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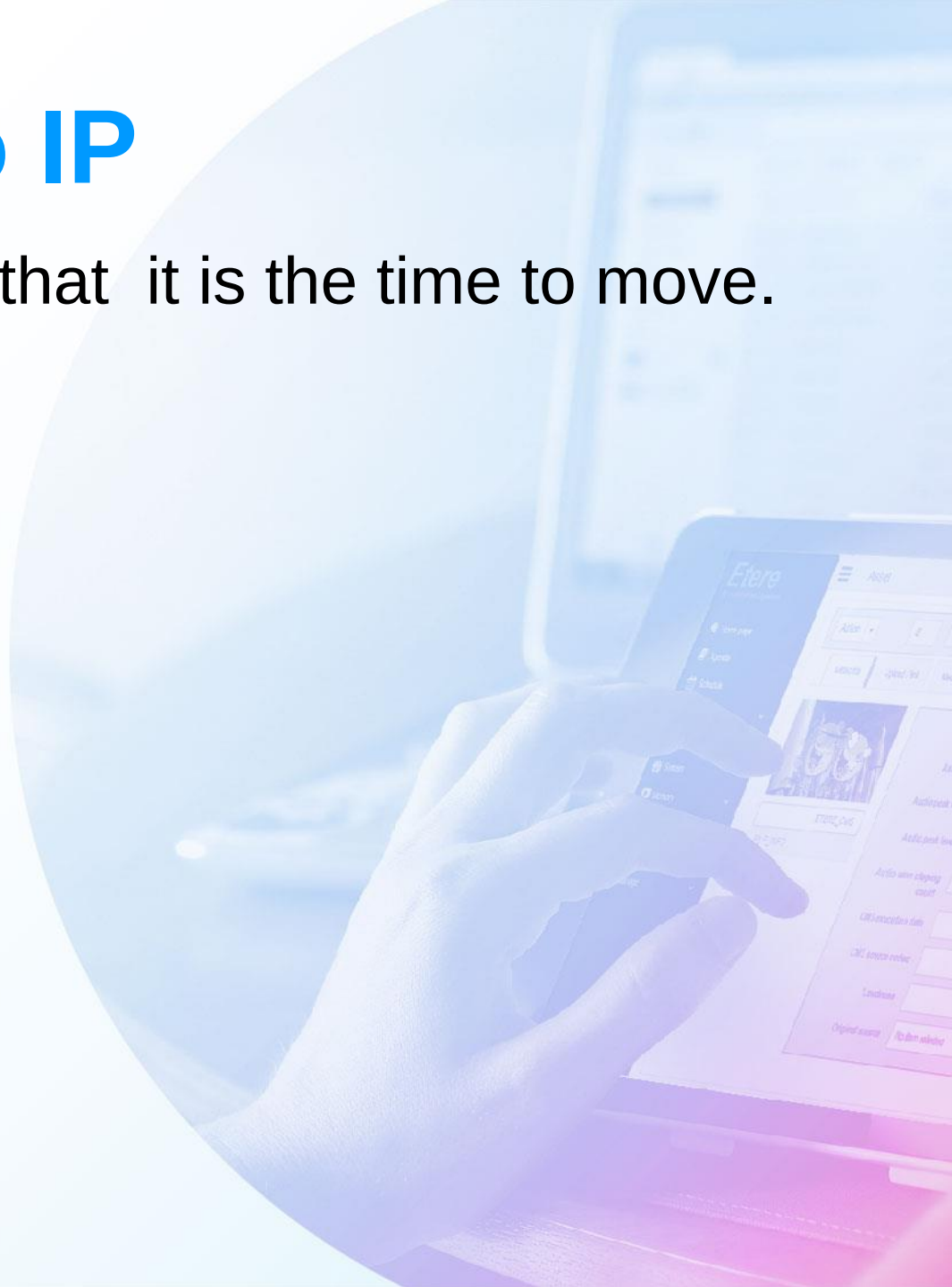
From SDI to IP

Moving to IP

- You will listen a lot of people saying that it is the time to move.
- IP is the future
- IP is better
- IP Is cheaper
- IP is more simple
- You need to move now.
- But it is true ?

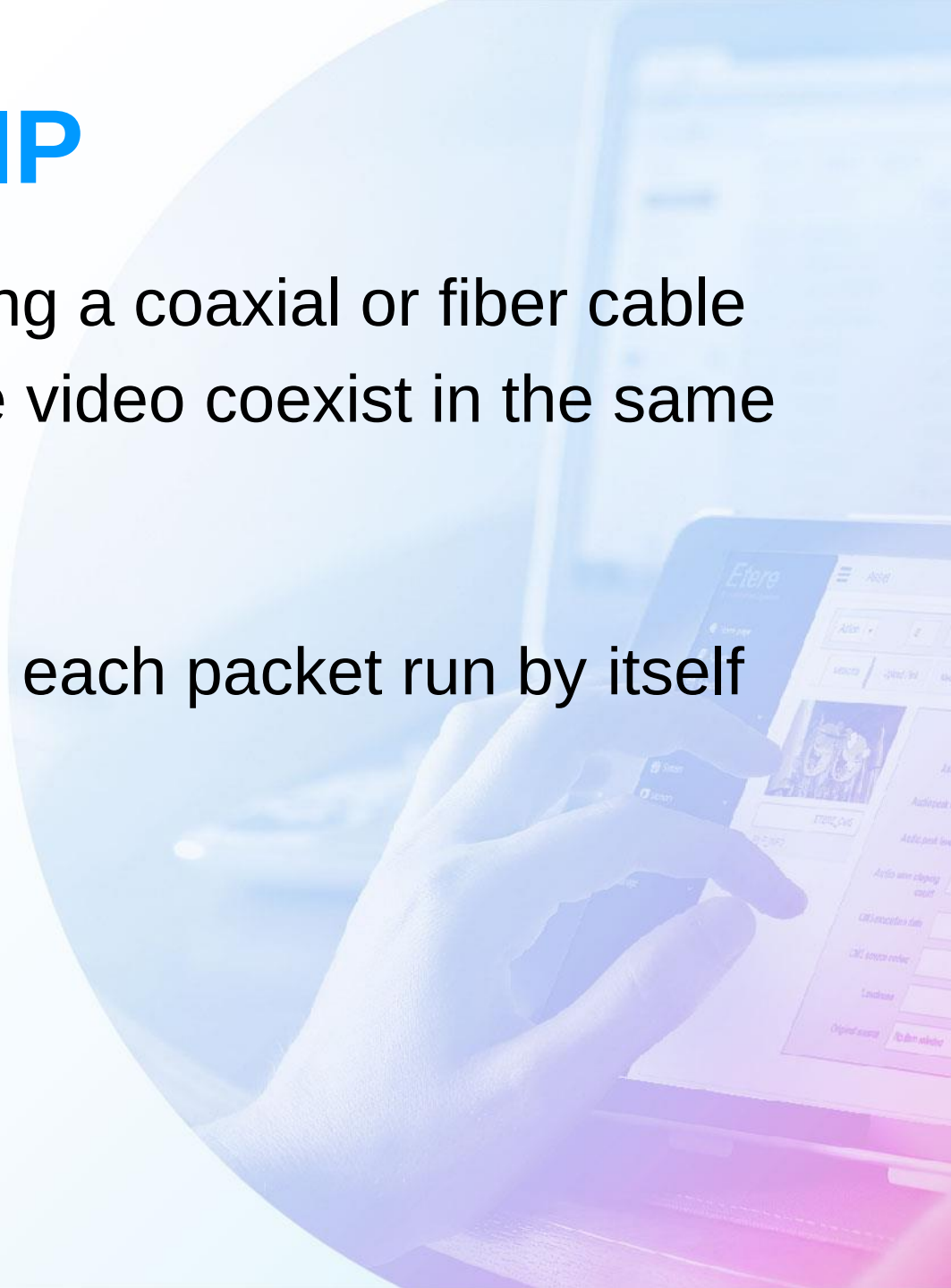


IP Main Challenges

- Standards
- Router
- Inputs
- Outputs

SDI and IP

- SDI is a point to point connection using a coaxial or fiber cable
- IP is a packet network where multiple video coexist in the same stream
- SDI video is a continuous stream
- IP the video is divided in packets and each packet run by itself



