Techno-economic Simulation of Costs and Revenues in coarse-grained CoS enabled NGNs

ITG-FG 5.2.3 - Next Generation Networks

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Thomas Martin Knoll
Chemnitz University of Technology
Communication Networks
Phone **0371 531 33246**
Email **knoll@etit.tu-chemnitz.de**

Outline

1. Motivation -> CoS concept
2. NGN network model

   (Impact guessing + Considerations)
3. Business-Modelling software
4. Survey on critical / interesting issues

Motivation

"NG Internet" carries all services?

- Service merging onto one common platform requires service class differentiation to meet the respective QoS requirements.
- The traditional approach of synchronous transmission of QoS critical services and packet-based networking for the rest is meant to be too costly.
- Cost reduction and enabling of new services through the upcoming "NGN merger" is the main argument.

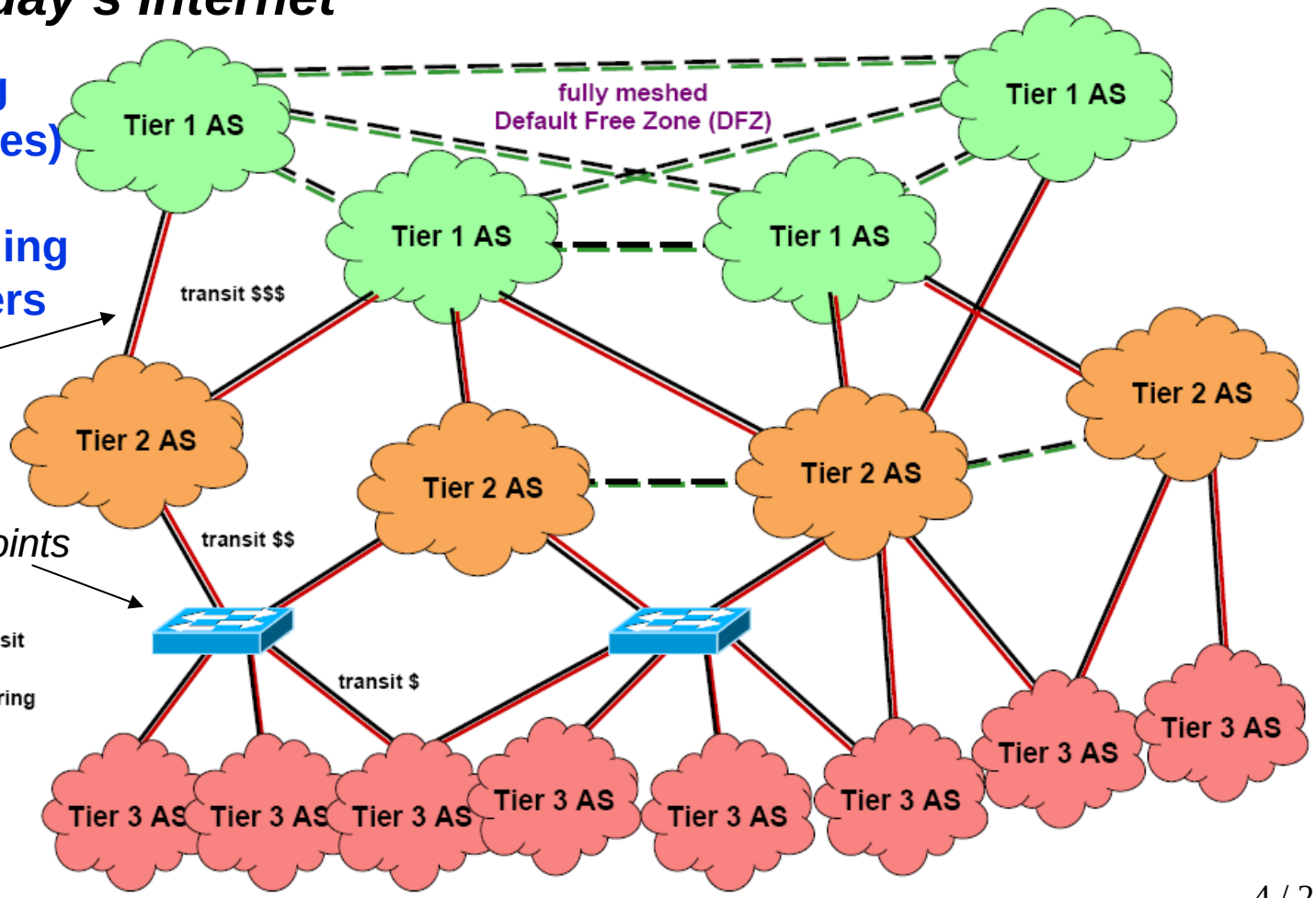
