



International Civil Aviation Organization

Sixth Meeting of CNS/MET Sub-Group of APANPIRG

Bangkok, Thailand, 15-19 July 2002

Agenda Item 3: ATN transition planning

INFORMATION FOR THE INCORPORATION OF THE IP (INTERNET PROTOCOL) IN THE ATN

(Presented by Japan)

Summary

This paper presents information for the incorporation of the Internet Protocol (IP) into the ATN environment.

1. INTRODUCTION

The Internet Protocol (IP) is being increasingly adopted and used worldwide for data communications. As the ATN is based on the ISO OSI Standards, there is no direct interoperability between IP and ATN.

2. DISCUSSION

Considering the increasing worldwide use of IP (Internet Protocol) technology, ATNP WG had started investigating how to incorporate IP into the ATN environment. There was considerable discussion on this topic at the recent round of ATNP WG meetings held in Phuket, Thailand, 12–20 March 2002, and although many issues remain to be discussed at the next meeting, this paper presents the Draft Position Statement adopted by WG B as Attachment-1, and additional related information on this matter in Attachment-2.

3. ACTION BY THE MEETING

The meeting is invited to note the information provided in this paper.

Attachment-1: “Draft Position Statement of ATNP WG B on the use of IP Subnetworks as part of the ATN”; Appendix E to the ICAO ATNP Draft Report of the Third Joint Working Group Meeting (JWG/3) dated 20 March 2002

Attachment-2: “Information for the incorporation of the IP (Internet Protocol) in the ATN”; hardcopies of slides in Microsoft Power Point format

**Draft Position Statement of ATNP WG B on the use of IP
Subnetworks as part of the ATN**

Considerations

1. The ATN was designed to embrace all air-ground and ground-ground communications technologies. IP subnetworks can and should be available for use by the ATN.
2. Non-ICAO Air-Ground networks are being developed that use IP for non-safety airborne applications. Where the Quality of Service provided is acceptable for ATC Applications, such networks could be useable as part of the ATN.
3. The ICAO specification for the ATN uses OSI protocols, specifically CLNP and TP4, to support internetworking and reliable end-to-end connection mode communications. ICAO Applications and Upper Layers Communications Services including Security Services depend upon the availability of TP4. There has been considerable industry investment, of both resources and time, in these protocols, including the development and validation of the ICAO specification and the development and certification of ATN compliant products to ensure that they meet the safety, mobility and QoS requirements of the ATN applications.
4. TCP/IP communications protocols although functionally similar cannot replace the OSI protocols specified by ICAO without a similar level of investment in time and effort to produce certified products. Off the shelf implementations are not acceptable as they neither include additional features deemed necessary for ATC use nor have they been developed using the lifecycles and methodologies appropriate for certifiable software.
5. The ATN Mobile Routing strategy permits mobile platforms to :
 - act as a subnetwork and receive incoming connections on well known and statically assigned network addresses, and to make outgoing connections to ground systems;
 - seamlessly move between different mobile networks without disrupting end-to-end communications;
 - simultaneously use more than one mobile network; and
 - support Policy Based Routing Decisions in order to choose between alternative routes to the same destination.

Mobile IP strategies are directed to the support of single systems and support only the first two of the above functionalities. Mobile IP also introduces a special point into the network (the Home Agent) and has issues associated with a potential single point of failure, inefficient routing due to the necessity of routing through a Home Agent, and security due to apparent “spoofing” by a mobile system.

Conclusions:

It is appropriate, on both economic and technical grounds, to continue the use of CLNP and TP4 as the ATN core protocols whilst developing specifications to enable the use of IP subnetworks as ATN subnetworks for both ground-ground and air-ground use, where there is industry demand.

1. ATNP WGB SG1 will develop SARPs to permit the use of ground-ground IP subnetworks as ATN subnetworks for both BIS to BIS and within local domains.
2. Should demand ever develop, ATNP WGB SG1 could develop SARPs to enable the use of Air-Ground IP subnetworks for Airborne Router to Air-Ground Router interconnections.

In order to achieve the above, ATNP WGB SG-1 will develop SARPs and Guidance Material for an IP SNDCF to support the encapsulation of CLNP packets for their transit across an IP subnetwork. An IP subnetwork will have to meet the existing performance requirements that the ATN Technical Provisions already define. There is no intention that the public "Internet" should be used as an ATN subnetwork; the SARPs will apply to private IP subnetworks only.

Agenda Item 3:
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Information for the
incorporation of the IP
(Internet Protocol) in the
ATN

Attachment 2 to IP / 16

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 - Comparison in OSI Stack
 - IP as an ATN Subnetwork
 - AMHS fully based on IP
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- Some Considerations
- Conclusions

Summary

- ICAO ATN SARP
– Communication based on the ISO OSI
- Demand for the IP based protocol
– IP (Internet Protocol)
 - RFC (Request for Comments) 791/950/919/922, etc.
 - IP is the Internet Protocol used worldwide
 - It is not included in Doc 9705 SV-5 (Internet Communication Service)
- There is no direct interoperability between ATN and IP
 - ATN : CLNP in the Network Layer / TP4 in the Transport Layer
 - IP : IP in the Network Layer / TCP in the Transport Layer

– *OSI: Open systems
interconnection*

– *CLNP : Connection -
Less Network Protocol*

– *TP4 : (Connection
Oriented) Transport Protocol*

S u m m a r y

- Three possibilities

- Fully ATN Based Communication

- ATN Compliant
 - KEYWORDS: ATN Stack, OSI, CNLP, TP4

- Fully IP Based Communication

- IP in lieu of ATN (NOT ATN Compliant)
 - KEYWORDS: IP Stack, TCP/IP

- IP as an ATN Subnetwork

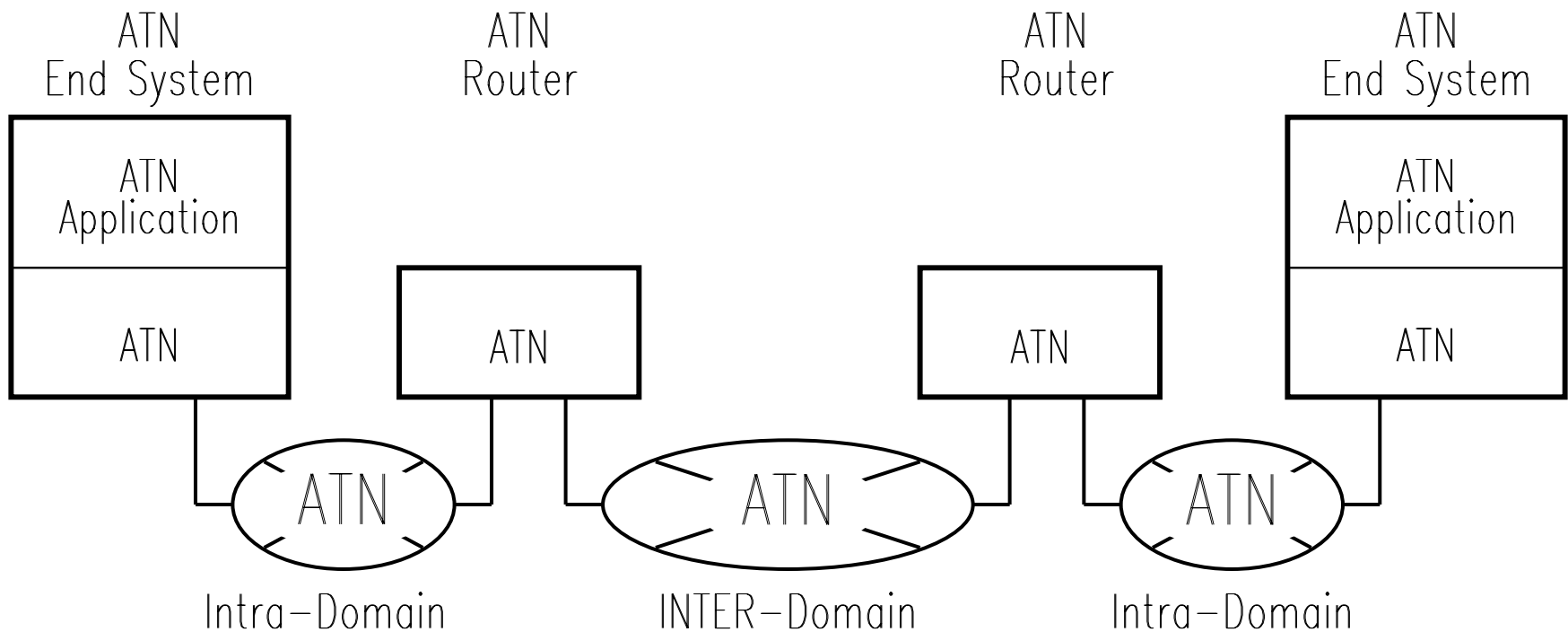
- ATN Compliant
 - KEYWORDS: Tunneling, Capsulation (Encapsulation/Decapsulation)