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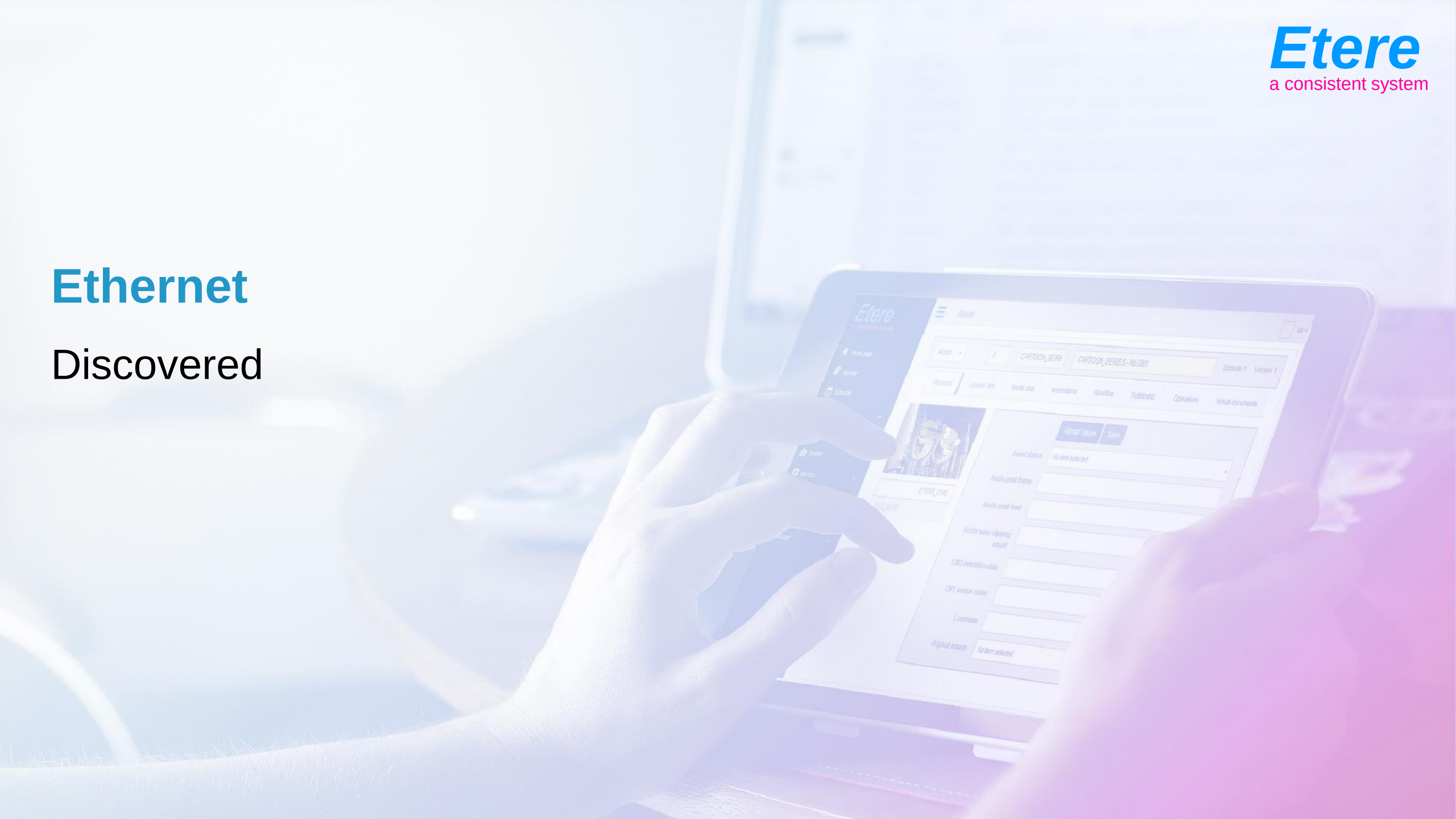
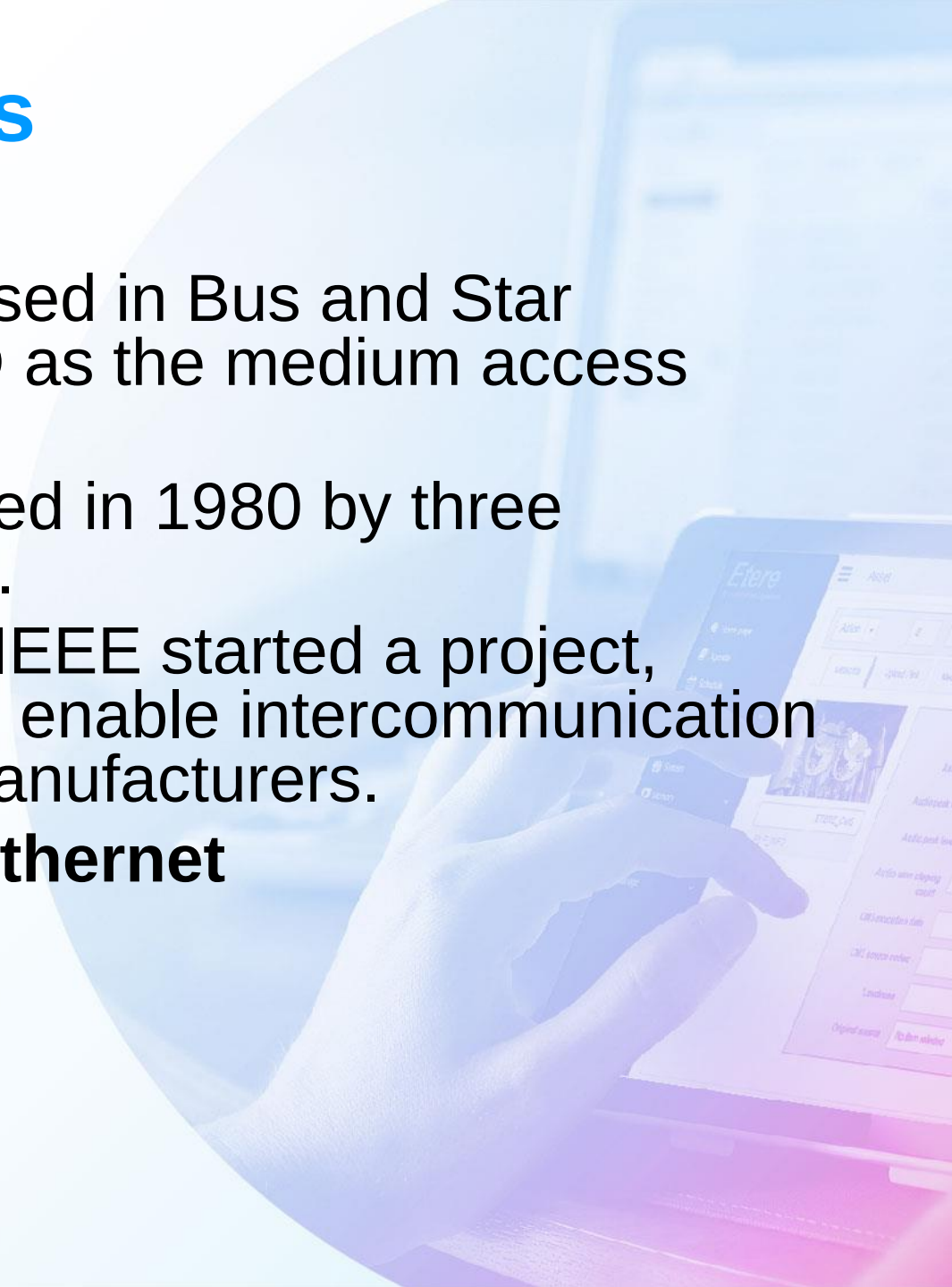
Ethernet

Discovered



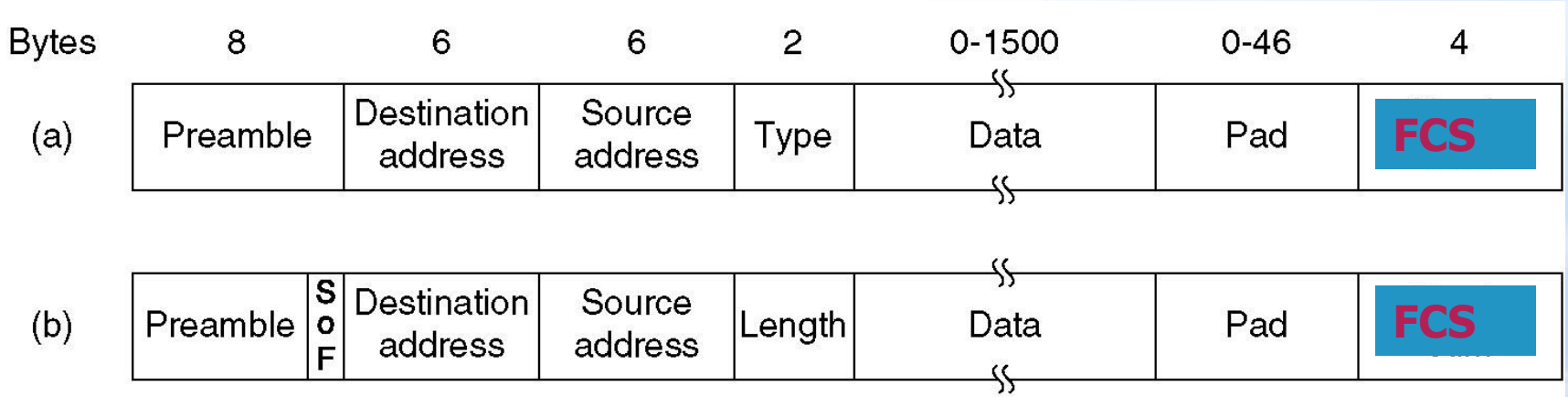
IEE Standards

- Ethernet: It is a LAN protocol that is used in Bus and Star topologies and implements CSMA/CD as the medium access method
- Original (traditional) Ethernet developed in 1980 by three companies: Digital, Intel, Xerox (DIX).
- In 1985, the Computer Society of the IEEE started a project, called Project 802, to set standards to enable intercommunication among equipment from a variety of manufacturers.
  - **Current version is called IEEE Ethernet**



Ethernet Frame

- **Ethernet Frame format**

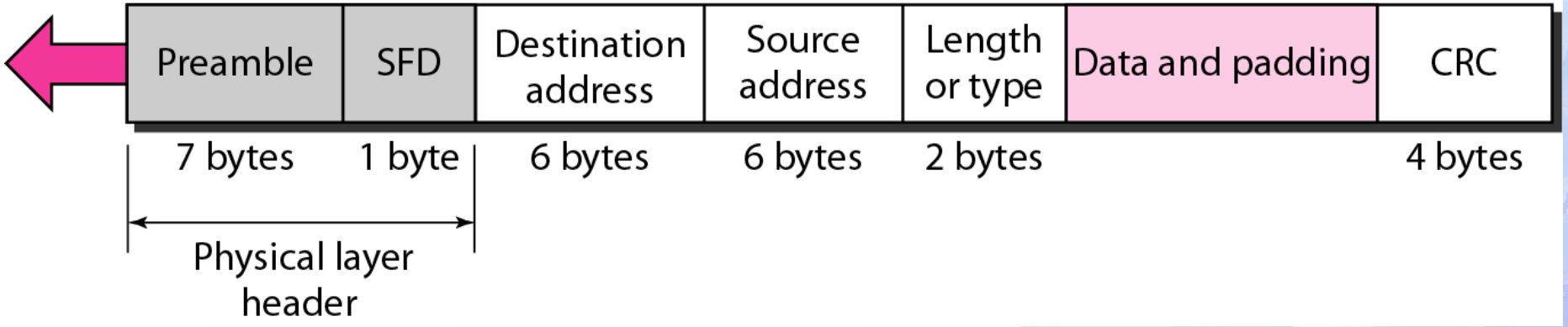


Frame formats. (a) DIX Ethernet , (b) IEEE 802.3.

