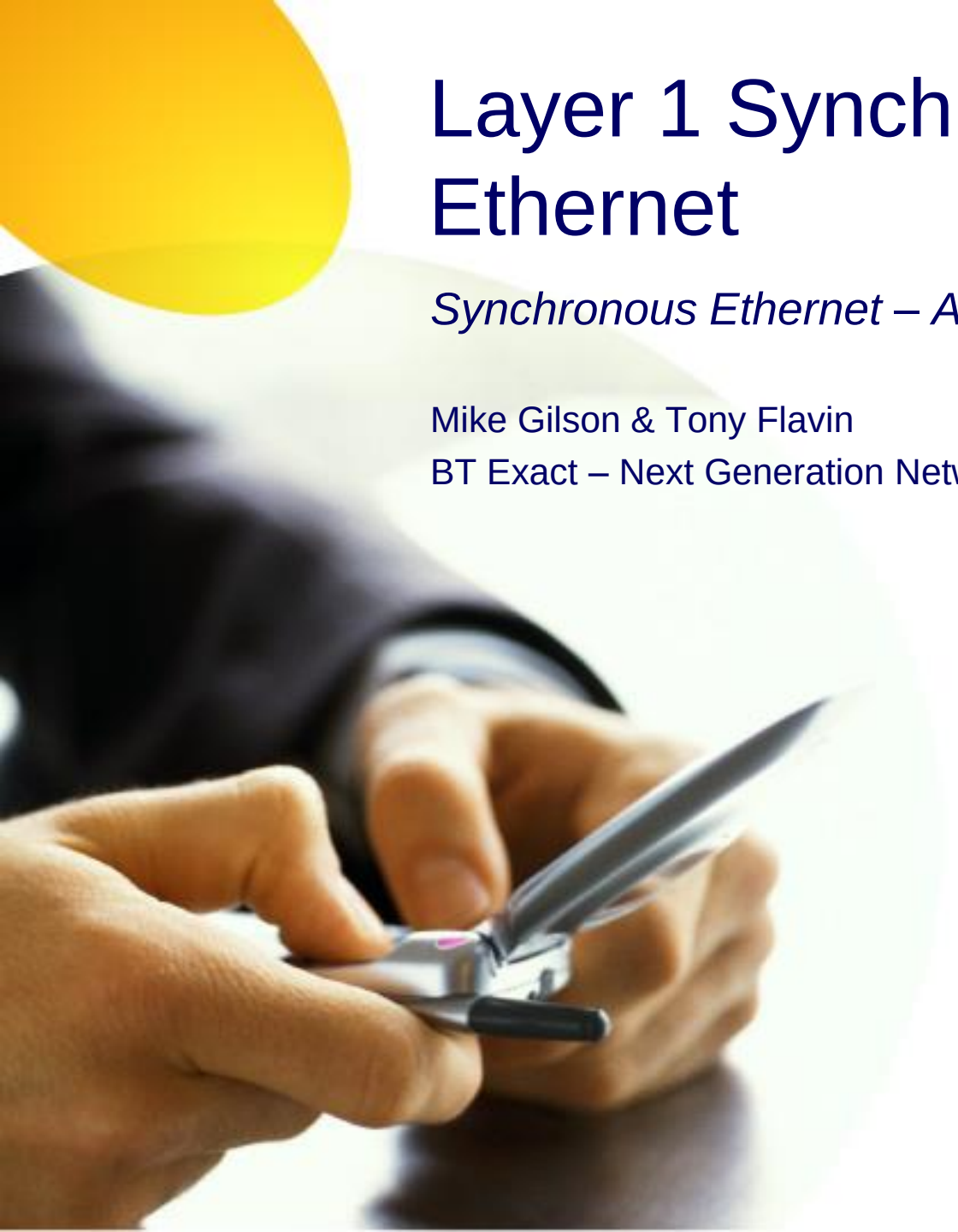
Layer 1 Synchronous Ethernet

Synchronous Ethernet – A Carriers Perspective

Mike Gilson & Tony Flavin
BT Exact – Next Generation Networks



Agenda

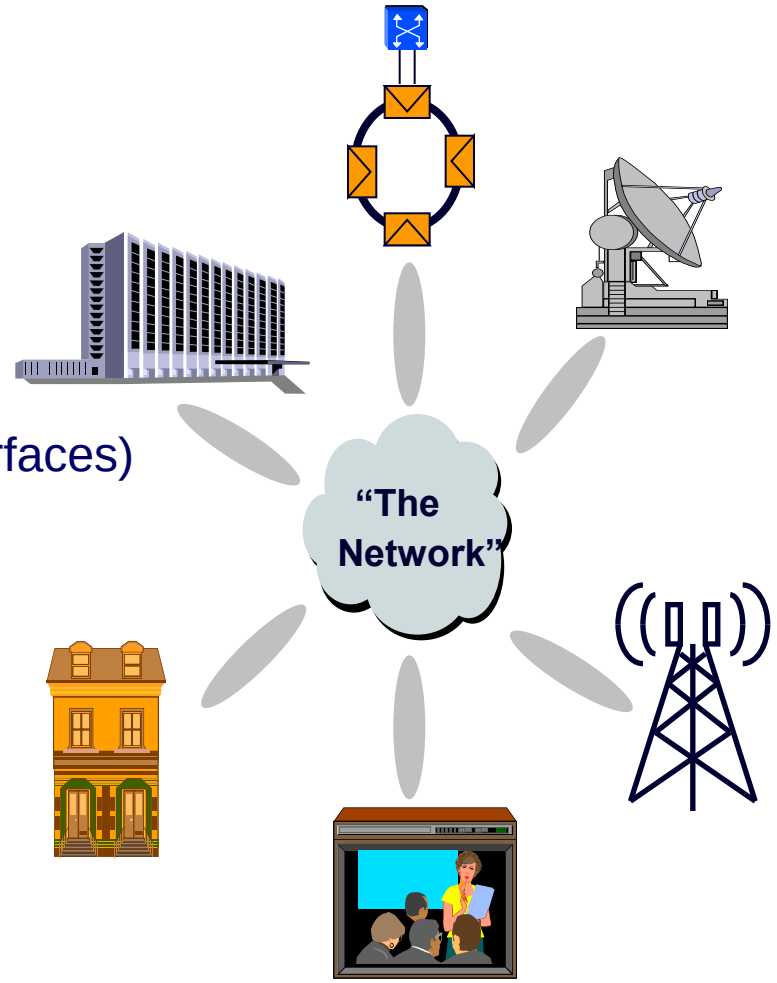
- The converging world
  - What's required – services
  - Packet environment
- 21C Architecture and the problems
  - The evolving network
  - Numbers involved and choices
- Synchronous Ethernet
  - Concept & Status
- Where do we currently stand

Are packets the answer?