– *T C P* : *T r a n s m i s s i o n C o n t r o l*
P r o t o c o l

– *I P* : *I n t e r n e t P r o t o c o l*

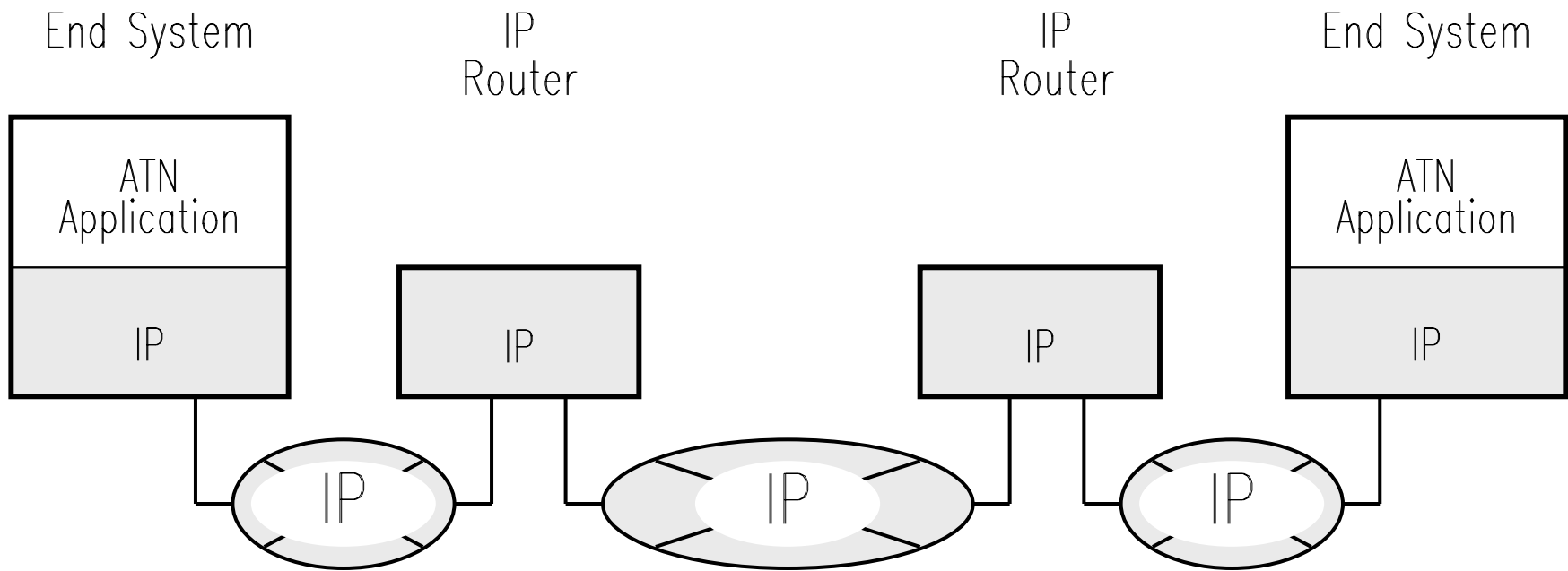
Summary

- 1st case: Fully ATN Based Communication
 - ATN Compliant
 - KEYWORDS: ATN Stack, OSI, CNLP, TP4



Summary

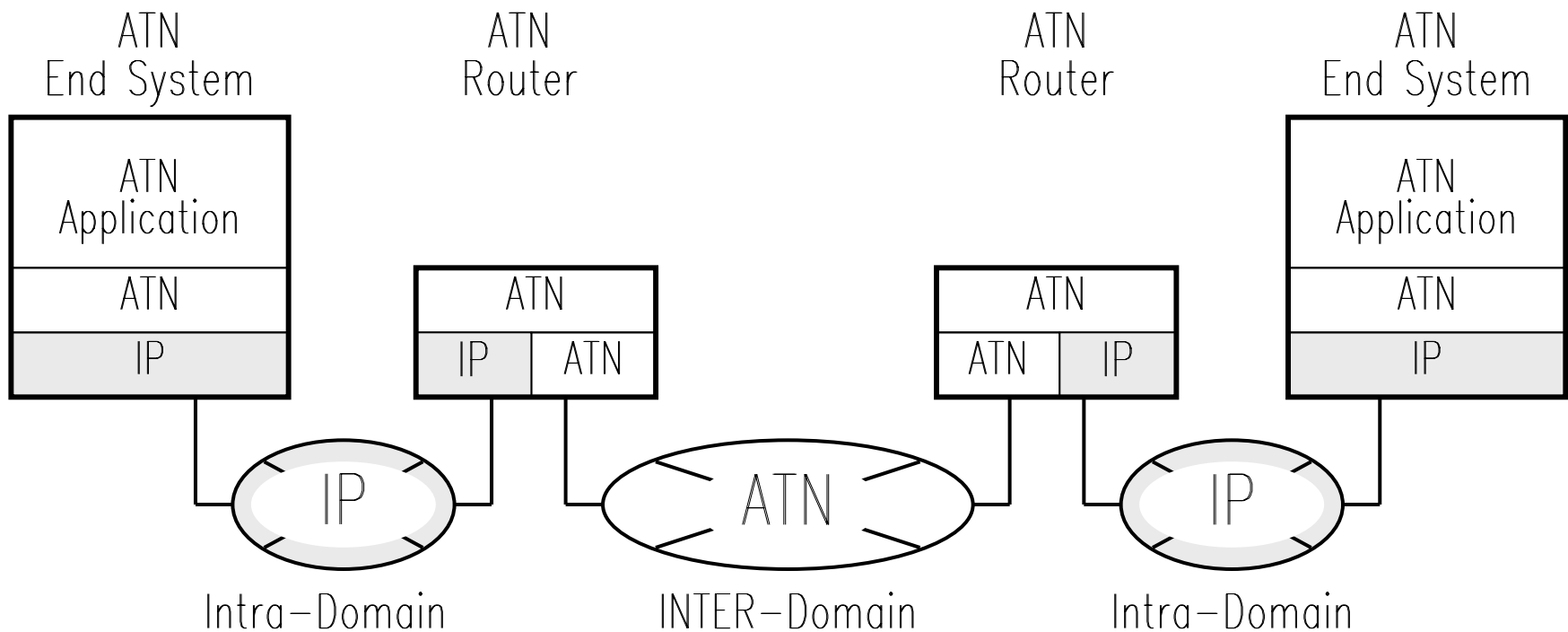
- 2nd case: Fully IP Based Communication
 - IP in lieu of ATN (NOT ATN Compliant)
 - KEYWORDS: IP Stack, TCP/IP



NOTE: There is no ATN Domain Concept in this case.

Summary

- 3rd case: IP as an ATN Subnetwork
 - ATN Compliant
 - KEYWORDS: Tunneling, Capsulation(En/De-capsulation)



Summary

- Recent ATNP WG Meeting (March 2002, Phuket)
 - Fully ATN Based Communication
 - All Air/Ground and Ground/Ground Applications
 - Context Management, System Management, Security, Directory
 - AMHS planning in the Asia/Pacific region (including FAA)
 - Fully IP Based Communication
 - No requirement for the A/G and AIDC Application
 - Some requirement by Eurocontrol and SITA for the investigation of the AMHS fully based on IP instead of ATN
 - There are many issues and WG continues investigation
 - IP as an ATN Subnetwork
 - ATNP WG B (Communication Service) made a Draft Position Statement to incorporate IP as an ATN Subnetwork.