MAC Frame

Preamble: 56 bits of alternating 1s and 0s.

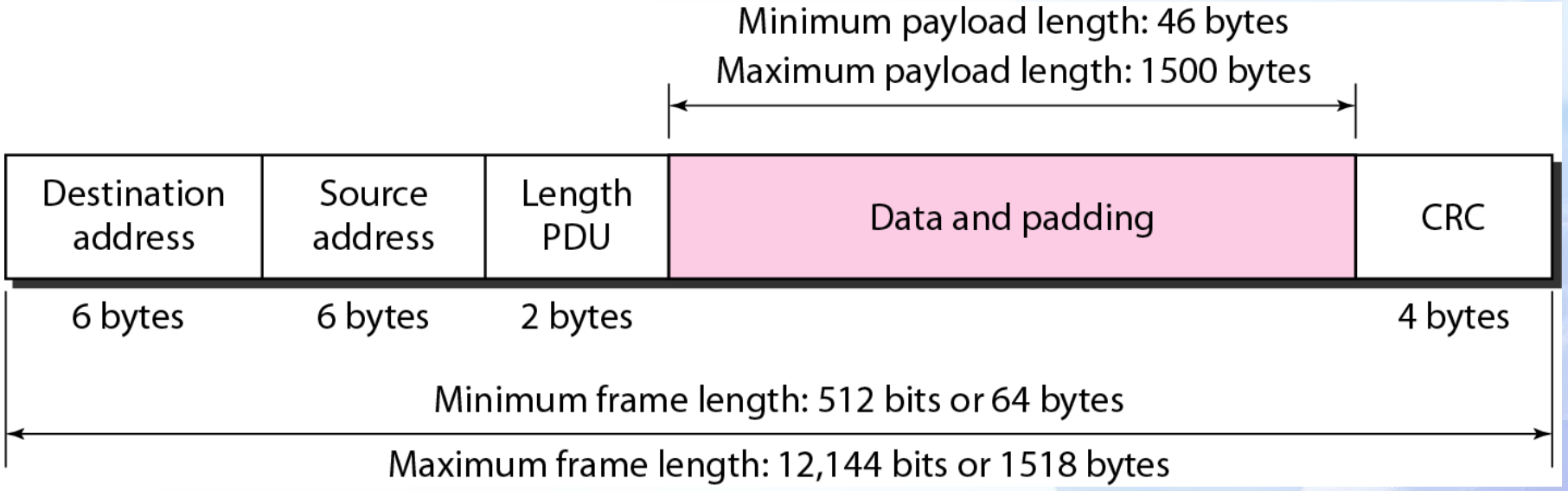
SFD: Start frame delimiter, flag (10101011)



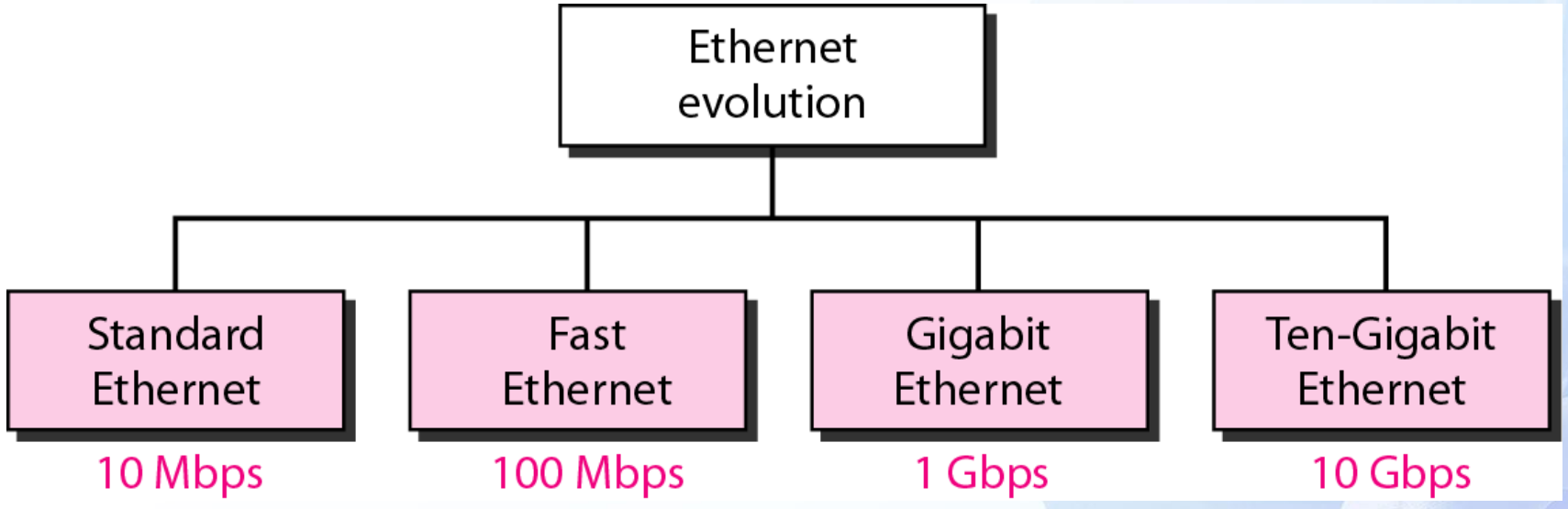
Unreliable, Connectionless Service

- Ethernet data link layer protocol provides connectionless service to the network layer
  - No handshaking between sending and receiving adapter.
- Ethernet protocol provides Unreliable service to the network layer :
  - Receiving adapter doesn’t send ACK or NAK to sending adapter
  - This means stream of datagram's passed to network layer can have gaps (missing data)
    - Gaps will be filled if application is using reliable transport layer protocol
      - Otherwise, application will see the gaps

Frames Size


Minimum payload length: 46 bytes
Maximum payload length: 1500 bytes
Destination address
Source address
Length PDU
Data and padding
CRC
6 bytes
6 bytes
2 bytes
4 bytes
Minimum frame length: 512 bits or 64 bytes
Maximum frame length: 12,144 bits or 1518 bytes

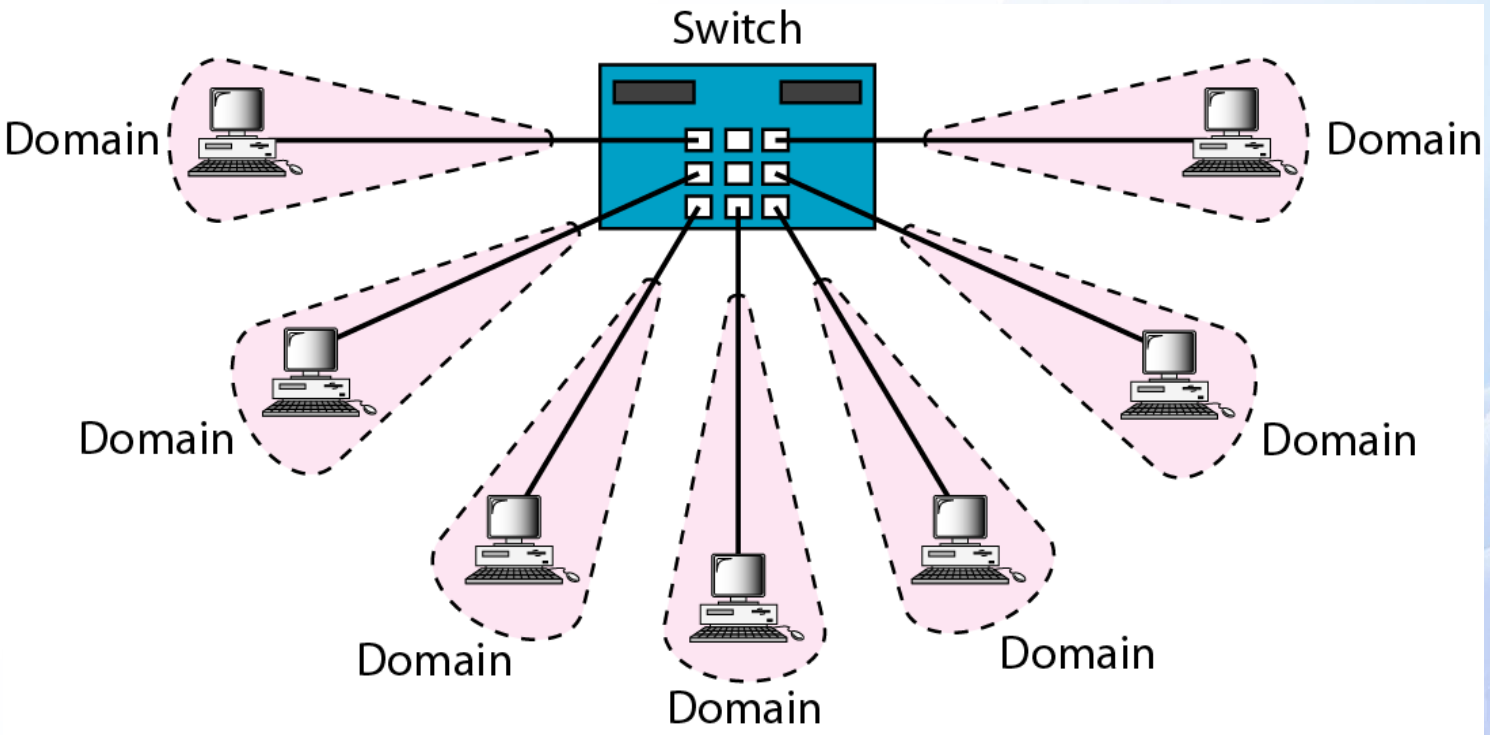
Ethernet Evolution



Full Duplex

- Traditional Ethernet is half duplex
  - Either transmit or receive but not both simultaneously
- With full-duplex, station can transmit and receive data simultaneously
- With full duplex, Throughput (actual transmission rate) is doubled.
  - 10-Mbps Ethernet in full-duplex mode, theoretical transfer rate becomes 20 Mbps
  - 100-Mbps Ethernet in full-duplex mode, theoretical transfer rate becomes 200 Mbps
- Changes that should be made with any computer in order to operate in Full-Duplex Mode
  - Attached stations must have full-duplex NIC cards
  - Must use two pairs of wire one pair for transmitting from host to switch (inbound) and the other pair for transmitting from switch to host (outbound)
  - Must use a switch as a central device not a hub
  - Devices must be connected point-to-point (dedicated) to the switch
  - Each station constitutes separate collision domain
    - CSMA/CD algorithm no longer needed (no collision)
    - No limit on the segment length
    - Same 802.3 MAC frame format used