- The world is converging
  - Fixed & mobile, Transport technologies
- Packet technologies do allow synchronisation to be transported. However, there are challenges ahead!
- Need to understand the architecture
  - the physical layer, impairments impact
  - repeatability and stability
- One method to overcome some of the architecture issues is a Layer 1 approach
- Synchronous Ethernet

The Service Problem

- Which services?
- Existing services
  - TDM (PDH / SDH / SONET interfaces)
- Mobile Services
  - RF & Traffic
- New services
  - Business
  - Residential
    - Residential Ethernet

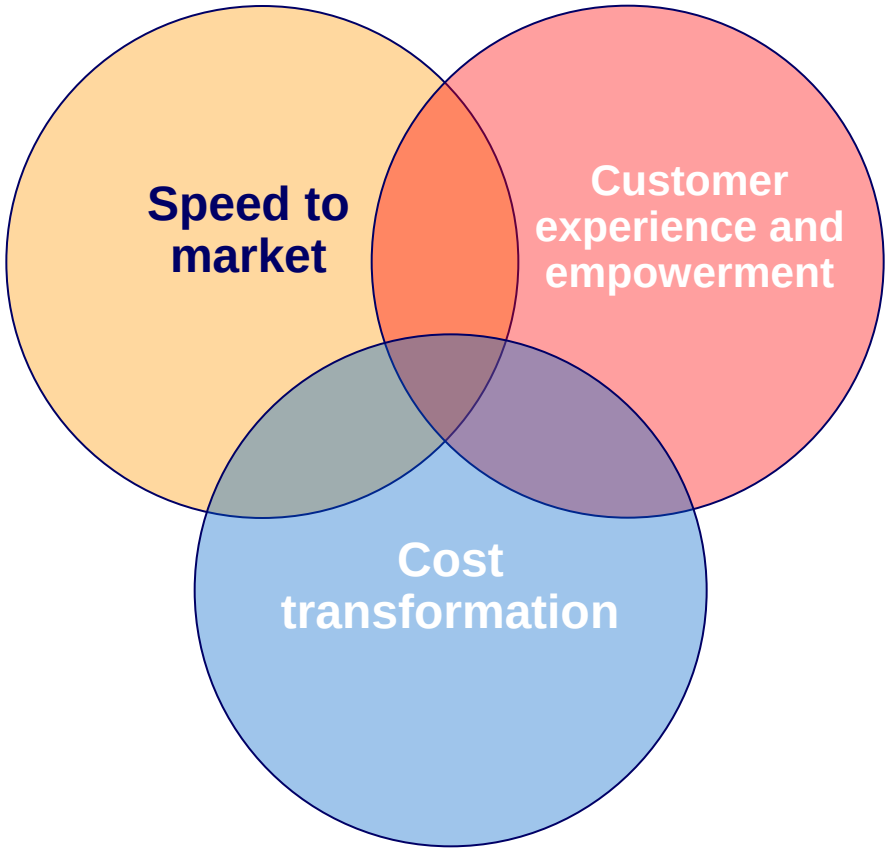


What's required?

- Timing transparency
  - TDM -> Packet -> TDM environment
  - supporting existing TDM ccts
  - e.g. 2Mbit/s & 1.5Mbit/s hierarchy
- Timing traceable
  - access to a reference clock
  - phase stability at the edge
- Time of Day
  - when something happens
    - precise time instead of phase?
    - requires base stability / traceability

