

# Managing Infrastructure Deployment of Next Generation Networks and Optical Fibre Networks in a Competitive Environment

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# Infrastructure Deployment of NGNs and Optical Fibre Networks

- Different routes to NGN
  - NGN core versus NGN access
  - Funding mechanisms
  - Regulatory implications
- Key implications for regulators
  - Physical Layer
  - IP-based Network Layer
    - Interconnection
    - Assured Quality of Service (QoS)
  - Application Layer

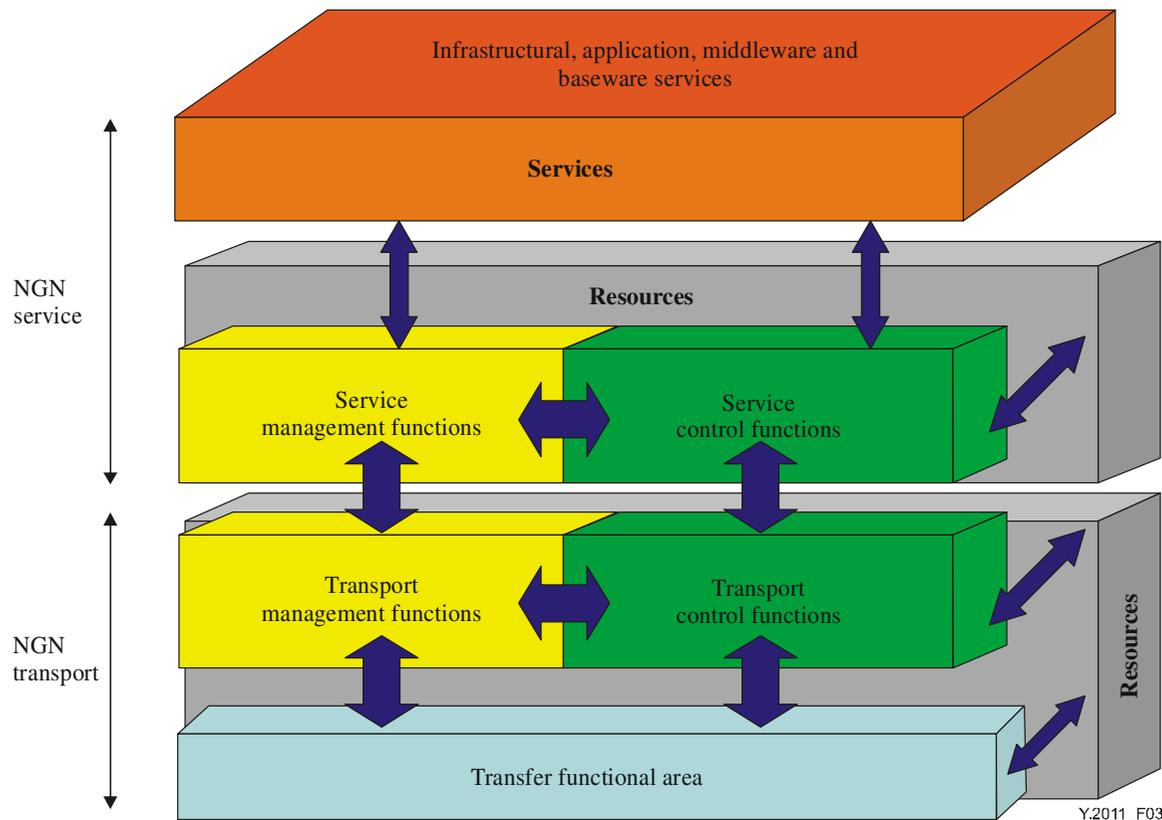
# Different routes to NGN

- British Telecom
  - Operational savings, faster time-to-market.
  - NGN core only, little emphasis on NGN access.
  - “Structural separation light” undertakings with Ofcom.
- KPN: Comprehensive revamping of both access and core networks.
  - Funded by sale of real estate no longer needed.
  - VDSL for the access network – relatively short loops.
  - Challenges to subloop unbundling – high density needed.
- DTAG: VDSL for similar reasons to KPN.
- FT
  - FTTB/FTTH in dense metropolitan areas
  - Many unresolved challenges as regards unbundling.

# Key Implications for Regulators

- NGN carries further the separation of the *service* from the *network*.
  - Changes the character of competition.
  - Raises challenges to many non-SMP-based obligations.
- Market power
  - New forms of competition may mitigate some bottlenecks.
  - Last mile bottlenecks will nonetheless likely persist until at least three fully competitive facilities-based operators are well established in a geographic area.
  - New bottlenecks may emerge at the Network or the Applications Layer.