Switched Ethernet



Gigabit Ethernet

- Speed 1Gpbs
- Minimum frame length is 512 bytes
- Operates in full/half duplex modes mostly full duplex

Name	Cable	Max. segment
1000Base-SX	Fiber optics	550 m
1000Base-LX	Fiber optics	5000 m
1000Base-CX	2 Pairs of STP	25 m
1000Base-T	4 Pairs of UTP	100 m

10 GB Ethernet

- Maximum link distances cover up to 40 km
- Full-duplex mode only
- No CSMA/CD
- Use as media
  - Singlemode fiber Optical
  - Multimode fiber Optical
  - Cat6 cables (Up to 100m) 10GBASE-T
- 10GBASE-T arrives in 2006 !

Terabit Internet

- Support MAC data rate of 400 Gbit/s
- Preserve the Ethernet frame format utilizing the Ethernet MAC
- Preserve minimum and maximum frame size of current Ethernet standard
- Define physical layer specifications that support link distances of:
  - at least 100 m over multi-mode fiber (400GBASE-SR16)[12]
  - at least 500 m over single-mode fiber (400GBASE-DR4)[13]
  - at least 2 km over single-mode fiber (400GBASE-FR8)[14][15]
  - at least 10 km over single-mode fiber (400GBASE-LR8)[16]
- Support a bit error ratio (BER) of 10-13, which is an improvement over the 10-12 BER that was specified for 10GbE, 40GbE, and 100GbE.
- Support for OTN (transport of Ethernet across optical transport networks), and optional support for Energy-Efficient Ethernet (EEE).

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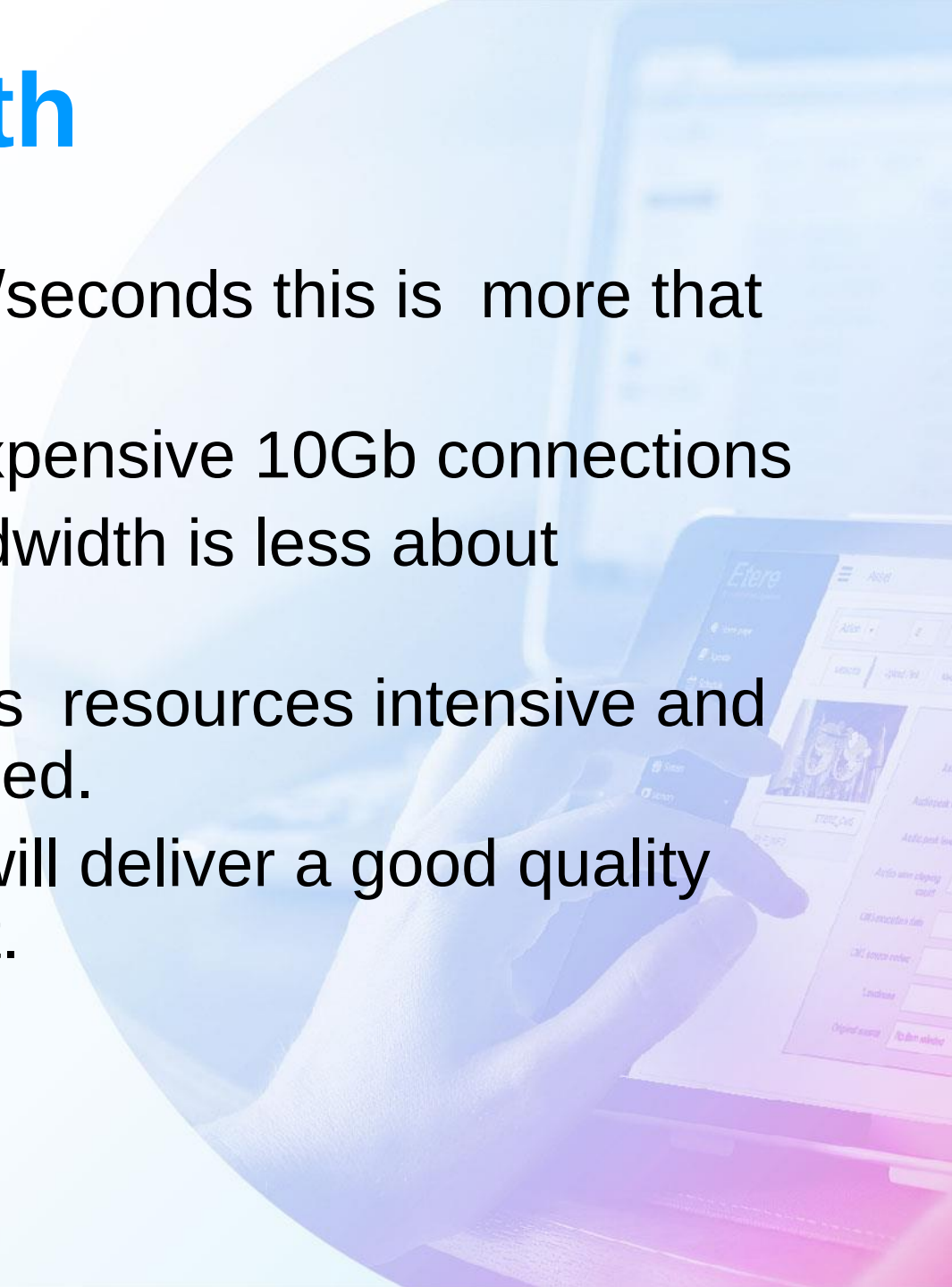
Back to Video over IP

Standards

- IP transfer has many standards
- SMPTE 2110 is one but it has more than 6 substandard, still new, it defines the different transport schemas and error corrections.
- The challenge is how to deliver video with UDP assuring quality.
- But as usually the world is more simple
- Most of the systems today use a Transport stream with a compressed payload, without error correction, as subset of SMPTE 2110
- Easy simple working.