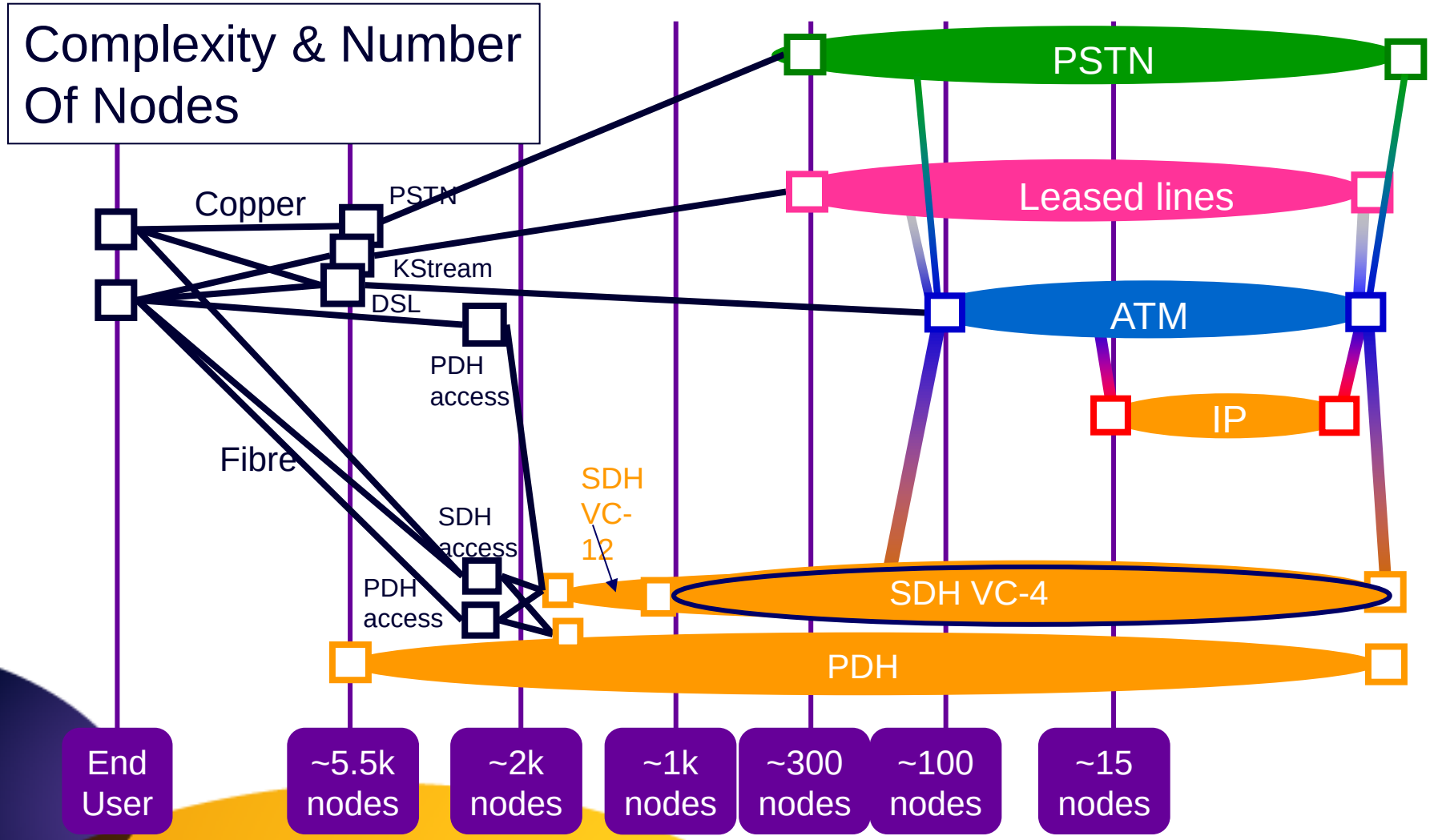
21C Rationale

- Convergence is gaining momentum
- Convergence needs an underlying infrastructure to deliver and support it
- Customers want more choice, flexibility and control
- Simplicity is key

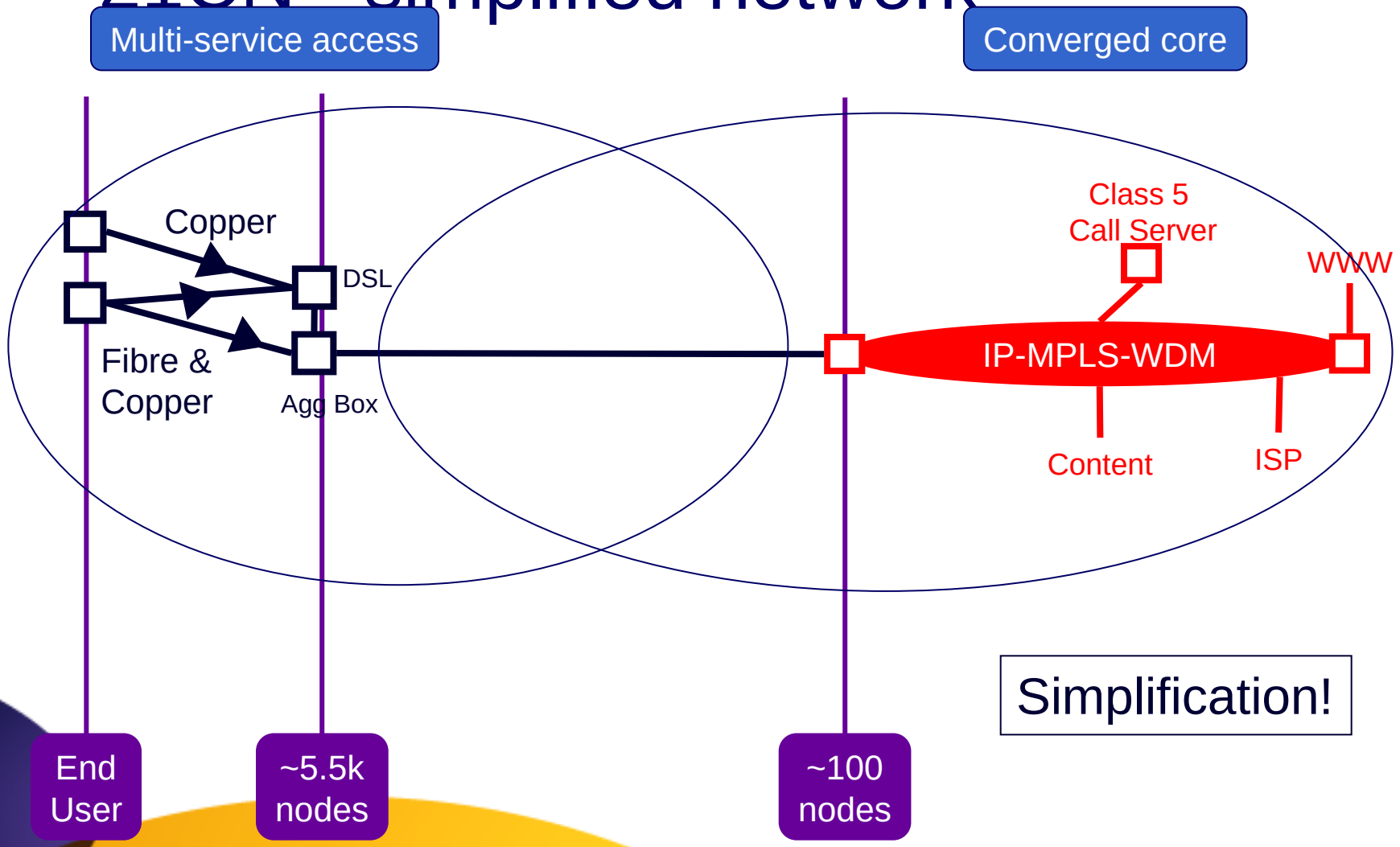


21CN - current network

Complexity & Number Of Nodes



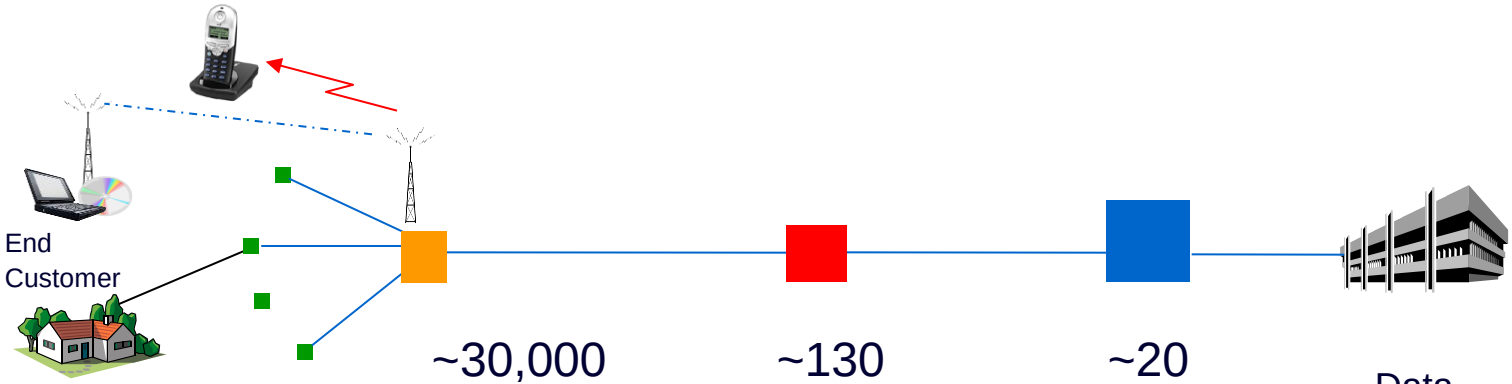
21CN - simplified network



Simplification!