S u m m a r y

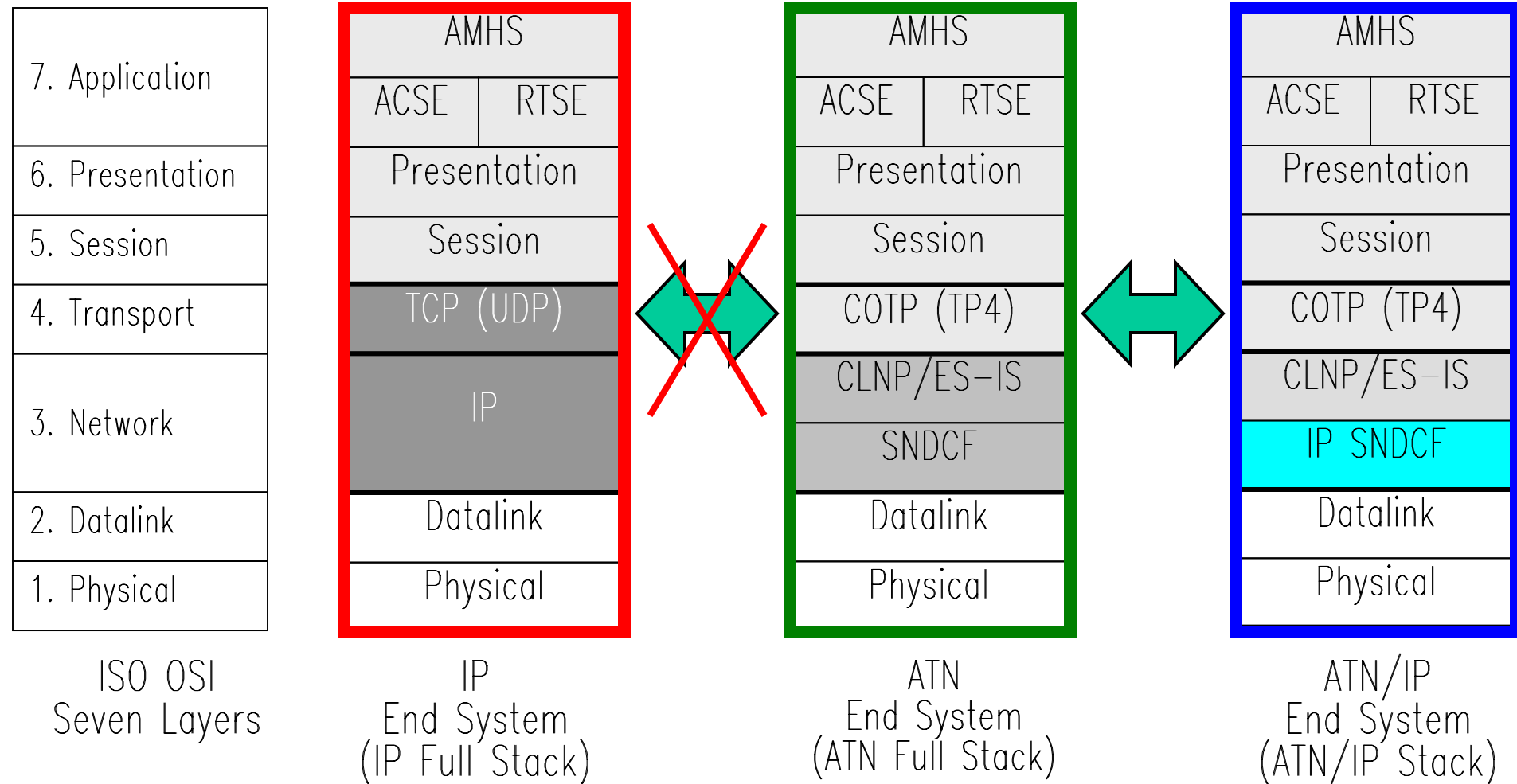
- Draft Position Statement of ATNP WG B (March 2002)
 - Considerations
 - ATN uses OSI protocol (CNLP and TP4)
 - There has been considerable industry investment on ATN
 - TCP/IP protocols cannot replace the OSI protocol easily
 - ATN Mobile Routing cannot be satisfied by Mobile IP strategies
 - Conclusions
 - To continue the use of CNLP and TP4 as the ATN core protocols
 - To use IP subnetworks as ATN subnetworks for A/G and G/G use
 - To use G/G IP subnetworks as ATN subnetworks for both BIS to BIS and within local domains
 - To use A/G IP subnetworks between Airborne Router and A/G Router (when demand should ever developed)
 - SARPs and Guidance Material will be developed for IP SNDCF to support the encapsulation of CLNP packets for their transit across an IP subnetwork