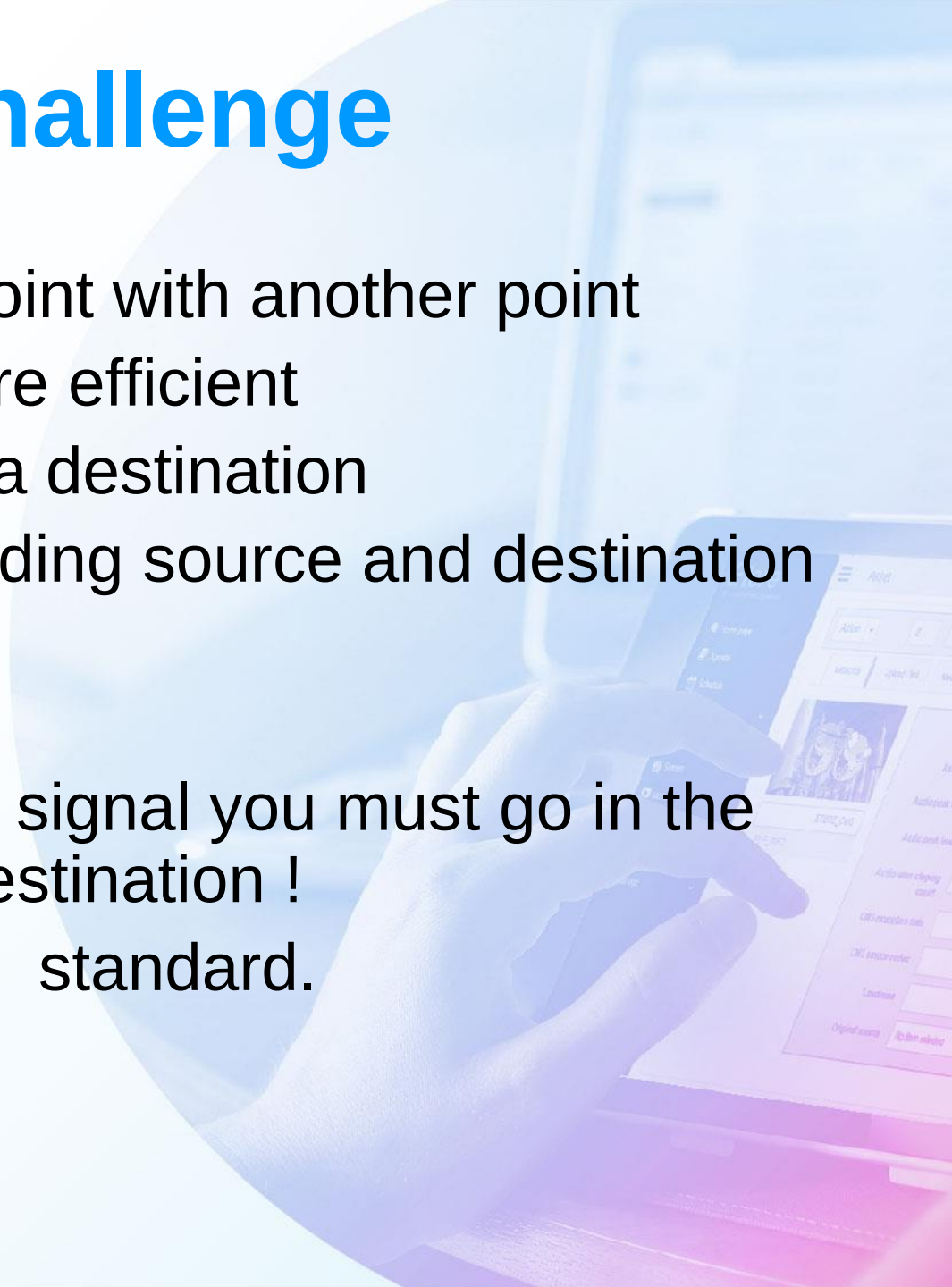
Bandwidth

- Uncompressed video is about 1.5Gb/seconds this is more that the standard gigabit connection.
- You need multiple gigabit cards or expensive 10Gb connections
- If you deliver a transport stream bandwidth is less about 24Mb/second using H264
- But encode and decode and H264 is resources intensive and limits the concurrent streams produced.
- A more common 100Mb/sec MPG2 will deliver a good quality and will have a low CPU requirement.



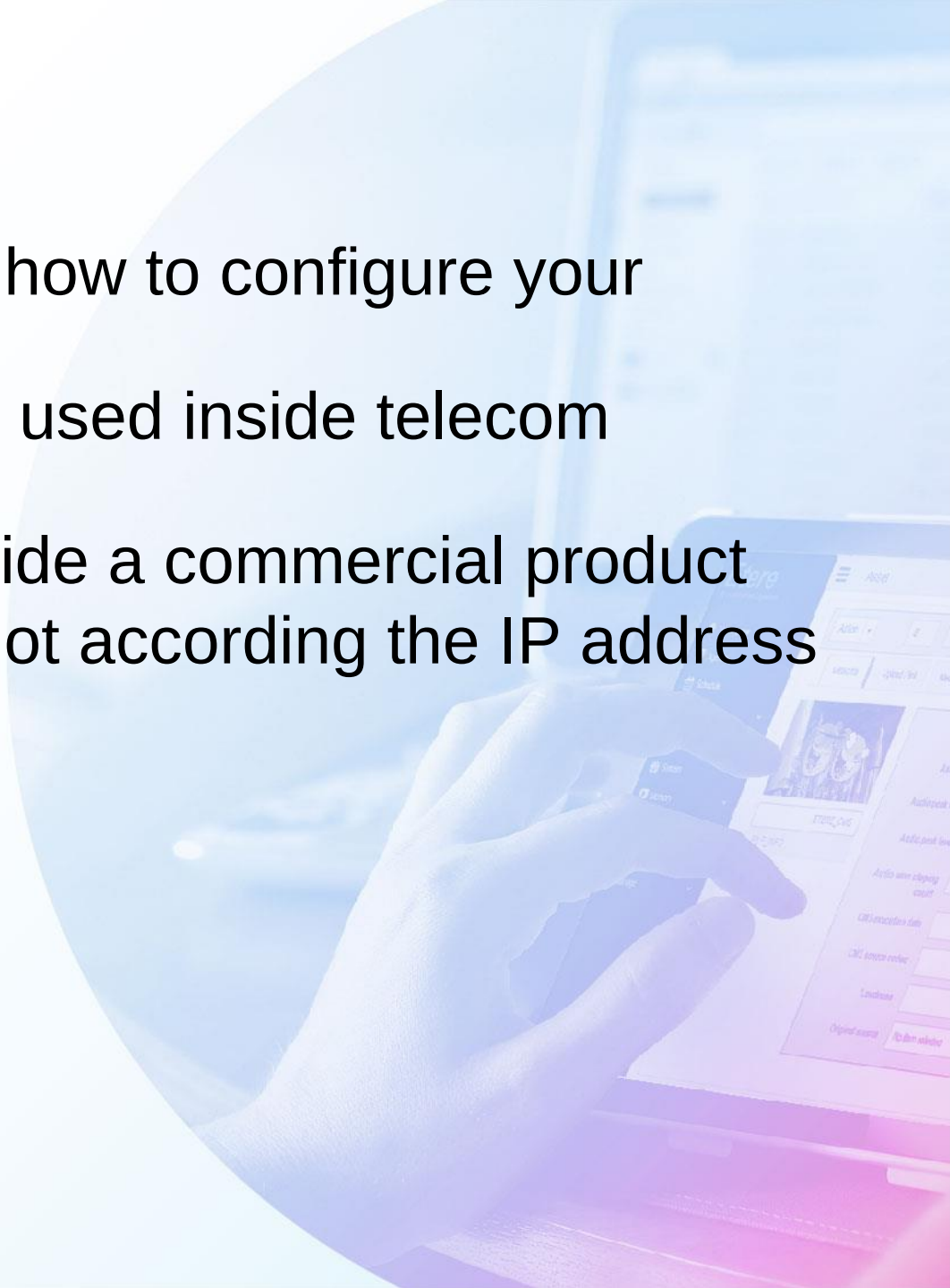
The Router Challenge

- In SDI a router simply connect one point with another point
- It is like to use a patch panel but more efficient
- In IP every packet has a source and a destination
- The routing is done by the switch reading source and destination address.
- So.
- To choose the monitor where view a signal you must go in the camera and add an address to the destination !
- Not very comfortable, and there is no standard.



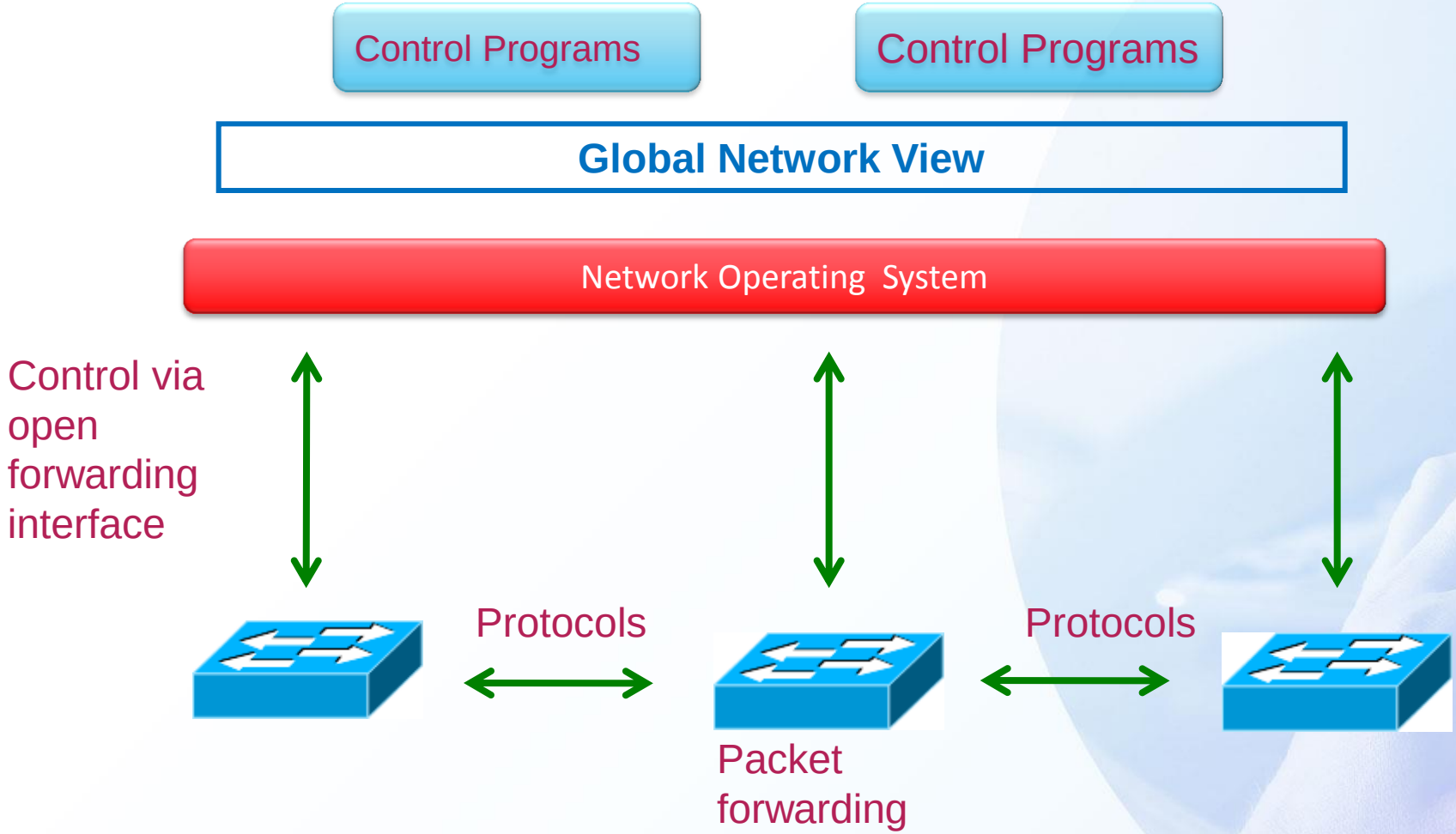
Now SDN

- SDN (software defined network) is how to configure your network switches
- SDN was born in 1995 mainly to be used inside telecom companies.
- Only in 2001 the SDN start to be inside a commercial product
- The switch will address the packet not according the IP address but using the SDN.
- It will act as a router.
- Easy ? Simple ? Inexpensive ?
- Not really.