# The layered structure of the NGN



| TCP/IP         | OSI          |
|----------------|--------------|
| Application    | Application  |
|                | Presentation |
| Transport      | Session      |
|                | Transport    |
| Internet       | Network      |
| Network access | Data Link    |
| Physical       | Physical     |

# The Physical Layer

- NGN can support many kinds of physical and logical transmission media.
  - Fixed versus mobile.
  - Cable television.
  - ADSL
  - VDSL
  - FTTB/FTTH
- Some operators will not offer their own access at all (the provider operates an NGN core, but does offer its own access).
- Many operators will offer a hybrid of two or more of the above.
- Special regulatory challenges have emerged with:
  - VDSL
  - FTTH/FTTB

# The Physical Layer: Access: VDSL

- VDSL supports only limited loop lengths.
  - Tends to be used only in countries or areas with short loops.
  - DSLAMs at the MDF could support only a limited fraction of the user base.
  - DSLAMs at the street cabinet could serve more users.
- Numerous regulatory challenges:
  - Impractical to deploy a second (or third...) street cabinet.
  - Limited ability to deploy a second (or third ...) DSLAM to the street cabinet due to (1) space, (2) manageability, and (3) heat dissipation.
  - Backhaul from the cabinet to the MDF is crucial to the business case; however, unlikely to be available other than from the incumbent. Duct availability a key concern.

# The Physical Layer : Access: FTTB/FTTH

- FTTB/FTTH will tend to be preferred
  - Where loop lengths are longer.
  - As an end game wherever high speed to the end user is desired.
- Substantial civil engineering costs.
- Significant regulatory challenges:
  - Last mile concerns with building wiring for multiple dwelling units.
    - Owners will not accept a second set of fiber.
    - Implies huge first mover advantage.
  - Unclear how to provide unbundled access in some cases, notably PON.
  - Ducts are again important.
- France is currently coordinating discussions with industry.

# The IP Network Layer: Interconnection

- Traditional telephony
  - Wholesale level
    - Calling Party's Network Pays (CPNP)
    - Private negotiated arrangements (à la Coase), often Bill and Keep
  - Retail level
    - Often Calling Party Pays (CPP)
    - Often (banded) flat rate
- Internet
  - Wholesale level
    - Private negotiated arrangements (à la Coase) with peers, often with no charges
    - Usually banded flat rate to transit customers
  - Retail level diverse, often flat rate

# The IP Network Layer: Interconnection

- CPNP wholesale arrangements will be difficult to sustain in their current form in an NGN world.
  - Competitive pressure from service providers who do not operate networks.
  - Difficult or impossible to use a surcharge on the *service* to pay for costs of the *network* when these are not necessarily provided by the same integrated firm.
  - Current metrics (minutes of use) correlate only weakly with real usage-based marginal costs.
  - The attribution of cost causation to the party placing the call was always questionable, and much more so in an NGN world.
  - Substantial challenges with measurement and accounting, especially where the service provider and the network operator are distinct entities.

# The IP Network Layer: Interconnection

- Private “Coasian” negotiated arrangements (with preconditions) have worked well, and are more likely to be sustainable.
  - Mobile operators and non-dominant fixed operators in the US, Canada, Singapore
    - Much higher utilization (MoU) than in Europe
    - Lower marginal consumer price (service-based revenue per MoU)
    - Substantially higher ARPU
    - Fewer distortions between fixed and mobile usage
    - No need for regulatory rate-setting
  - Internet arrangements
- Countries that implement very low termination rates (e.g. India) may be better positioned to make a transition.