Detailed explanation

- Comparison in OSI Stack
- IP as an ATN Subnetwork
- AMHS fully based on the IP

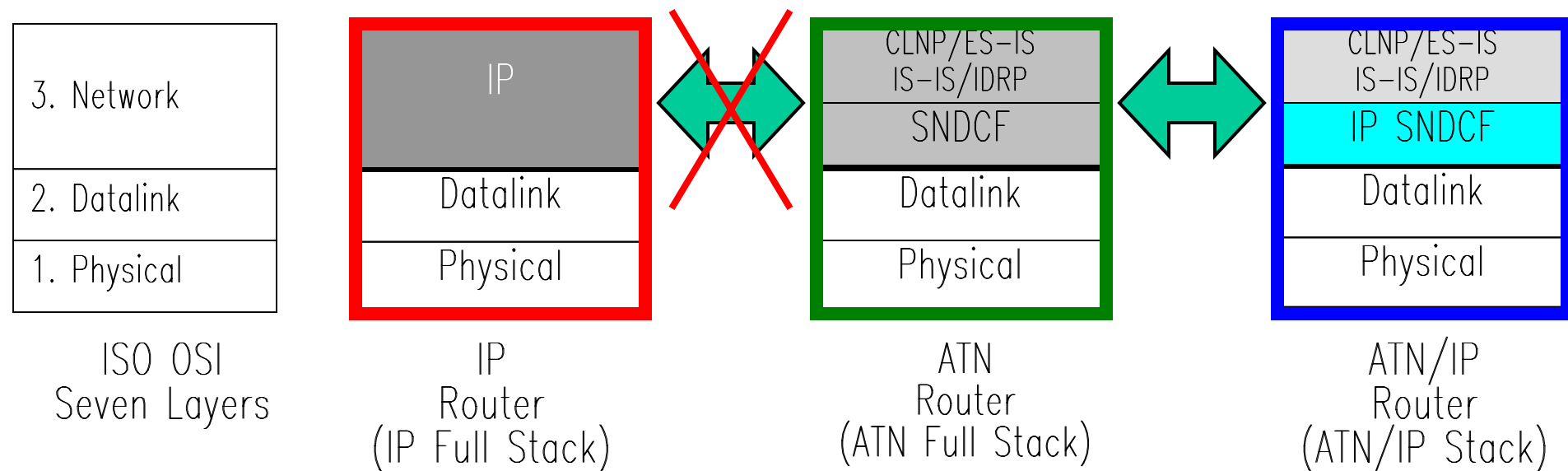
Comparison in OSI Stack

- End System in IP, ATN and ATN/IP Stack



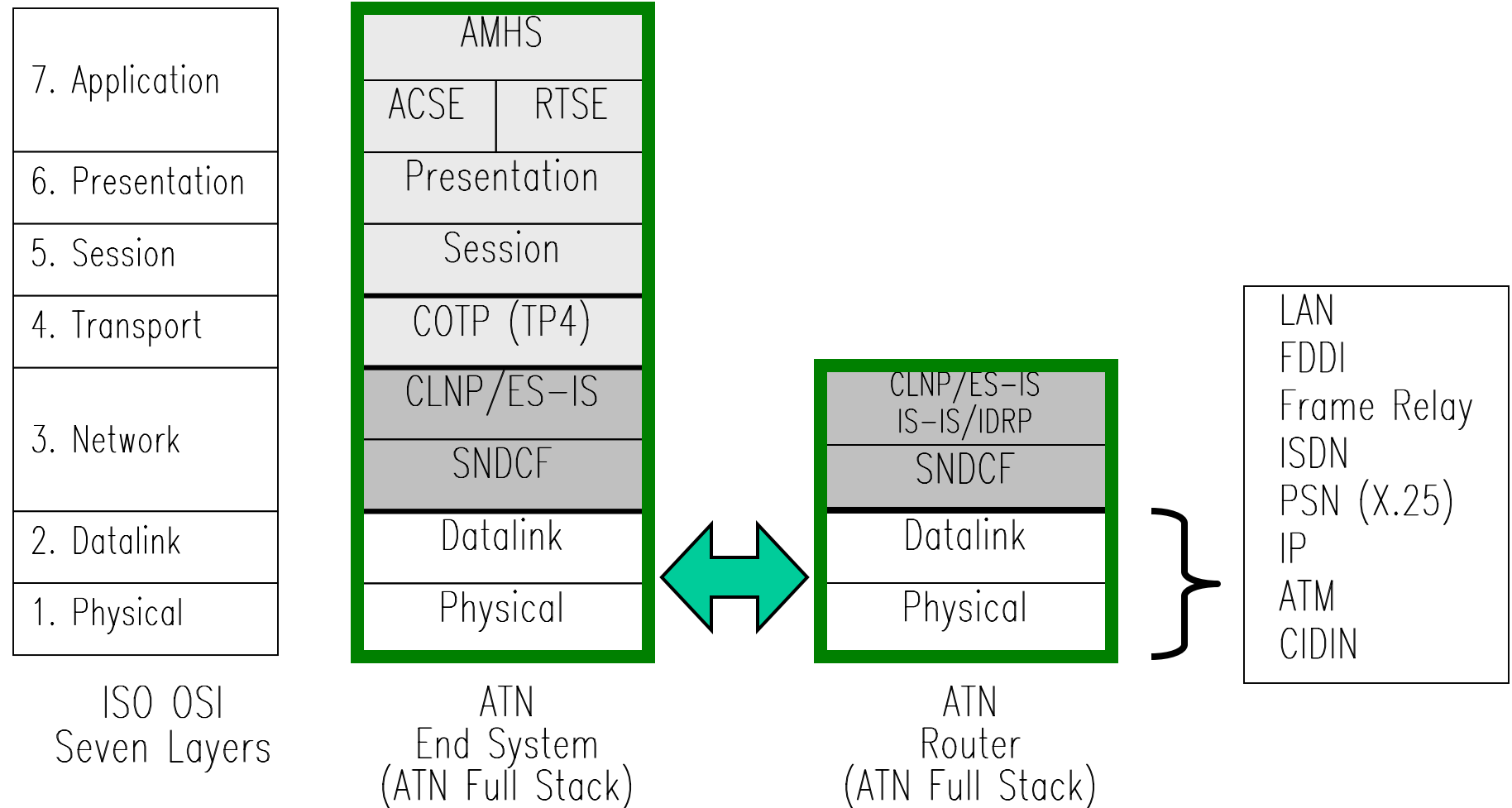
Comparison in OSI Stack

- ATN Router in IP, ATN and ATN/IP Stack



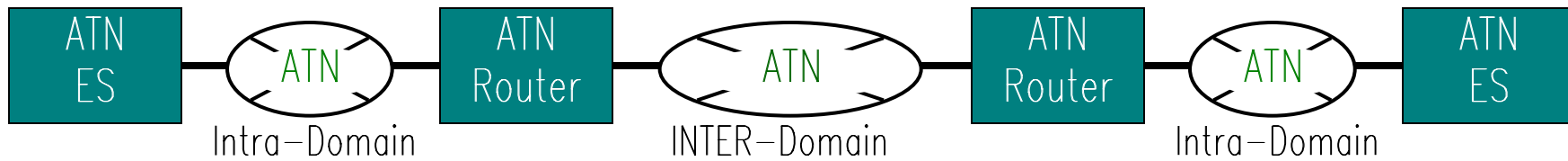
Comparison in OSI Stack

- In addition; Local matter for Subnetwork (Datalink/Physical Layer)

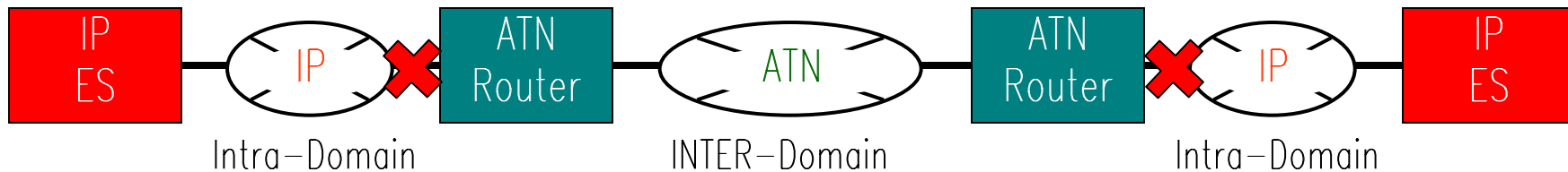


Comparison in OSI Stack

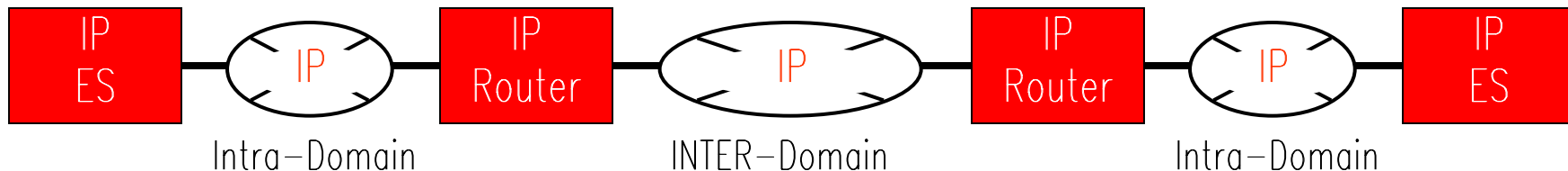
- ATN Full Stack (ICAO ATN)



- ES in IP Full Stack (NOT connect with ATN)

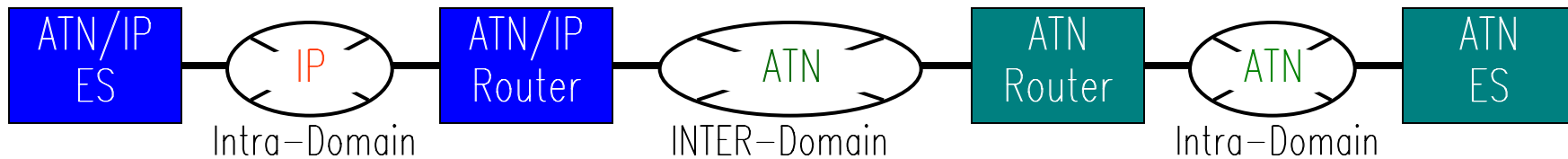


- IP only World (NOT compliant with ICAO ATN)

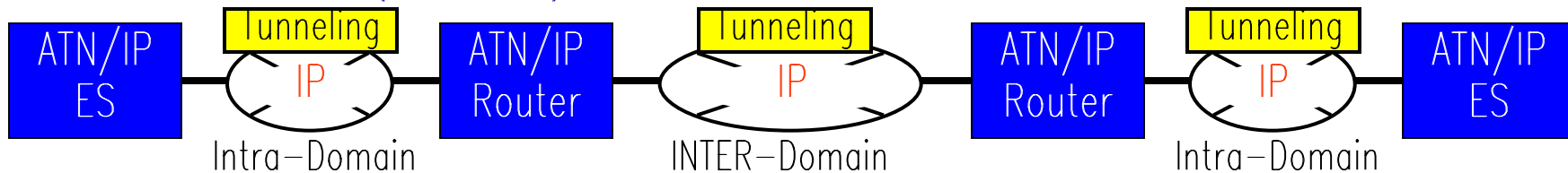


IP as an ATN Subnetwork

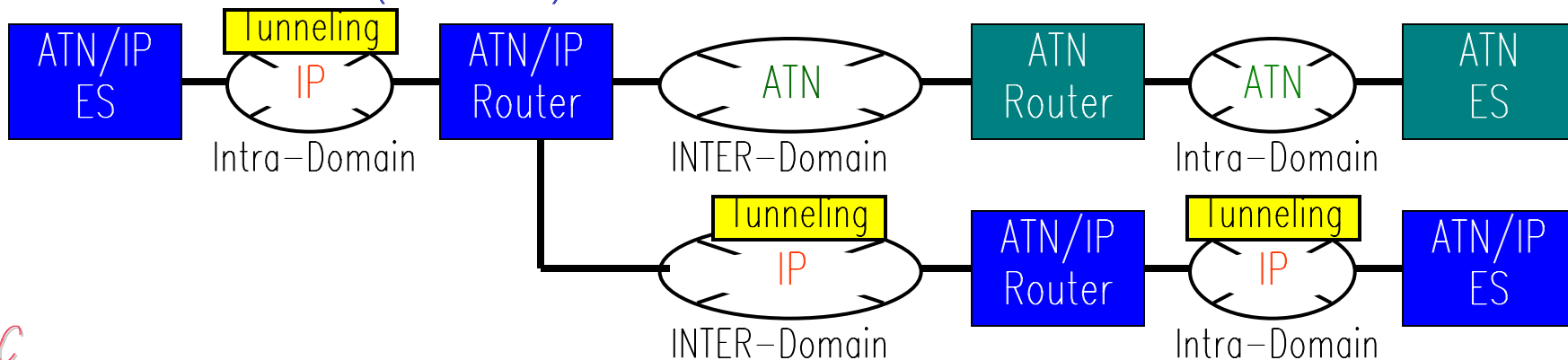
- IP as Subnetwork (Case 1)