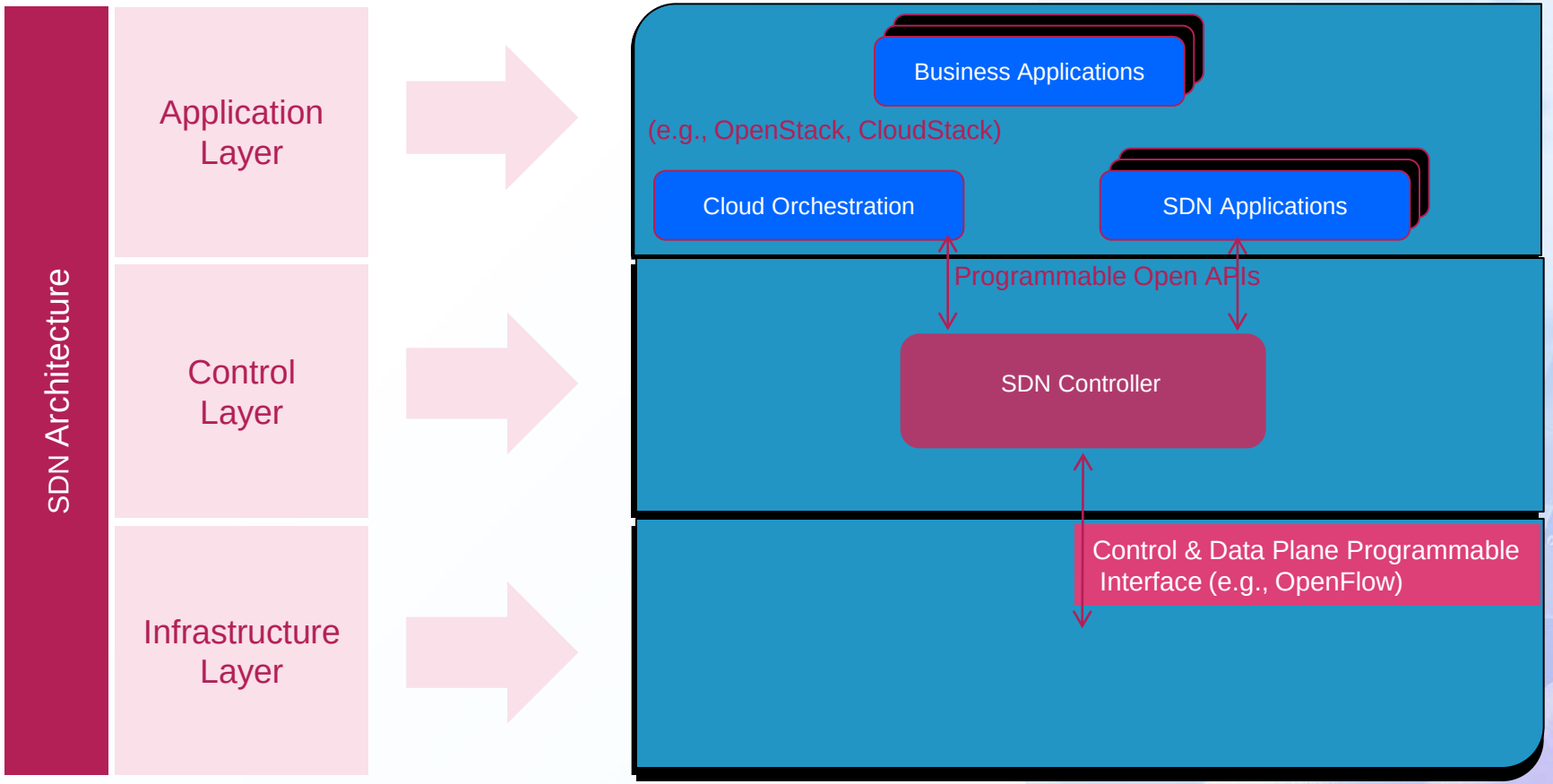


Os for networks

Software-Defined Networking (SDN)