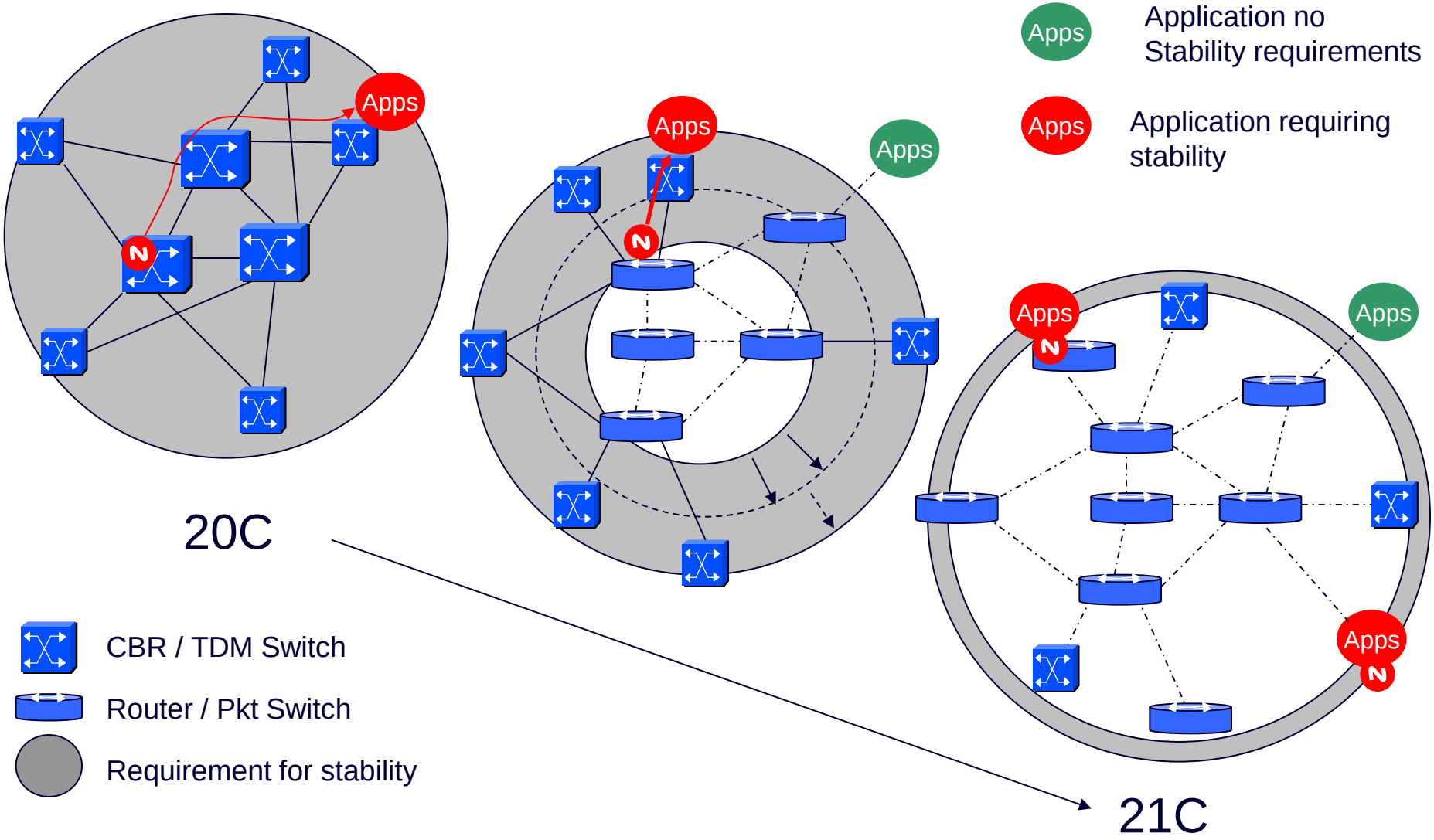
Current thinking.
No implementation assurances

The Numbers!



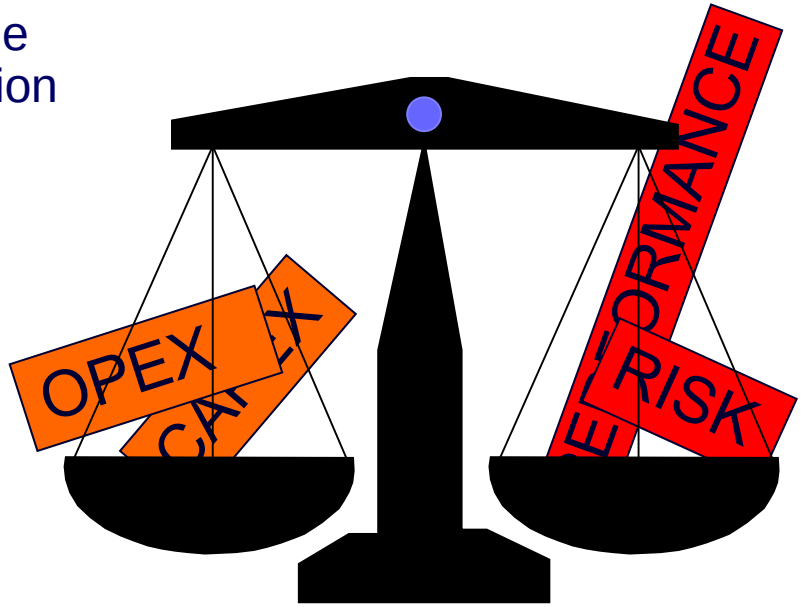
Millions? ◄- - 5,000+ Nodes ◄- - - 100+ Nodes