Motivation

Layout of today's Internet

BGP signalling (routes & attributes) + IP packet forwarding between providers

Interconnection Transit / Peering

Internet Exchange Points IXP



Motivation → Concept: Proposed Improvements

Proposed Improvements → Inter-AS CoS

- **Provides knowledge** about the available traffic separations and markings. **Cross-layer mapping** & **transitive Cross-domain signalling** is a novel feature.
- Enables **marking adoption** (and possibly route selection) **without guarantees**.
- Fair **signalling of class overload** limitations and **excess traffic handling** with local scope

- **Twofold "free to join" concept** (single or combined usage):
  1. global class set + cross-layer marking signalling (transitive attribute)
  2. local class set + rate limitation signalling (between neighbours)

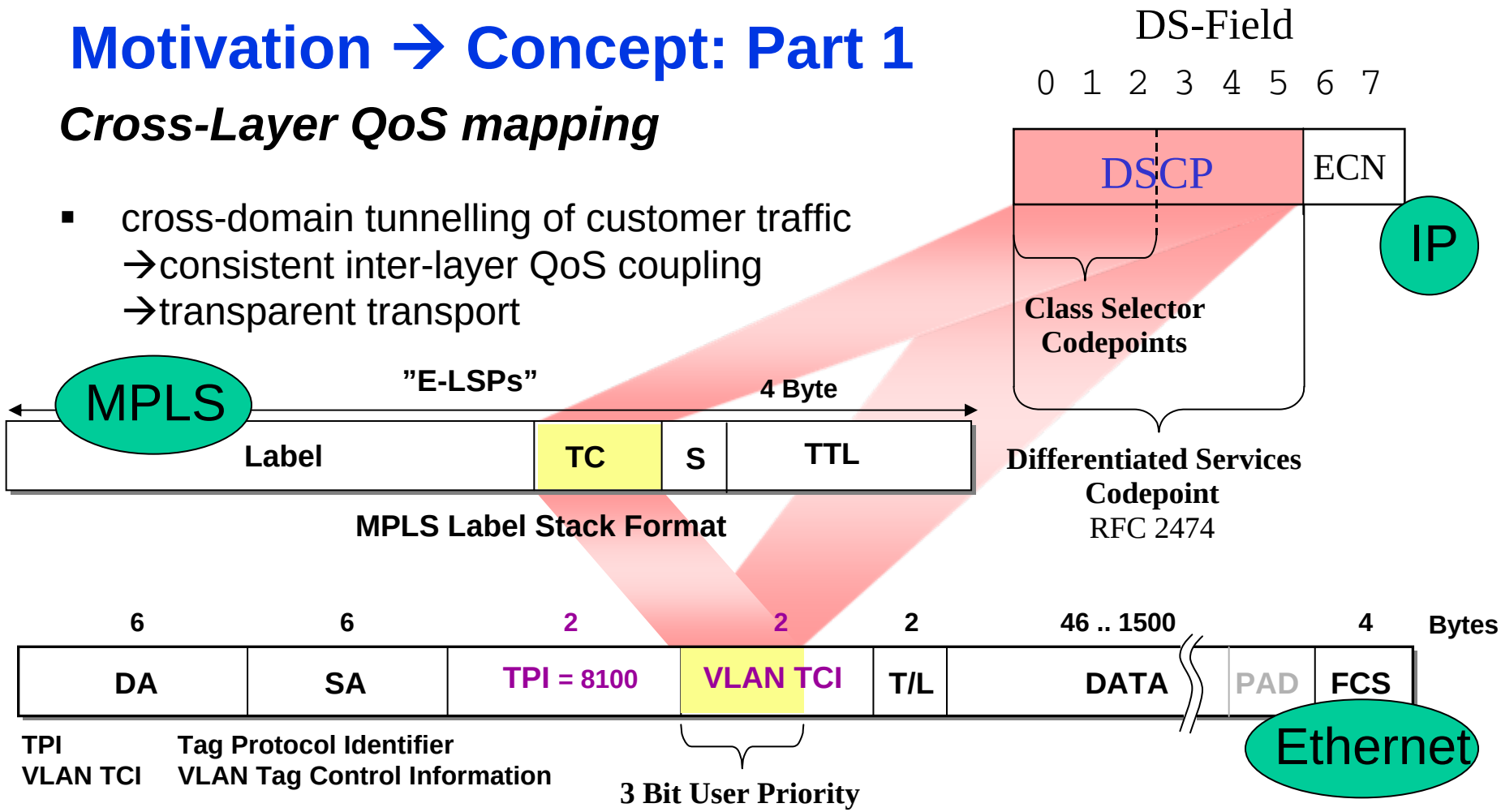
Traffic Separation and Simplicity is key