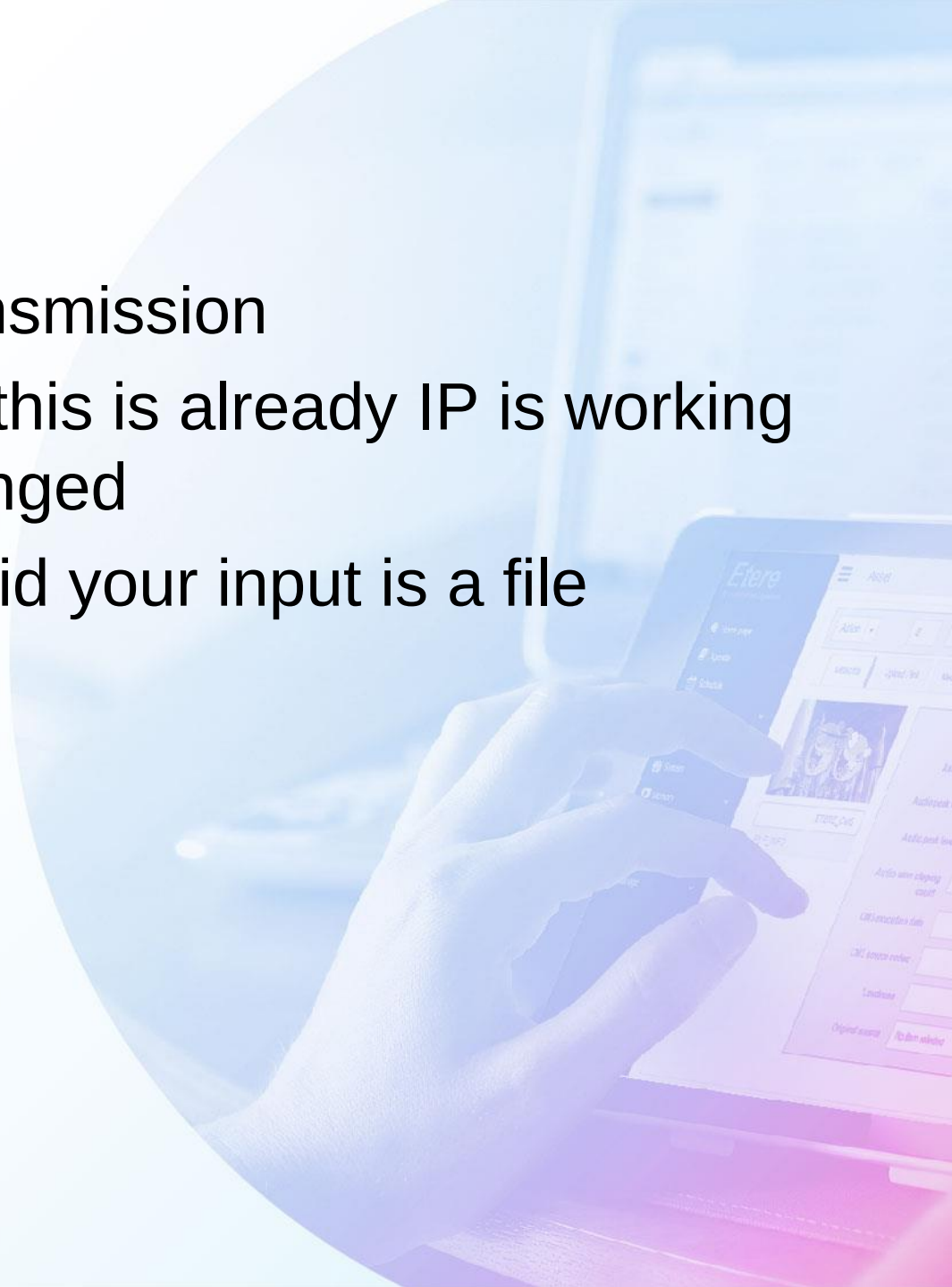


SDN structure



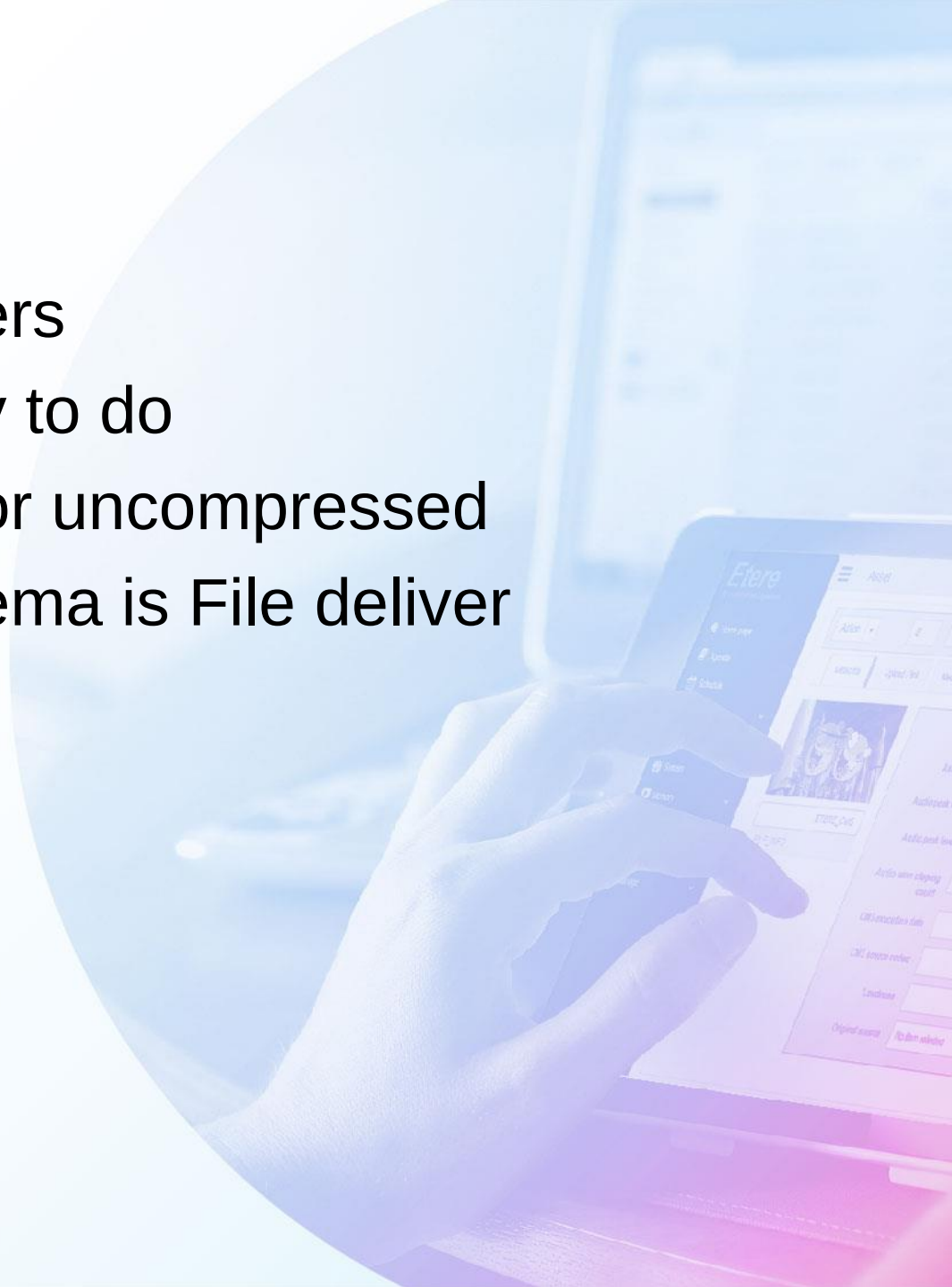
Live from IP

- IP in is true only if you have a live transmission
- All other cases today is simply file in, this is already IP is working it is cheap and do not need to be changed
- You do not need a VTR and a router id your input is a file
- So on IP world your router is smaller



IP out

- Still only to transmitters or streamers
- All others are file out, already easy to do
- Monitoring for live this can be TS or uncompressed
- Note that most of the delivery schema is File deliver

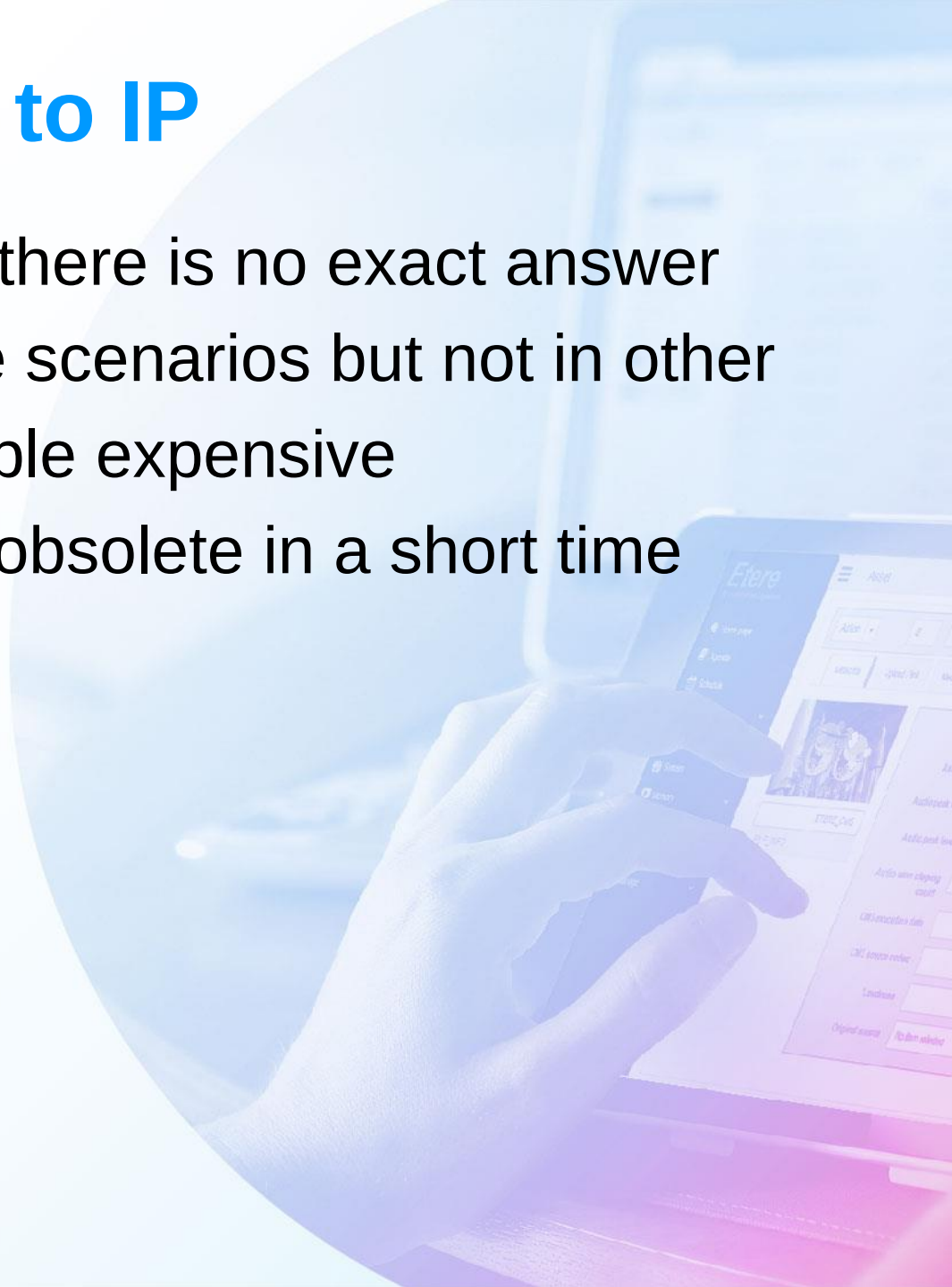


Why move to IP

- IP cabling is less expensive.
  - Today this is true for a bitrates of less than 1G, otherwise you need to go to 10G
- Router can be expanded with a network switch
  - This is true but you need an hi class Switch plus a SDN controller, probably this combination is more expensive than the traditional router.
- You have more bandwidth to run 4K and 8k
  - Today only using FIBER connection fiber will give you bandwidth even with SDI
- More easy to connect and operate
  - Today there is no standard for IP connection, SMPTE 2110 (6 standard is not really so common)

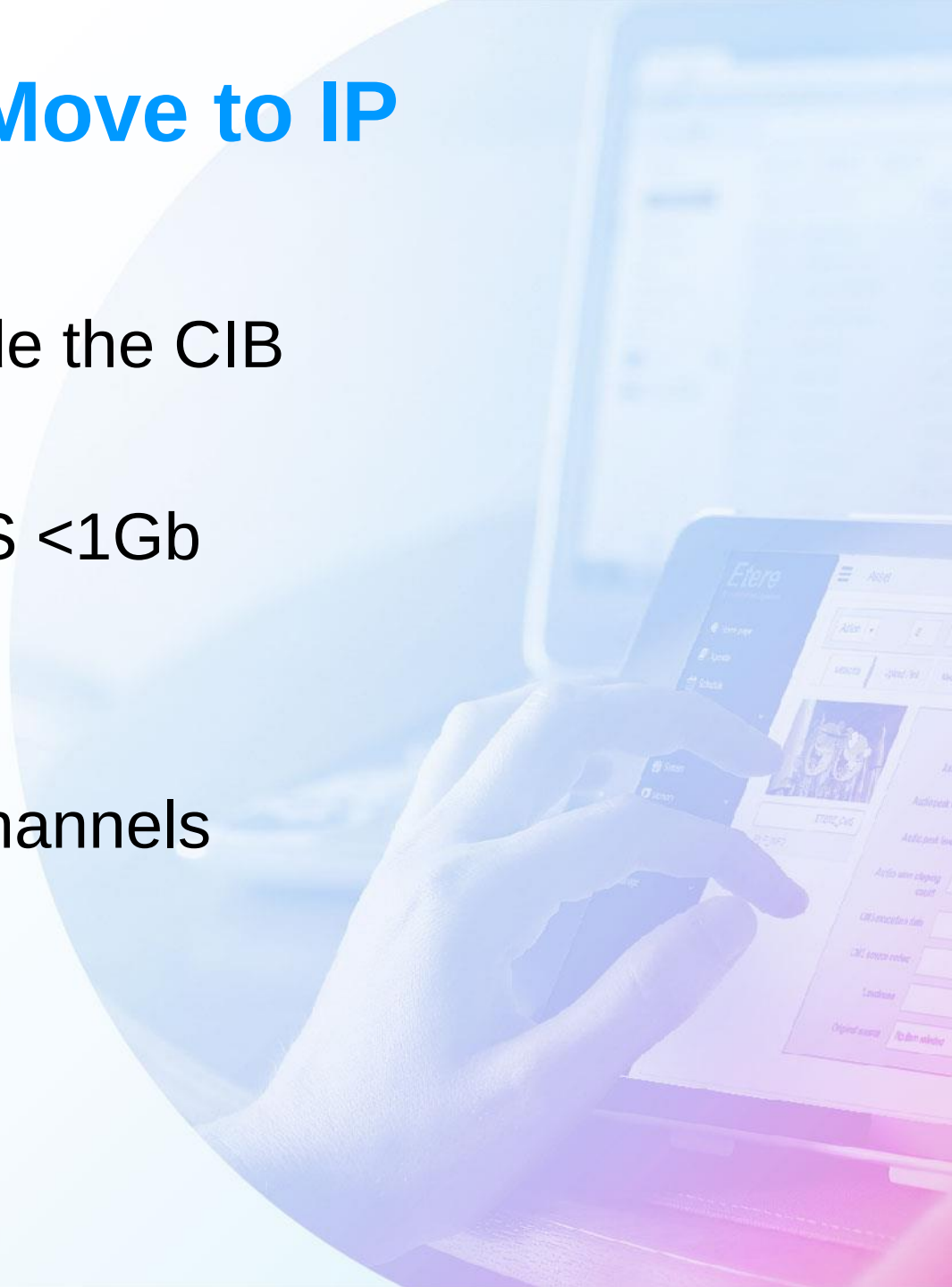
It is time to move to IP

- As any other engineering process there is no exact answer
- Move today can be better in some scenarios but not in other
- Move to IP too early could be simple expensive
- Today IP technology can became obsolete in a short time