Evolving Network Architecture



The Choices

- If timing is required at the Edge of the Network e.g. Multi-Service aggregation point
- Choices based on various factors
- There are a number of Technology choices. All have there pros & cons
  - Satellite based systems
  - Maintain an SDH / SONET Path
  - Packet Based Solutions
  - Propriety
- If Ethernet is to become the transport technology of choice
- Synchronous Ethernet
  - Physical Layer Timing Recovery



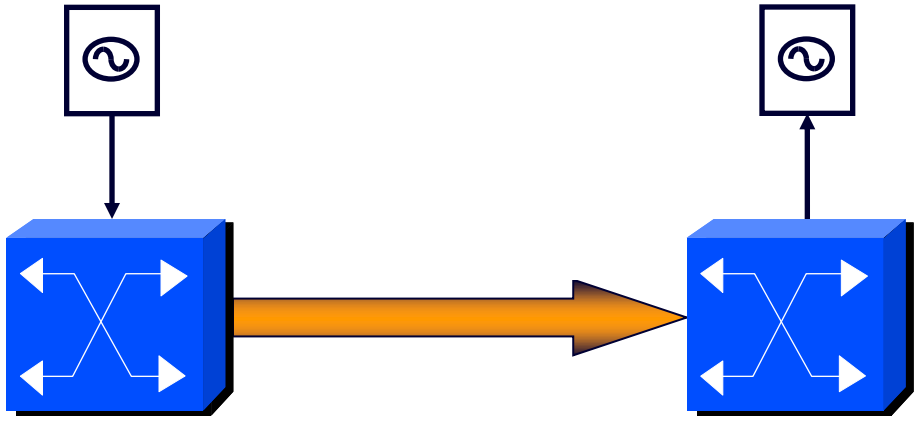
Synchronous Ethernet

- Designed to robustly deliver synchronisation
  - frequency / phase (Takes the best from SDH)
- Essentially looks like SDH / TDM timing
  - Helps in the migration process
  - Will inter-work with native Ethernet
- Does not change basic Ethernet Standards
  - Note this is not native Ethernet / can not be supported over native Ethernet
- Requires hardware changes
  - Ethernet Silicon may support also requires control silicon
- Not currently envisaged that will carry time
  - Other potential solutions exist e.g. IEEE1588
  - But message channel exists

ITU-T G.8261 – Synchronous Ethernet

- Standardised in approved ITU standard ITU-T G.8261
- Standard encompasses a fairly wide range of topics but specifically for Synchronous Ethernet covers:
  - Basic concept, Network synchronisation flow
  - Messaging channel proposed and endorsed by IEEE
  - Synchronisation Status Messaging (SSM)
- Synchronous Ethernet will inter-work with native Ethernet
  - Does not impact any IEEE standards
- Following slides provide more detail on
  - the concept
  - current status

Physical Layer timing recovery….

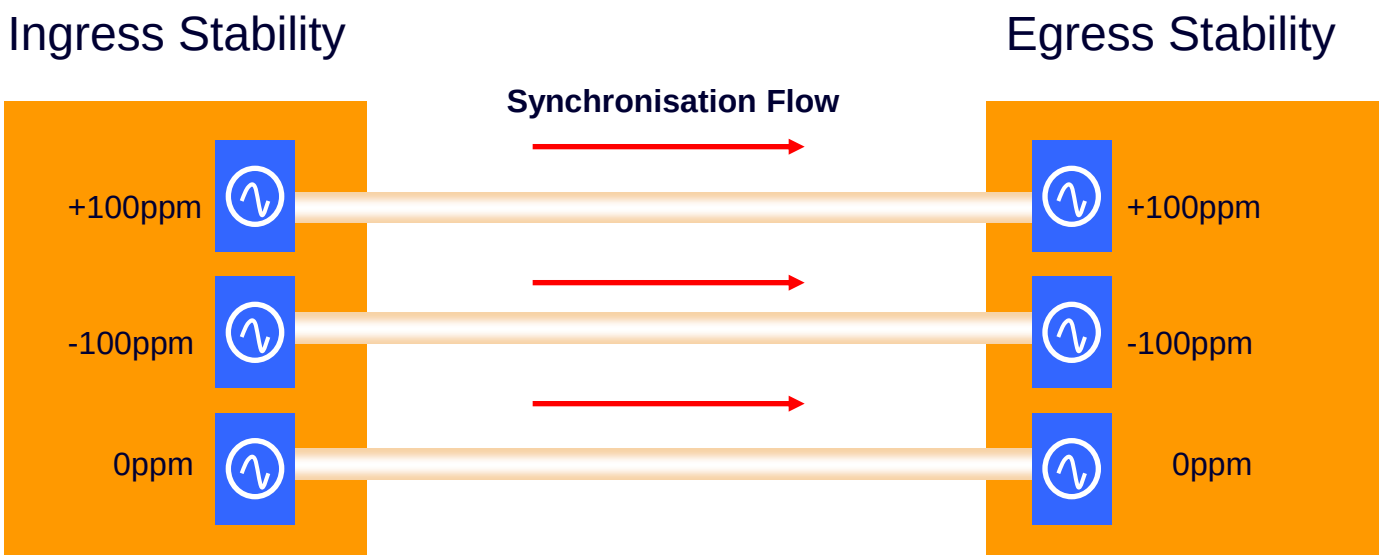


…is not New!

- PDH
- SDH
- SONET
- ETHERNET

- Clock recovery from “bit stream”
- Sufficient clock edges
  - line code
  - scrambling

Synchronisation Flow



Ethernet Silicon

Physical Layer timing flows are:

- Synchronous
- Point to Point
- Bounded

Key Delivery Requirements

- Source
- Physical Connection from source
  - Physical Layer
    - Point to Point
    - Filtering / holdover
- Traceability
  - Knowledge of “Status”
  - Message channel
    - Message set
    - Frequency of message

SDH / SONET	**Synchronous Ethernet – G.8261**
PRC	PRC
Bit stream	Bit stream
Embedded Osc ITU-T G.813	Embedded Osc **Based on G.813**
ITU-T G.707 SSM	ITU-T G.707 SSM
SDH Overhead	OAMPDU
8000 / sec	10 / Sec