- IP as Subnetwork (Case 2)

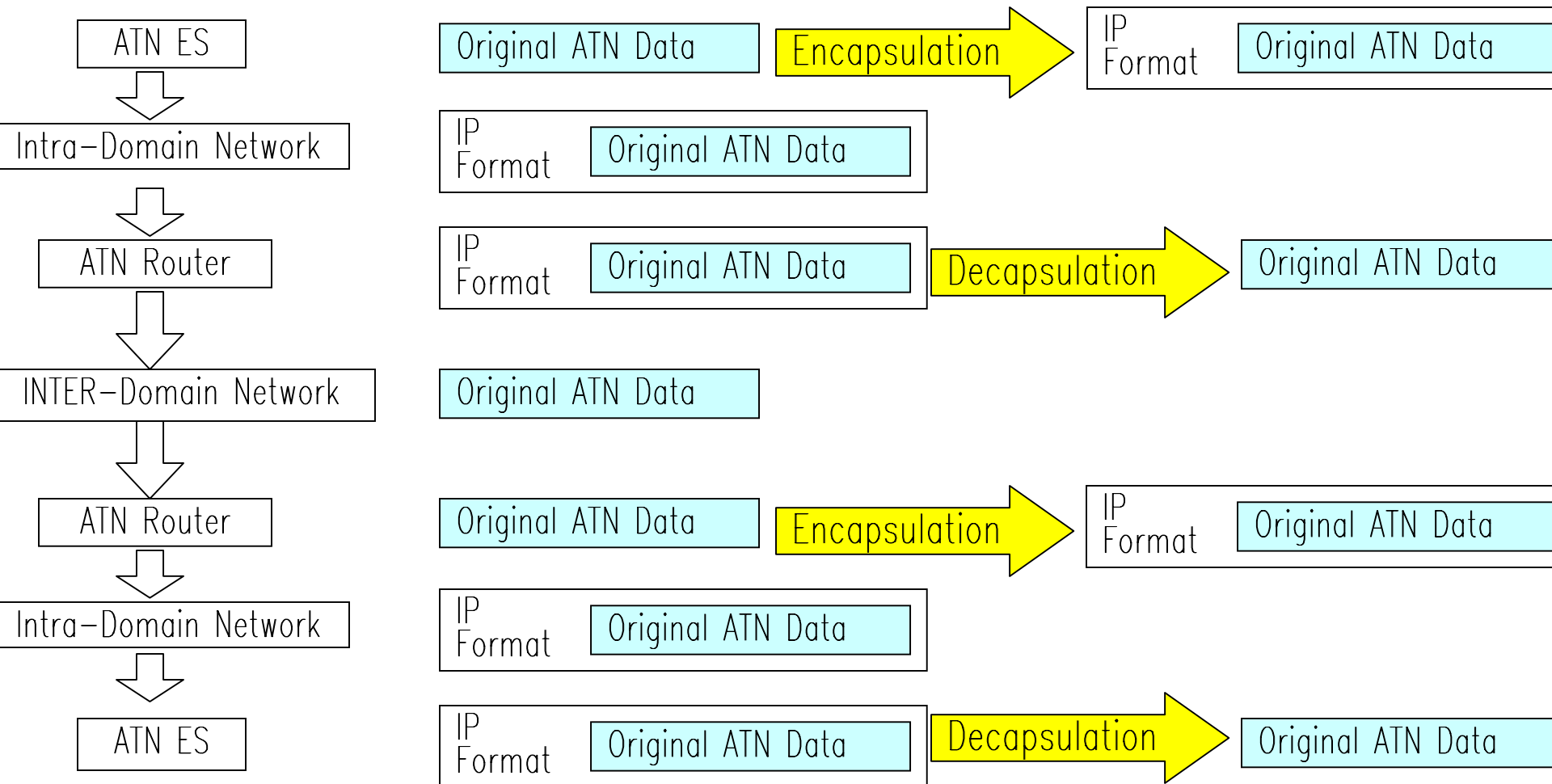


- IP as Subnetwork (Case 3)