# The IP Network Layer: Interconnection

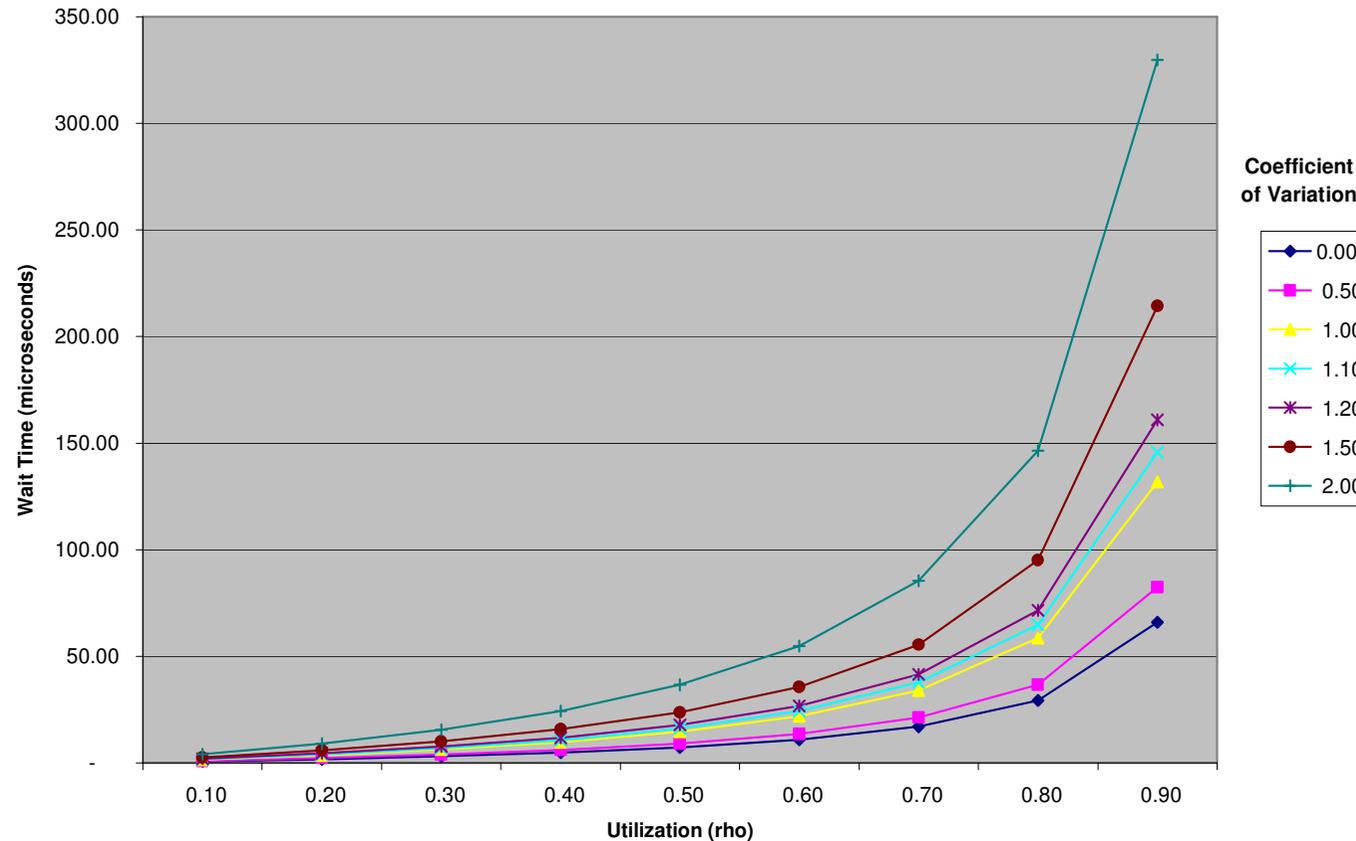
- The inherent IP-based nature of the NGN potentially opens the network to third party applications, including VoIP.
  - Will best-efforts IP be fully open to competitors, or will incumbents with SMP prefer their own services?
  - Will IP with assured Quality of Service (QoS) be fully open to competitors, or will incumbents with SMP prefer their own services?
- Best-efforts IP-based services could, in most cases, enable effective competition to the incumbent's own QoS-enhanced applications.
- Operators may prefer a closed environment.

# The IP Network Layer: Interconnection

- Will the incumbent attempt to impact performance of best-efforts IP?
  - Intentional degradation
  - Failure to upgrade infrastructure as needed (equivalent)
- Regulatory remedies to degradation
  - *Ex ante* nondiscrimination obligations
  - Obligation to publish QoS under Article 22 USD
  - Competition law (foreclosure)

# The IP Network Layer: Interconnection (QoS)

M/G/1 Queuing Delay (155 Mbps Link)



## M/G/1 queueing analysis of link performance

(with clocking delay of 50  $\mu$ secs (284 byte packets) and a 155 Mbps link)

# The IP Network Layer: Interconnection (QoS)

- For real time services such as voice telephony traffic, it is important that mean delay and variability of delay be held to low values.
  - Delay in excess of about 150 milliseconds causes “collisions”.
  - Buffering can address variability as long as the mean and variance are not too great.
  - The buffer then represents a fixed increment to the propagation delay.
- For circuit speeds of 100 Mbps and up, queuing delays in a properly designed network will generally be well under a millisecond per hop under normal operating conditions.
- Propagation delay (speed of light) will tend to dominate any variable queuing delays under normal operating conditions.

# The IP Network Layer: Interconnection (QoS)

- IMPLICATION: Most of the time, and under normal conditions, **variable delay in the core of the network(s) is unlikely to be perceptible to the VoIP user.**
- FURTHER IMPLICATION: **Consumers will not willingly pay a large premium for a performance difference that they cannot perceive.**
- Packet delay is more likely to be an issue:
  - For slower circuits at the edge of the network
  - For shared circuits (e.g. cable modem services)
  - When one or more circuits are saturated
  - When one or more components have failed
  - When a *force majeure* incident has occurred

# The IP Network Layer: Transition concerns

- How long should operators be required to provide SMP remedies?
  - Incumbent should be able to upgrade its network.
  - Preserve competition, not individual competitors.
- If POIs for access and interconnection are unilaterally discontinued, what is the impact on competition?
  - Incumbent should be able to upgrade its network.
  - Risk of stranded competitor investments.
  - Preserve competition, not individual competitors.
  - Likely reliance on consultative mechanisms and on notice.

# The Application Layer

- Will the migration to NGN facilitate or hinder competition with providers of application services?
  - Each layer of the NGN architecture is in principle open to competition.
  - IMS NGN is well-suited to either enabling or inhibiting third party access at the Application Layer.
- Operators with market power will likely prefer to maintain a closed “walled garden” rather than an open competitive environment.
- The degree to which this is a concern is unclear. Competition at the IP-based Network Layer might mitigate concerns with bottlenecks at the Application Layer.



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