Further details: http://archiv.tu-chemnitz.de/pub/2009/0165/

Motivation → Concept: Part 1

Cross-Layer QoS mapping

- cross-domain tunnelling of customer traffic
  →consistent inter-layer QoS coupling
  →transparent transport

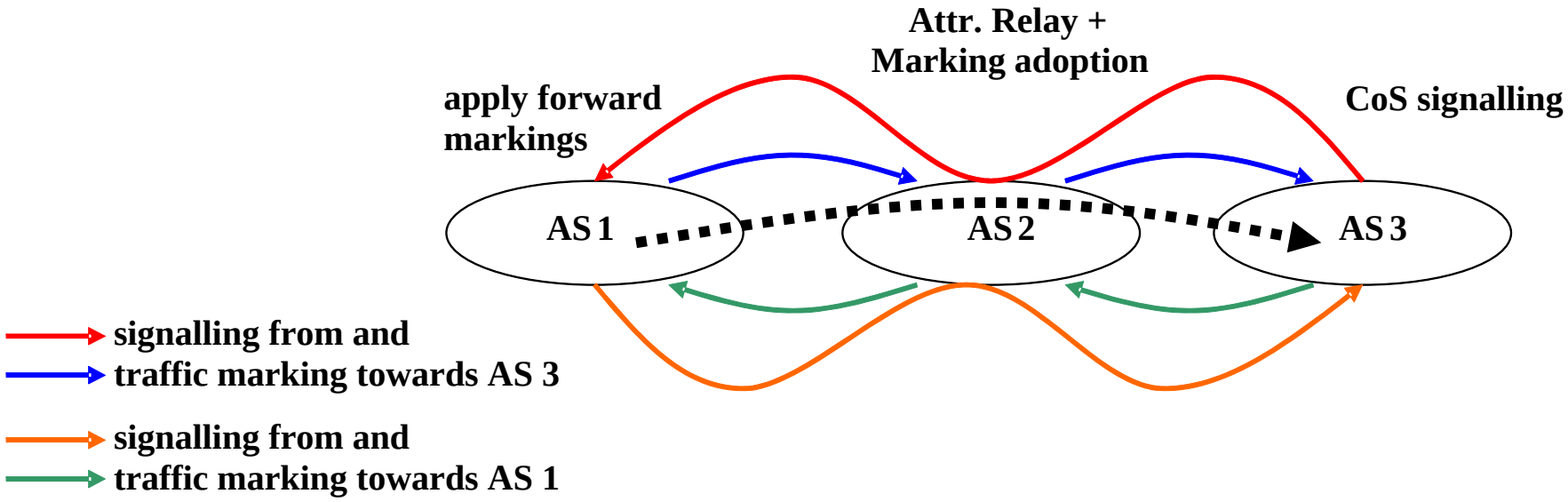


The aim is consistent classification and a consistent class-based forwarding behaviour on all layers of a transit traffic path.