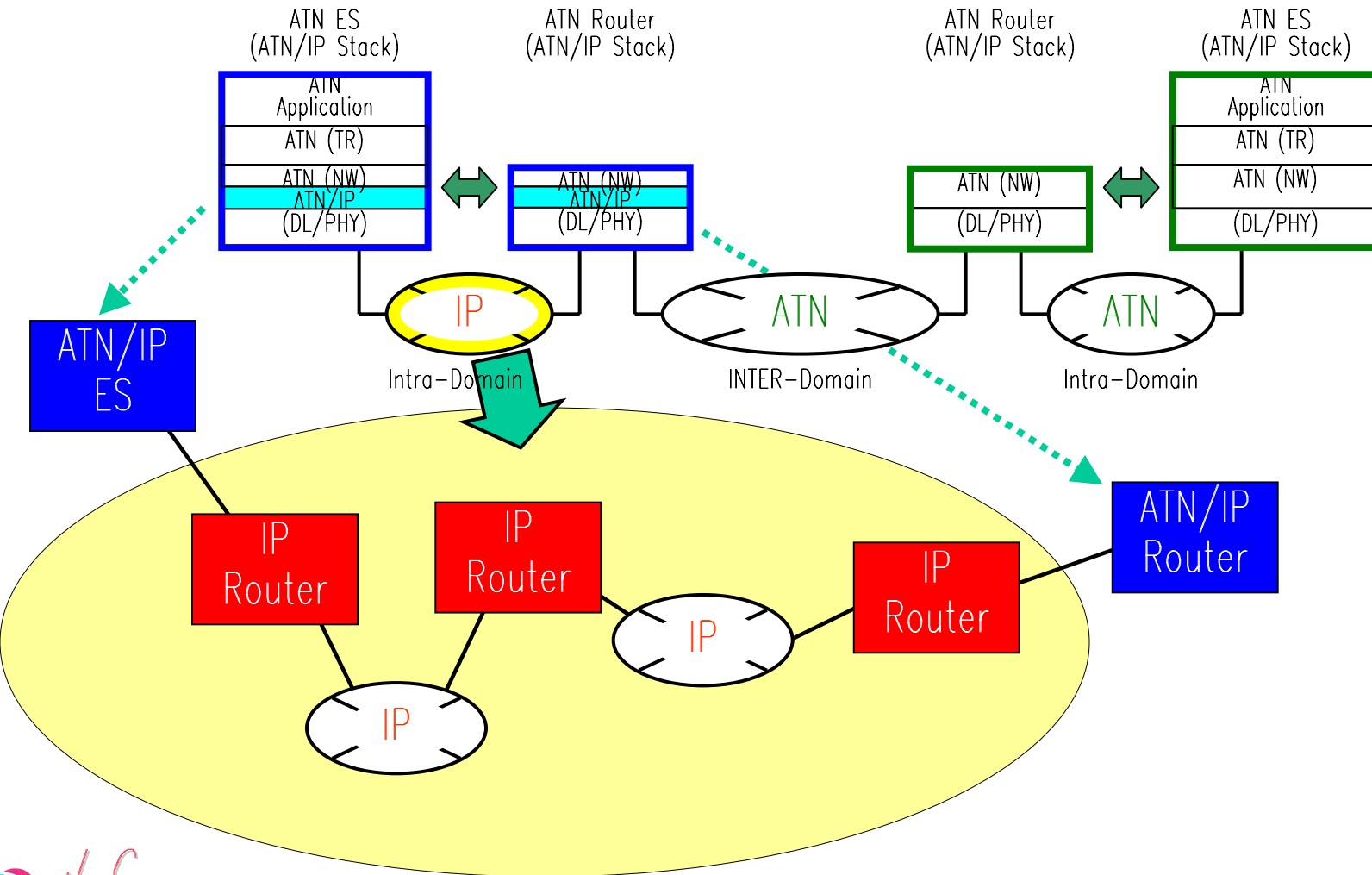
IP as an ATN Subnetwork

- Tunneling of ATN Data through IP by Capsulation



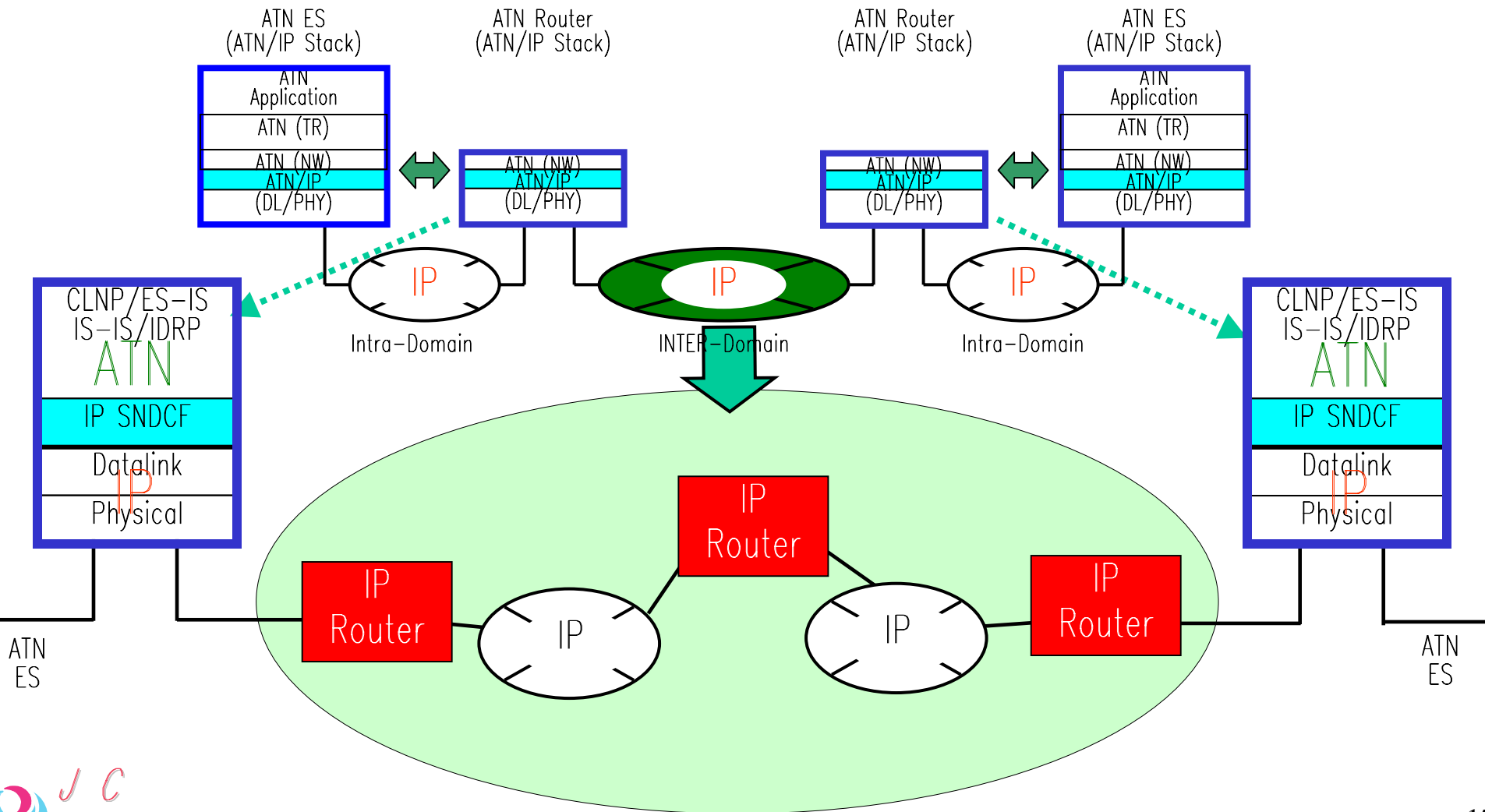
IP as an ATN Subnetwork

- Case 1: Intra-Domain IP Network



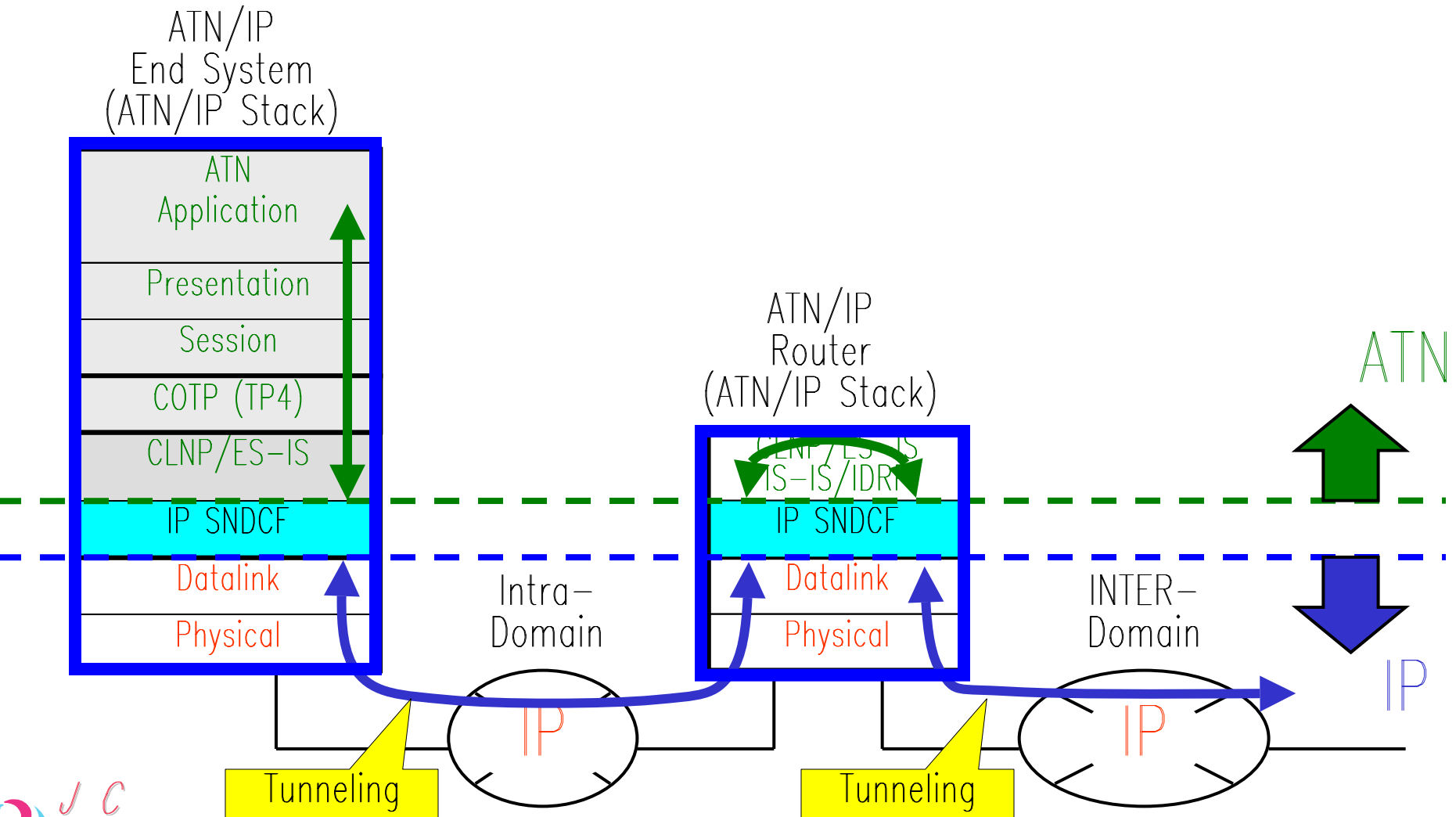
IP as an ATN Subnetwork

- Case 2: INTER/Intra-Domain IP Network (Bi-lateral agreement)