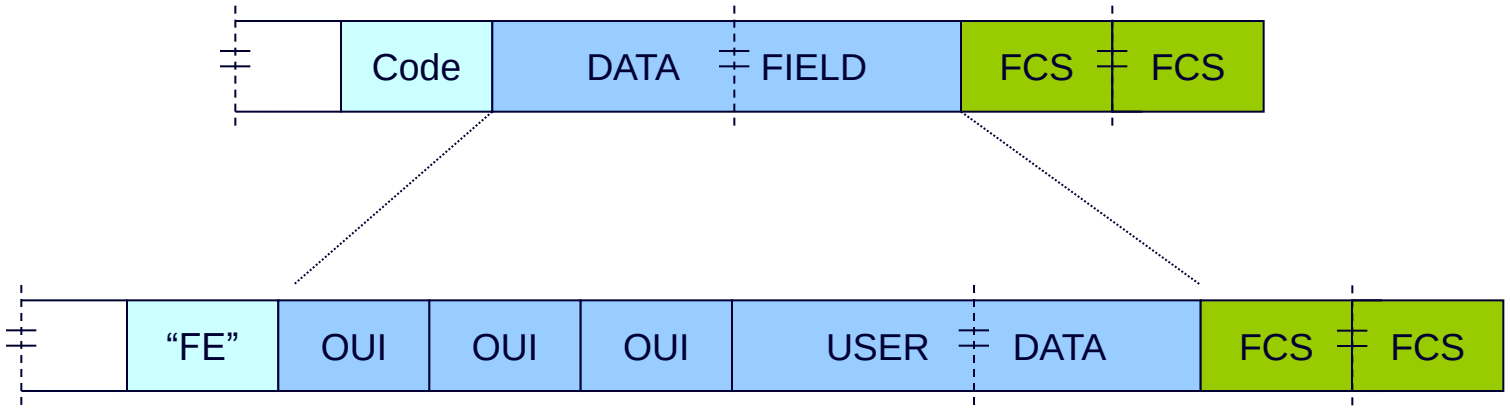
Status Messaging

- Two aspects to this
  - discussed during SG15 Geneva Nov 2006
- 1) The Message Set and its requirements
  - Existing SSM reuse
  - Scope for future development - not a priority
  - Processing point in the network elements
- 2) Message Channel
  - Essentially a pipe to carry the message
  - One of the solutions is the IEEE OAMPDU
  - following slides present OAMPDU

Messaging – OAMPDU Approach

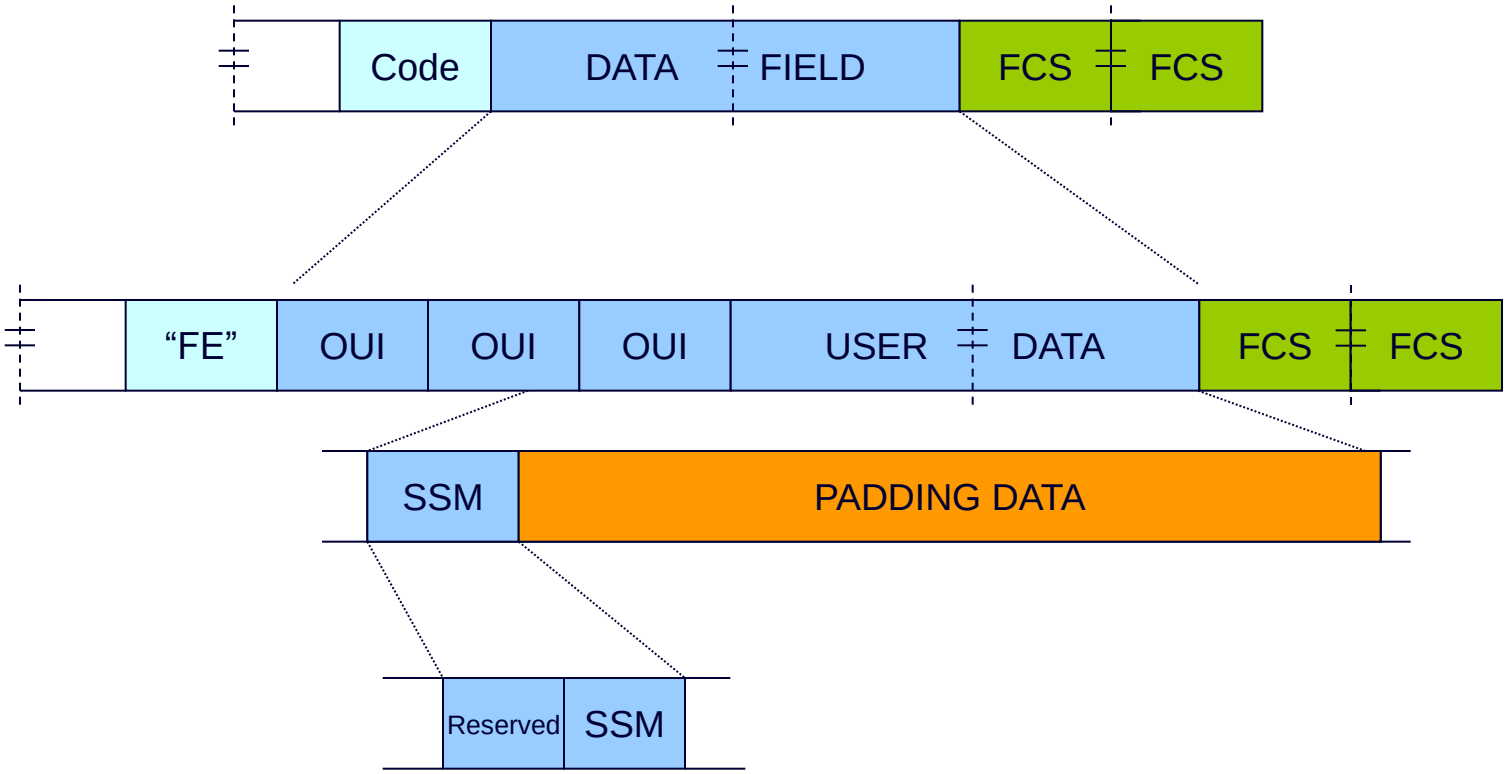
- IEEE Proposal to ITU
- Operations & Maintenance Protocol Data Unit (OAMPDU)
  - id by specific header fields in the Ethernet frame
- OAMPDU
  - Std Ethernet MAC frames
  - Id by length & type
  - Code field specifies which type
    - Organisation specific is “FE”
  - Code now supplied by IEEE for ITU use (SG15 Geneva Nov 2006)