Motivation → Concept: Part 2

Cross-Domain CoS signalling

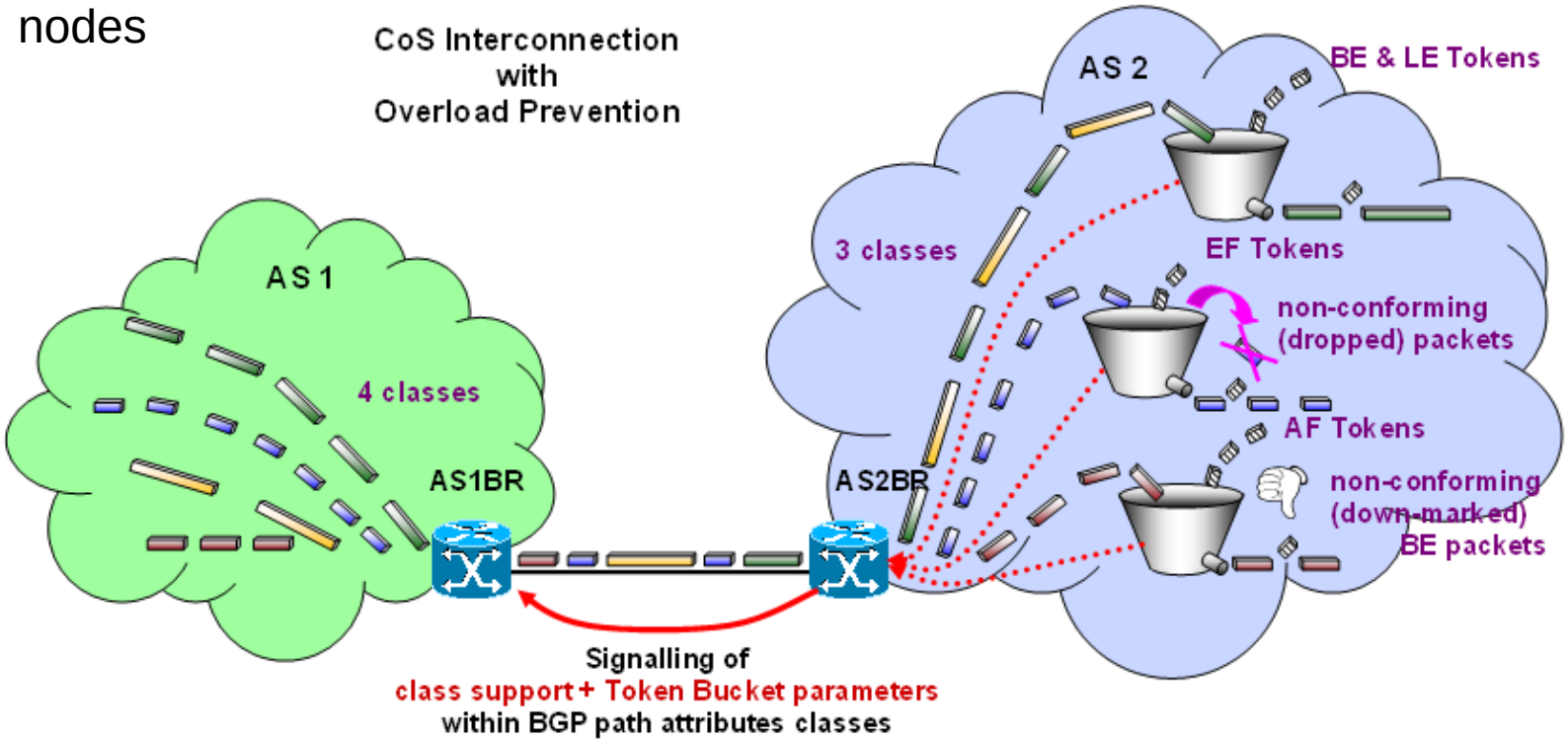
- **Upstream signalling of markings (transitive)**
  → original (originating AS) marking relayed unchanged
  → transit marking within each transit AS associated to original marking
  ➔ close marking (and treatment) adoption
- **Downstream Traffic marking and forwarding**
  → forwarding along consistent chain of re-markings



Motivation → Concept: Part 3

CoS – Class Overload prevention (optional)