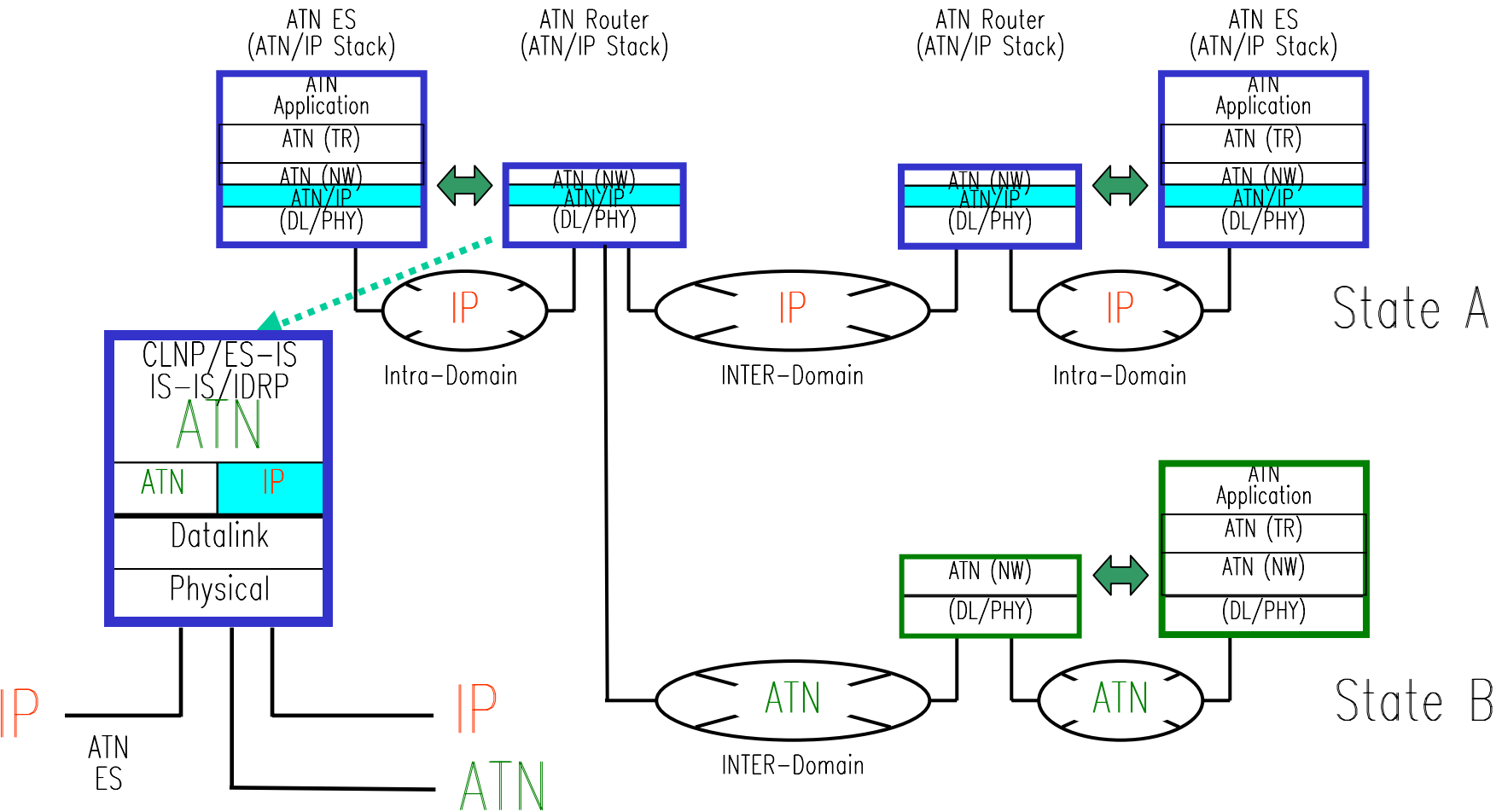
IP as an ATN Subnetwork

- Case 2: INTER/Intra-Domain IP Network (Bi-lateral agreement)



IP as an ATN Subnetwork

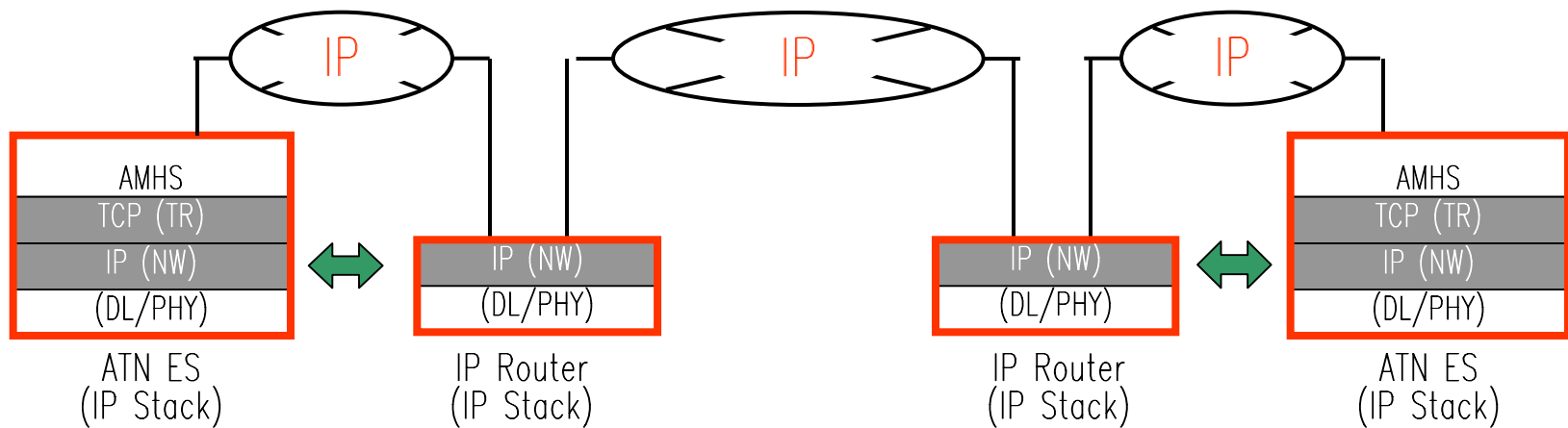
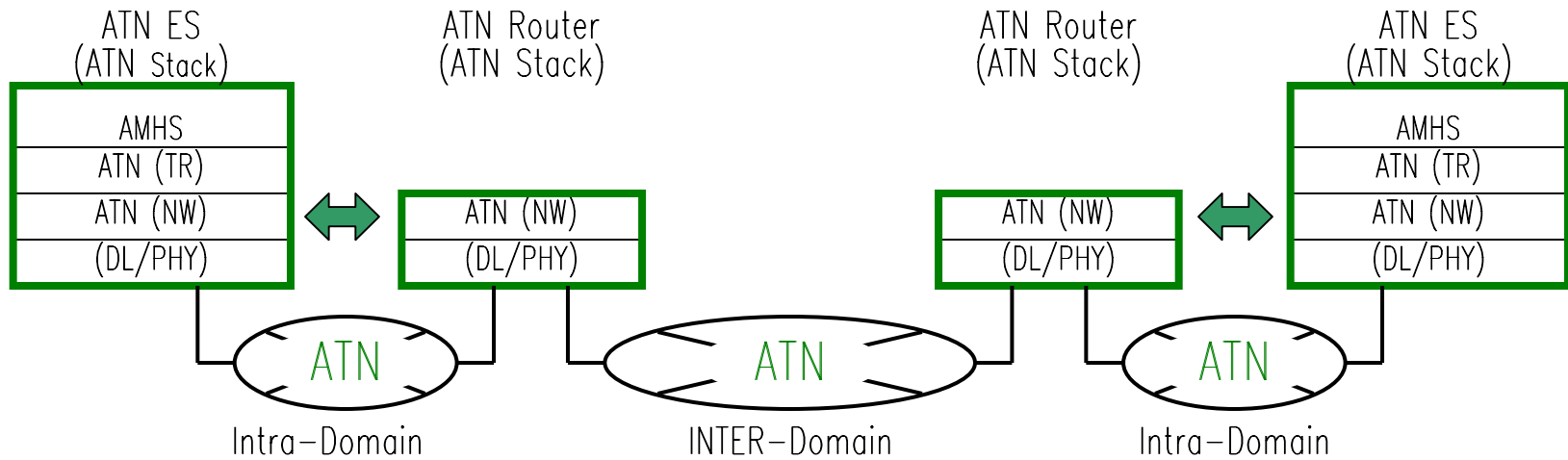
- Case 3: INTER-Domain IP (and OSI) Network (Bi-lateral agreement)



A M H S f u l l y

b a s e d o n / P

- ATN-based AMHS and IP-based AMHS (No ES-ES connection)



Regional Implementation

- Intra-Regional Connection

- It is recommended to implement AMHS at the location of BBIS or BIS simultaneously
 - No meaning to leave Regional ATN Backbone alone without any ATN Communication Application
- AMHS
 - AFTN/AMHS Gateway only
 - It is likely to implement at first
 - Combination of AFTN Connection, AMHS Connection (through ATN Backbone) and conversion between the two
 - AFTN/AMHS Gateway and ATS Message Server
 - In case of the AMHS Domestic Connection using User Agents
 - ATS Message Server only
 - In case no AFTN connection for both Domestic and International