OAMPDU Approach



- Relevant Section of OAM
- IEEE Slow Protocol – "FE" indicates Organisation specific
  - OAM flow Point to Point
  - OUI = "Organisation Specific Extension"

Synchronisation Status Message



XXXX 0010 e.g. ITU-T G.811

Synchronous Ethernet Status

- As given in ITU-T G.8261
  - Sits within Synchronisation & Time Question of ITU SG15
  - Consented 17th Feb 2006
  - Approved 1st June 2006
  - Two years work to get to current position
- ITU-T G.8261 contains the concept – ongoing standards work
  - Synchronous Ethernet is a Layer 1 solution
  - Planned completion of associated standards (approx 2008)
- Product Development Status
  - Limited silicon is available or in the development process
  - Number vendors evaluating product engineering problems
    - Maybe limited (initially) to certain products
  - Current best guess, limited products 9-18month, 12-24 months before products widely available

Synchronous Ethernet Status cntd

- Some basic test models exist
  - Prove basic concepts
- Operator interest
  - A number are assessing or have high degree of interest
  - Dependent on application and possible use within architecture
- Application
  - Metro - Access environment & delivery to base stations (3G, WiMax etc)
  - Possible enabler for advanced Ethernet services business / Res
  - TDM emulation across Ethernet transport
  - Others ….
- Like all solutions it will survive based on…
  - Market demand
  - On its merits

Associated ITU Recommendations

- G.8261 Issue 1 approved June 2006, Issue 2 under development
  - Highlights the issues with various techniques
  - Provides test techniques
  - Specifies some of the network limits

G.paclock Expected completion Feb 2008

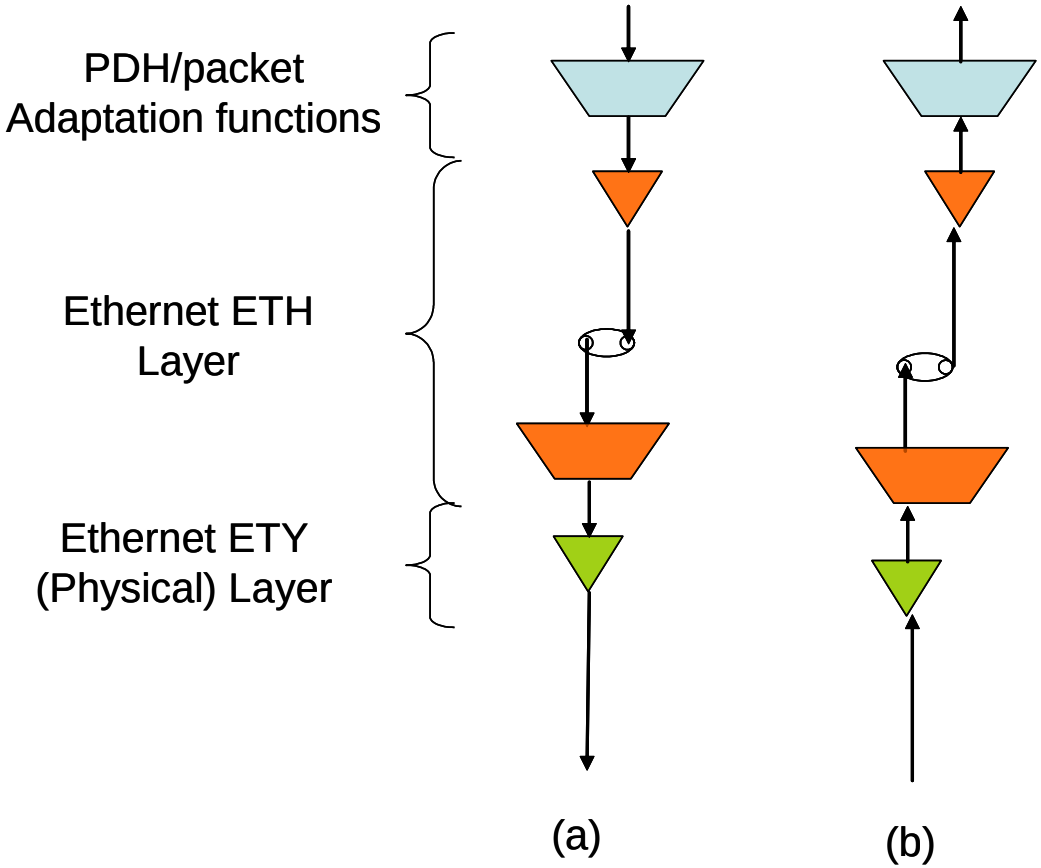
  - Development of the Clock Specification
  - split into two - (SG15 Meeting Geneva Nov 2006)

G.pacmod Expected completion Feb 2008

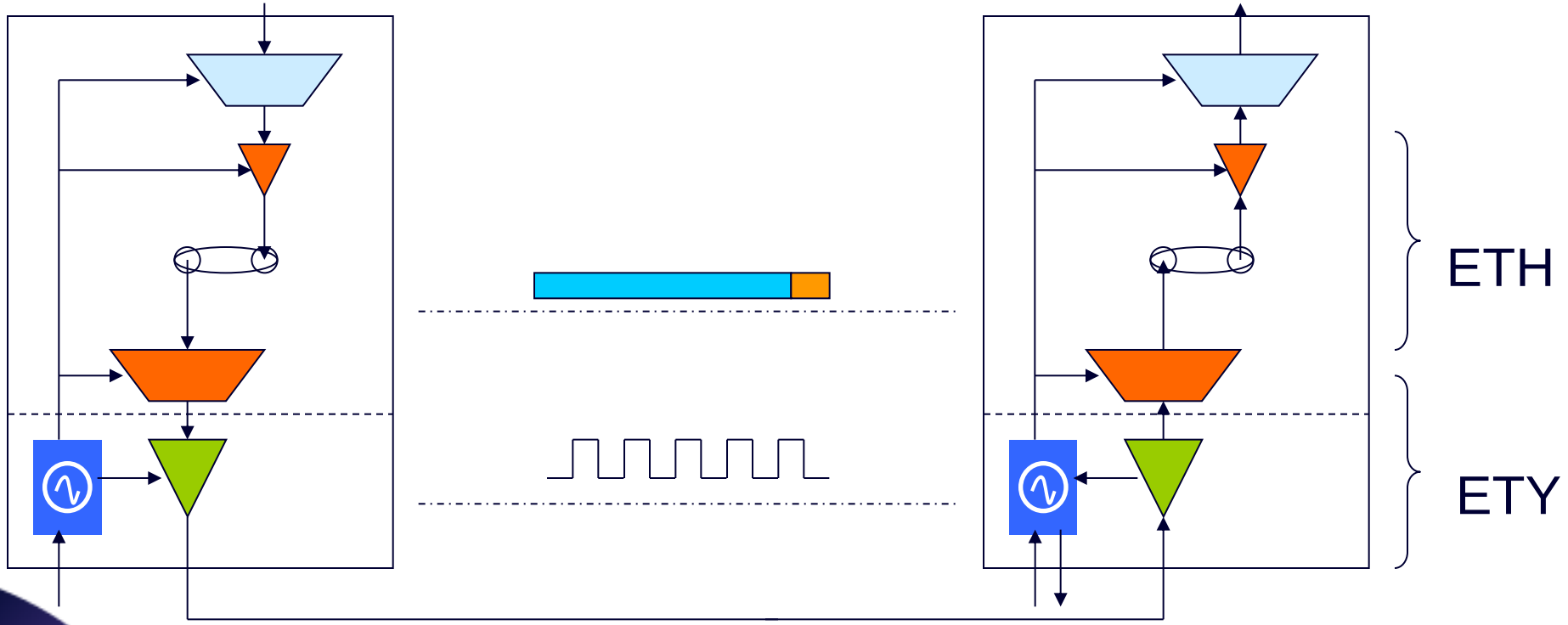
  - SSM Selection function (SG15 Meeting Geneva Nov 2006)
  - Development of architecture through use of modelling