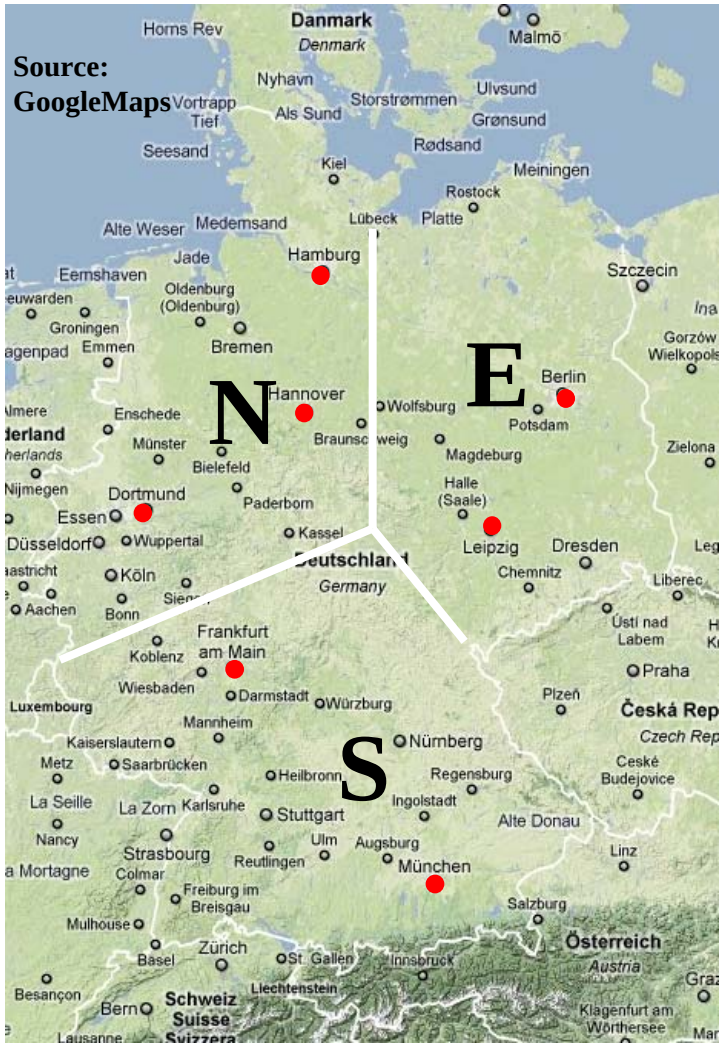
- Traffic separation and enqueueing into separate – prioritised – queues tempts users to **overload the higher priority classes**.
- **Limitation and punishment concept** using Token Bucket filter at ingress nodes



Model of a coarse grained NG Network

Network setup + assumptions

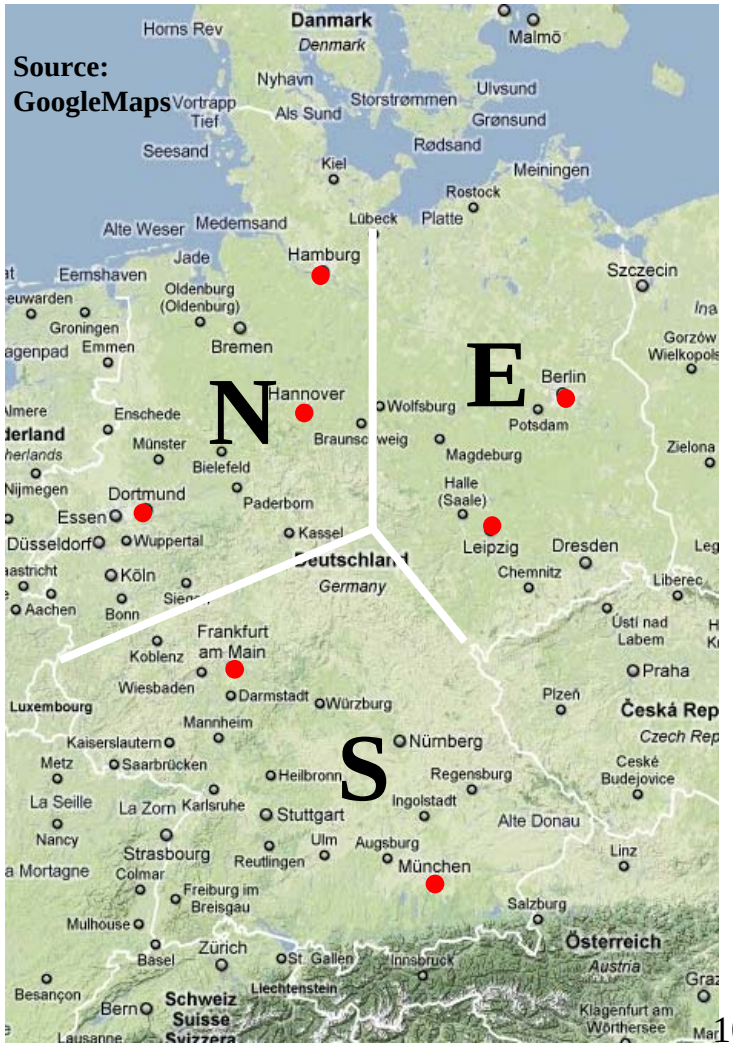
- German network with 3 regions and 7 major cities (star access + metro ring)
- Traffic separation into at most 4 classes (EF, AF, BE, LE)
- 5 access profiles offered with different tailoring of class shares
- Market shares and service penetrations are based on real inhabitant numbers and expected growth rates
- 10 year life cycle simulation
- Usage dependent technology base (1G…100G / copper … fibre transition) per city
- CAPEX and OPEX costs as well as physical and financial lifetime of the resources are modelled



Model of a coarse grained NG Network (contd.)