R e g i o n a l

I m p l e m e n t a t i o n

- Inter-Regional Connection
 - BBIS and AMHS for Inter-Regional Connection
 - To absorb the difference among Regions
 - Difference among Regions
 - AMHS ICD and ATN Router ICD is applicable for APAC Region only
 - In the worst case, IP-based AMHS will be connected with a AMHS in APAC Region

Regional Implementation

- In addition; Use of the public Internet for AFTN
 - This issue is different from the IP issues explained above
 - “IP issues” is for the ATN world after ATN implementation
 - Fully ATN Based, Fully IP Based, IP as an ATN Subnetwork or AMHS Fully IP Based
 - “Use of the public Internet for AFTN” is for the AFTN world before ATN implementation
 - To use the public internet technology to support AFTN for low speed AFTN stations
 - Only interim measure till the ATN Implementation
 - Guidance Material will be developed

Future Activities

- ATNP WG

- IP as an ATN Subnetwork; **ATN Compliant**
 - Further investigation on Policy, Performance, Security, Addressing, Management, COTS S/W Issues; and IP Version (IPv4 or IPv6)
- AMHS fully based on IP; **NON ATN Compliant**
 - Asia/Pacific Region must be NEGATIVE since there will be enormous impact on the past investment and current planning
 - More investigation is required, even if Non ICAO ATN be adopted
 - Interoperability between ATN-based AMHS and IP-based AMHS
 - Migration from AFTN to IP-based AMHS (Gateway?)
 - How to incorporate Directory Service (X.500)
 - When the SARPs will be completed?
 - Cost/Benefit Analysis

Future Activities

- 5th Meeting of ATNP Sub-Group A3 (10–11 July 2002)
 - Sub-Group for ATN Ground-Ground Application
 - Position Statement by the US on IP-based AMHS
 - Position Statement of Japan on IP-based AMHS
 - IP-based AMHS should not be an ICAO ATN solution (only ATN-based AMHS shall be recognized as the solution)
 - The issue is the interoperability and not the discussion on technical merits
 - Considerable work has been done by ICAO ATNP and APANPIRG
 - Denial of ATN concept/benefits derived from common infrastructure
 - IP-based AMHS can be described in Guidance Material, not in SARPs
 - This AMHS is permissive as a “local solution” within a State or Region
 - Inter-Regional connection shall be ATN
 - Parties that implement IP-based AMHS shall be responsible for taking necessary measures to ensure interoperability with other ATN domains
- Next ATNP WG (1–10 October 2002, France)

F u t u r e A c t i v i t i e s

- APANPIRG

- Guidance Material tasked to ATN Transition Task Force

- Use of IP

- Develop guidance material for the use of IP as a Sub–Network for ATN
 - » In accordance with the work being performed by ATNP, develop guidance material for the support of IP as a Sub–network of the ATN, with particular emphasis on system compatibility between adjacent centers and security.
 - Issues after the Transition to the ATN

- Use of the public Internet

- Develop guidance material for the use of the public internet technology to support AFTN, where required
 - » Study the possibility of using the public Internet and develop guidance material for its use to support low speed AFTN stations, as an interim measure, with particular emphasis on security and reliability
 - Only interim measure till the Transition to the ATN

S o m e

C o n s i d e r a t i o n s

- Whose property?
 - AMHS (ATN ES)
 - AMHS Terminal (User Agent)
 - ATN Router (BIS)
 - ATN Network (domestic)
 - ATN Network (international)
 - ATN ES for Air/Ground Application
 - Air/Ground Subnetwork
- Regional ATN Backbone
 - AMHS
 - AIDC
 - Air/Ground

Considerations

Considerations

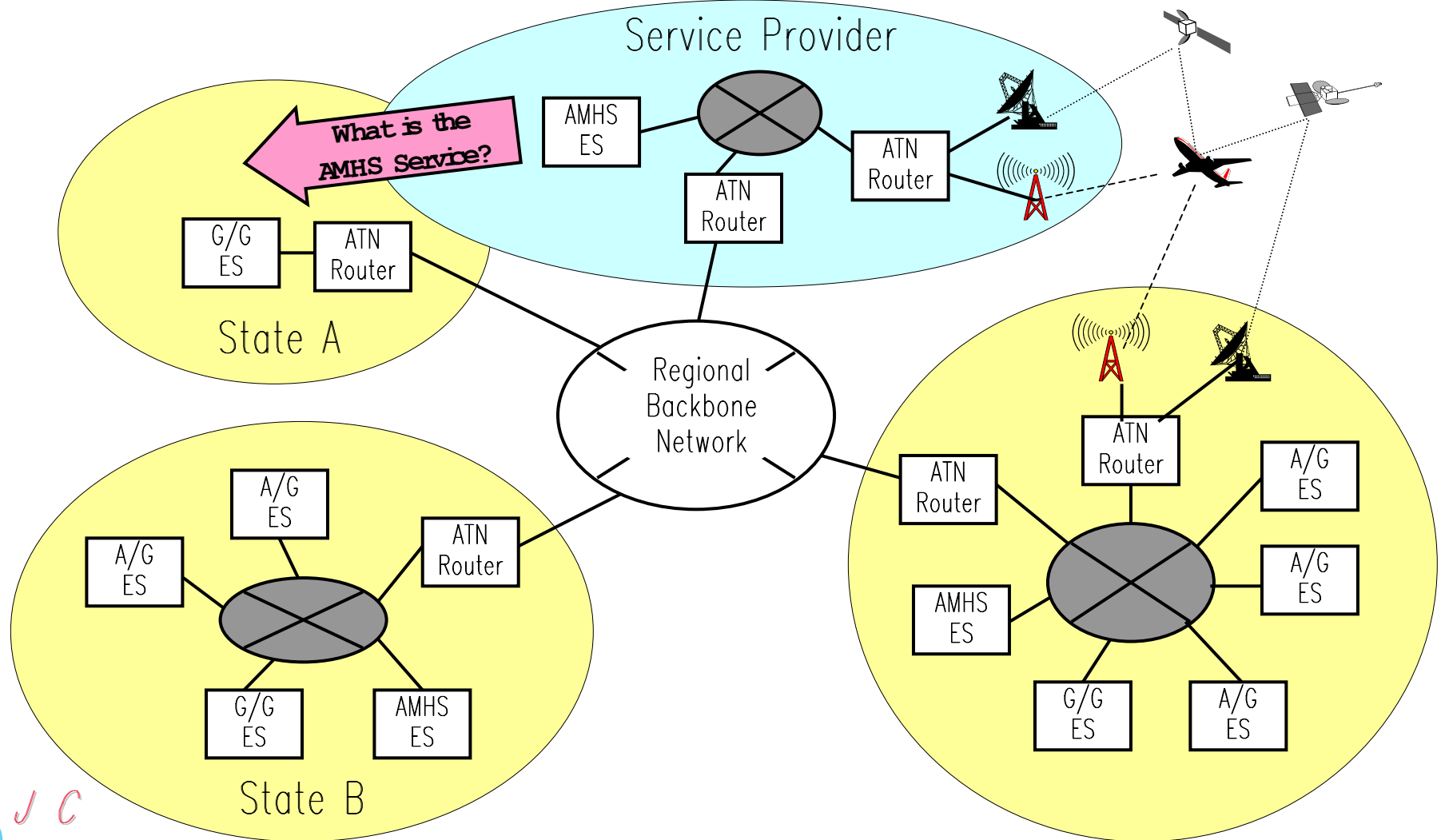
- Whose property? (ATN Concept) : one example

- Whose property? (ATN Concept) : one example

Some

Considerations

- Whose property? : one example



Conclusions

- Make sure which he is speaking
 - Fully ATN Based Communication : ATN Compliant
 - KEYWORDS: ATN Stack, OSI, CNLP, TP4
 - Fully IP Based Communication : NOT ATN Compliant
 - KEYWORDS: IP in lieu of ATN, IP Stack, TCP/IP
 - IP as an ATN Subnetwork : ATN Compliant
 - KEYWORDS: Tunneling, Capsulation (Encapsulation/Decapsulation)
- Watch the further activities by ATNP WG on the IP issues
- Remember the ATN policy
 - Common infrastructure for all the ATN application
 - Regional ATN Backbone is the common network for ATN
 - End to End Connection
 - Between one ATN End System and another ATN End System
 - State is recommended to implement own ATN End System (i.e. AMHS)

Any Question?