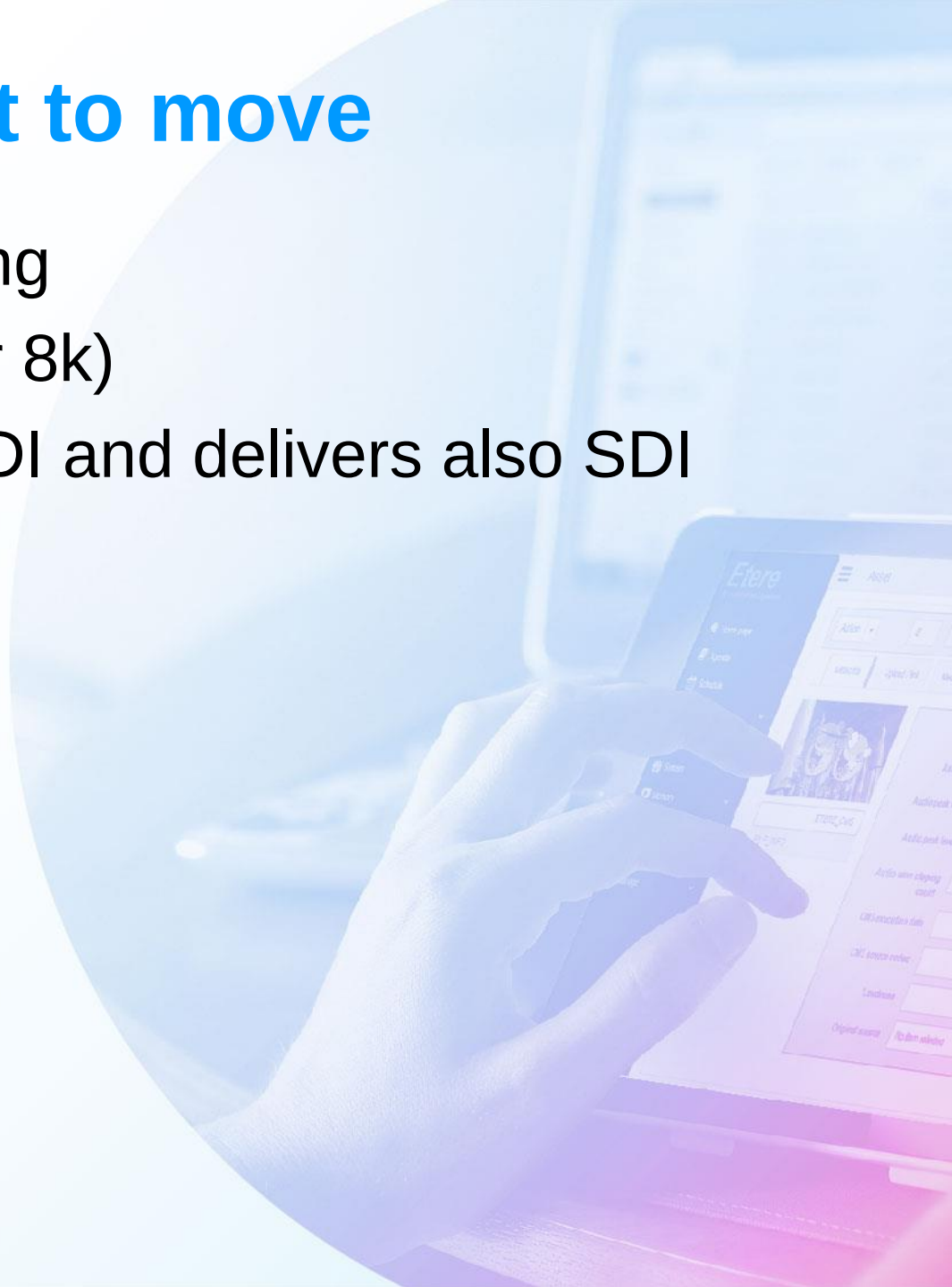
When its better to Move to IP

- Playout from CIB to Encoder
  - All the signal is generated inside the CIB
  - Fixed monitoring
  - Transport using compressed TS <1Gb
  - Gigabit connection
  - No SDN
- This scenario is typical of movie channels



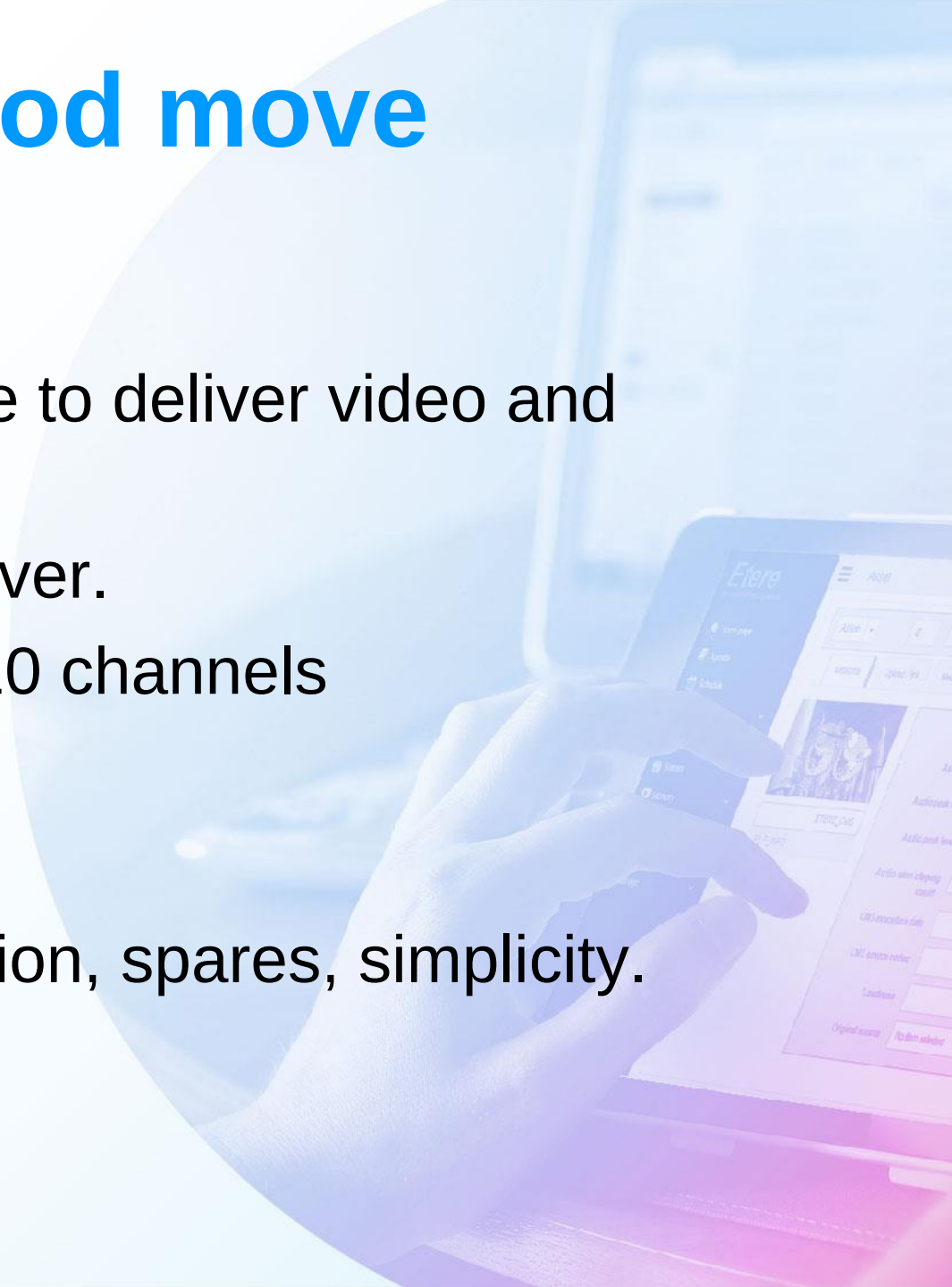
When it is better not to move

- SD or HD facility with a lot of routing
- No plan to go more than HD (4k or 8k)
- Most of the delivers are already SDI and delivers also SDI
- You have a limited budget



Example of a good move

- You have a multiple movie channel
- You have an IP ready CIB that is able to deliver video and graphics.
- Your software can run in a blade server.
- With a simple 5 RU system you run 10 channels
- Another 5 RU for the backup
- Instead of 5 racks you have 10RU
- A big advantage for power consumption, spares, simplicity.



Conclusion

- As it happens the new is not always better
- Probably a more practical solution than SDN will make the move
- Also in about 3 years 10Gb switch will be used in the homes, this will make the technology cheaper even 10 times

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Thank You

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