Network setup + assumptions

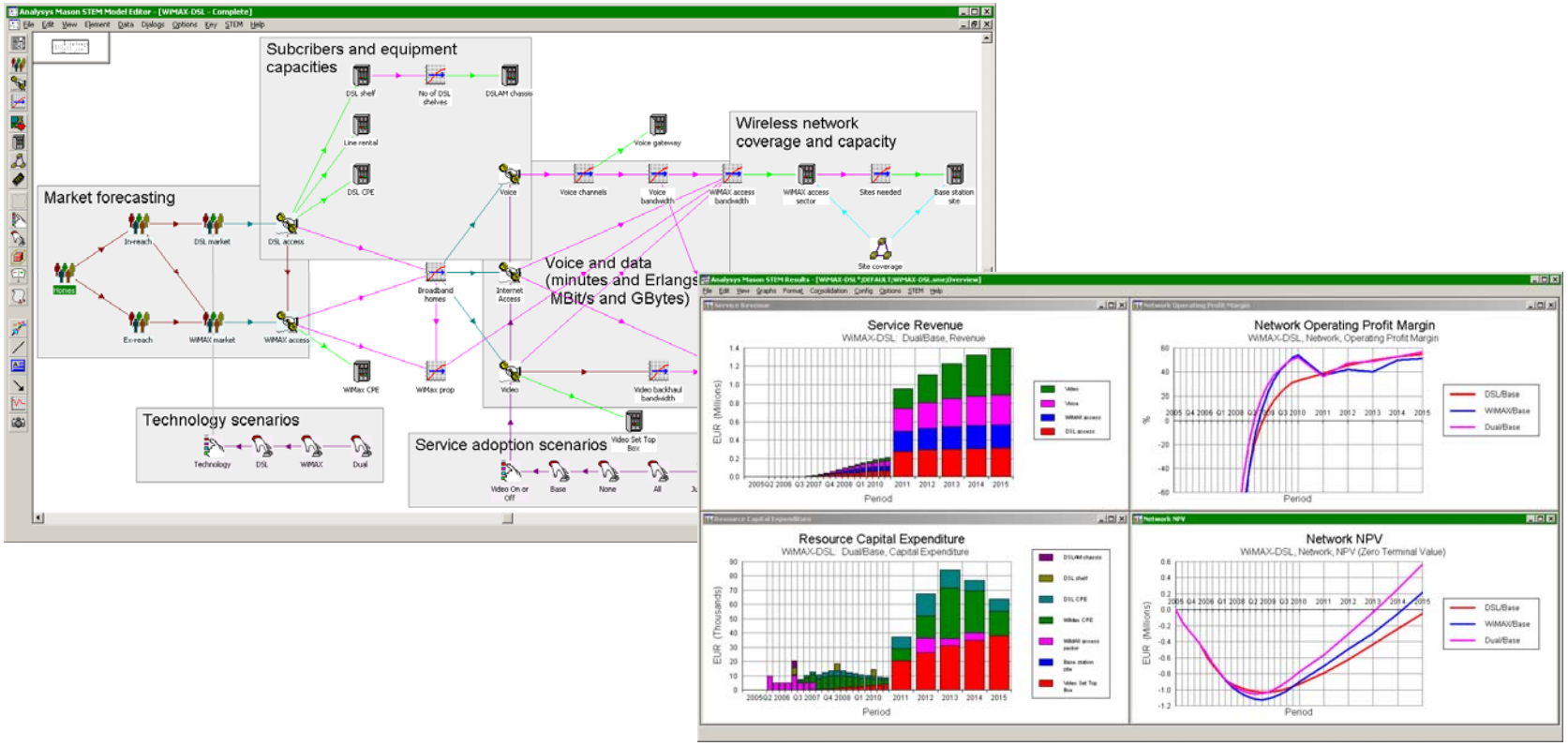
- Class based interconnection with in/out and transit/peering differentiation
- Model allows for simulations and reporting of:
  - assumed market share development
  - resulting usage (traffic demand)
  - automatic resource installation and transition
  - operating expenditures (capital expenditures + operating costs)
  - transit/peering connection and volume dependent traffic costs
- End user tariffs and tariff feedback to demand models will be incorporated to encompass the income and revenue modelling as well.



