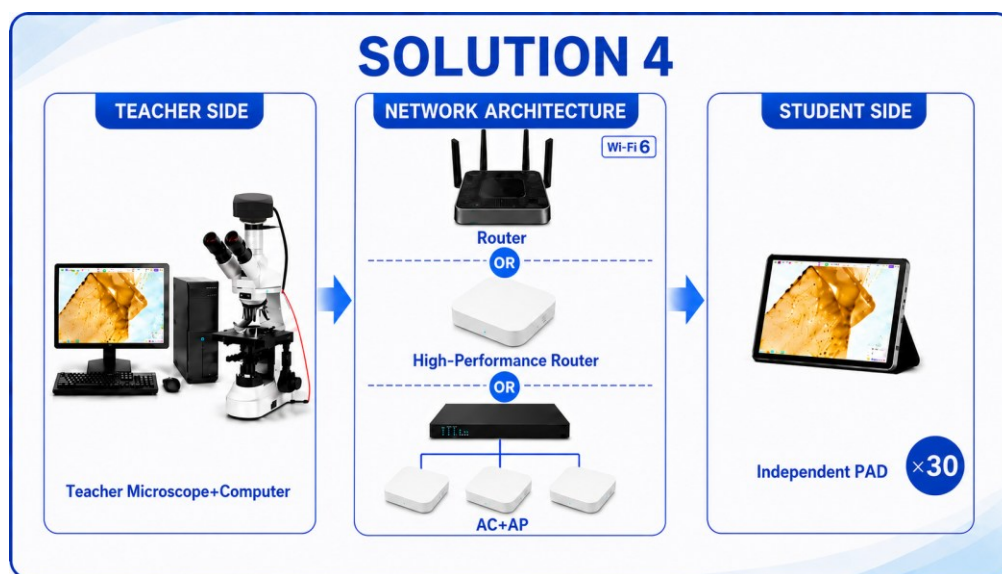
Application Scenario: Students operate the system via PAD devices combined with our compact and lightweight Type-C interface cameras, effectively reducing the overall student-side deployment cost. PAD devices can be flexibly deployed according to actual teaching environments and application requirements, enabling adaptable operation across different classroom scenarios.

Solution 3: 15 Microscope Terminals + 15 Independent PAD Devices



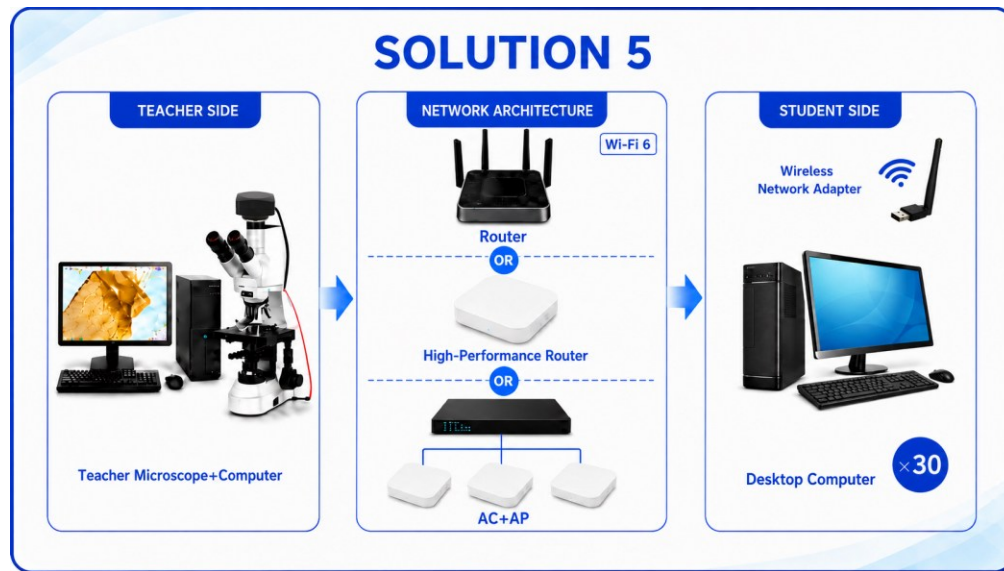
Application Scenario: Either the AIOCAMW Series all-in-one camera solution or the Type-C interface cameras + PAD solution may be flexibly selected according to specific teaching requirements. During classroom sessions, students may work in groups or take turns using PAD devices for microscopic observation and image interaction, improving equipment utilization efficiency while enhancing classroom participation and collaborative learning effectiveness.

Solution 4: 30 Independent PAD Devices



Application Scenario: This complete set includes 30 standalone tablets, requiring no student microscope imaging devices. It features simple deployment and lower overall costs. Each student is equipped with an individual tablet to receive the teacher's live feed synchronously, enabling full-class simultaneous observation and interaction. This solution is ideal for labs with limited budgets focusing on demonstration teaching and mobile classrooms.

Solution 5: 30 Desktop Computers



Application Scenario: This solution includes 30 desktop PCs. Optional student-side microscopic imaging devices are available. Existing lab computers can be reused with wireless network adapters. Each student receives the teacher's screen synchronously for observation and interaction. It is suitable for laboratories with existing computer rooms for fixed-site teaching.

6.Summary of Hardware Equipment

Num	Device Name	Description
1	Teacher-side camera	Any of our cameras
2	XCamLab dongle	For teacher-side XCamLab software
3	XCamLab Placeable WiFi6 Router (China Version)	Up to 30 terminals (Customers may purchase independently)
4	XCamLab Placeable WiFi6 Router (EU Version)	Up to 25 terminals (Customers may purchase independently)
5	XCamLab Ceiling-mounted WiFi6 Router (China Version)	Up to 50 terminals (Customers may purchase independently)
6	Student-side WiFi6 PAD	Provide XCamLab Android software (Customers may purchase independently)
7	Student-side AIOCAMW Series Cameras	Windows system
8	Student-side UCAM Series Cameras	Connect to student-side PAD
9	Student-side WUCAM8MPA Camera	Connect to student-side PAD. Only supports Type-C interface connection to PAD; its built-in WiFi cannot connect to interactive teaching system
10	Student-side CXCAM Series Cameras	Connect to student-side PAD. Only supports USB Video interface connection to PAD