Modelling Language

- Within ITU modelling language is used to
  - Develop architecture
  - Equipment
- Viewing and determining timing flows
  - problematic
  - which timing flow
- Breaking down timing flows within equipment
- Development of modelling language



Synchronisation Injection - ETY

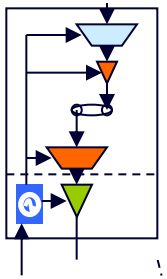


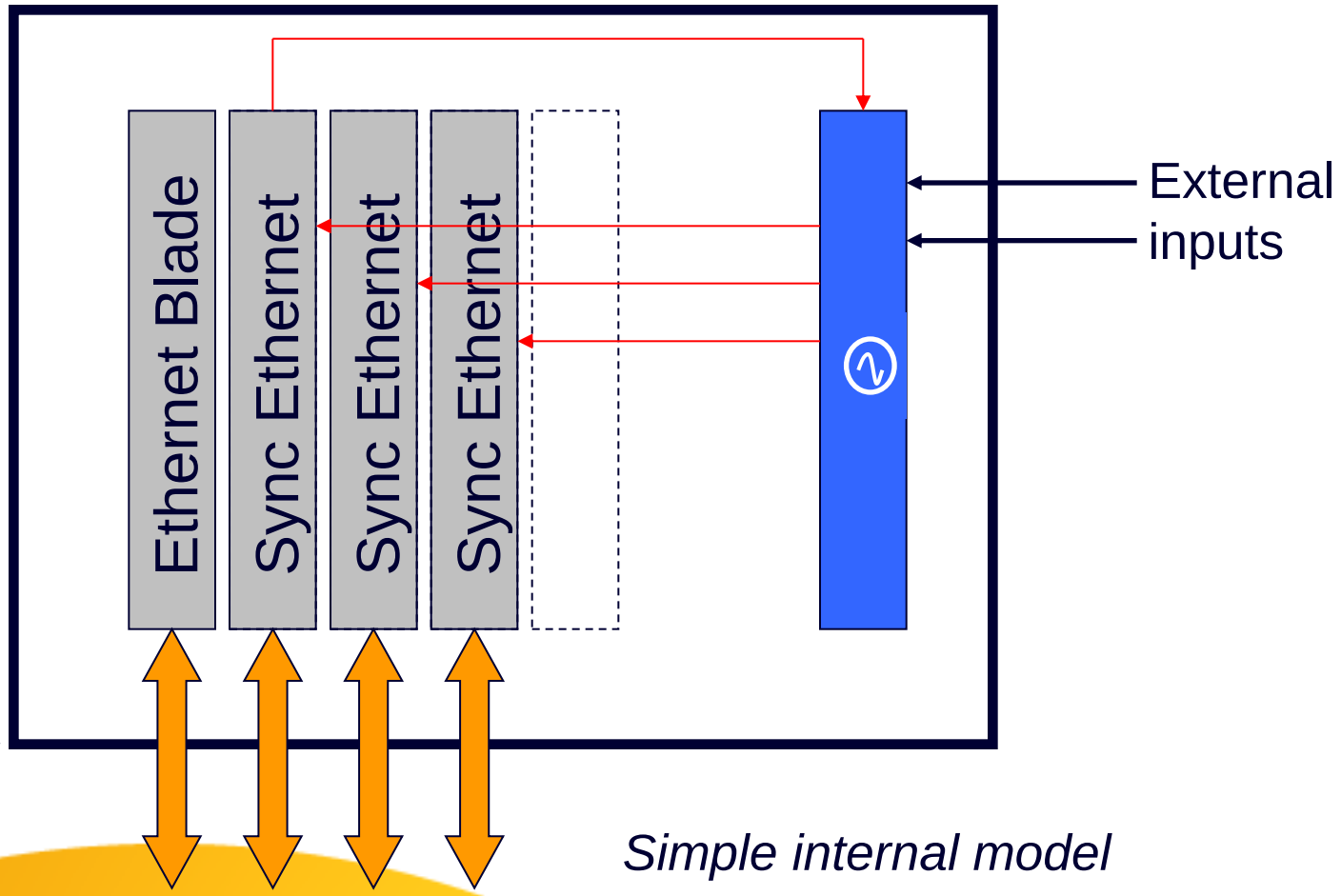
CI = Characteristic Information including timing

Flows

Objective – Development of Equipment

Typical Clock Chain





Simple internal model

Conclusions

- The 21C architecture
  - creates great opportunities in network simplification
  - creates some challenges if stability is required at the edge
- Many choices exist
  - Some of these require CAUTION, appropriate use
- Synchronous Ethernet provides an additional choice
  - Its real and works
  - Provides a stable base for carrier scale networks
- If you want this you have to ask now!
  - Equipment and silicon is being developed & fixed

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