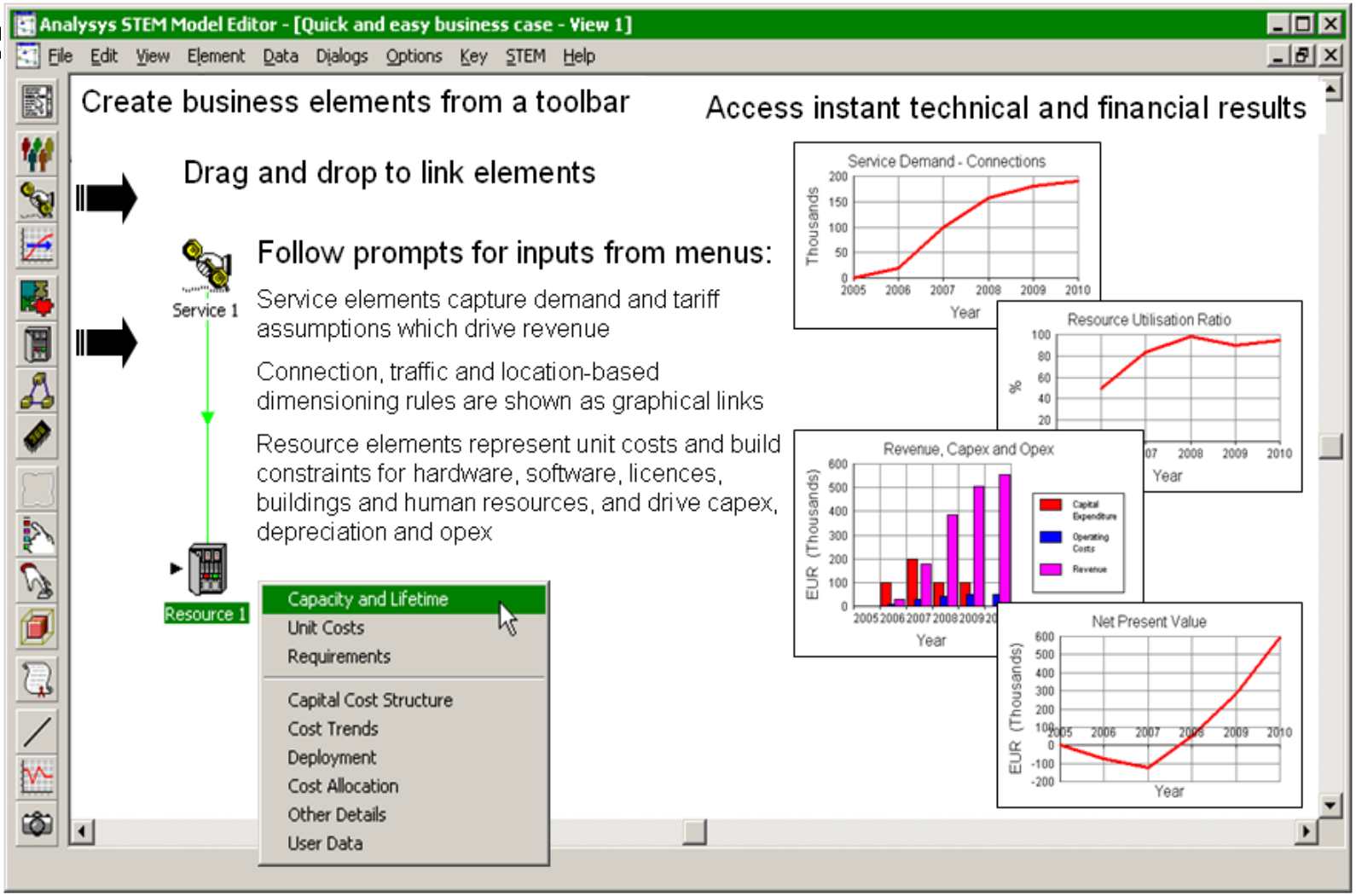
Business-Modelling software

STEM (Strategic Telecoms Evaluation Model)

- STEM is an accelerated financial-modelling platform designed to manage the complexity inherent in the business modelling of service-provider functions



Business-Modelling software

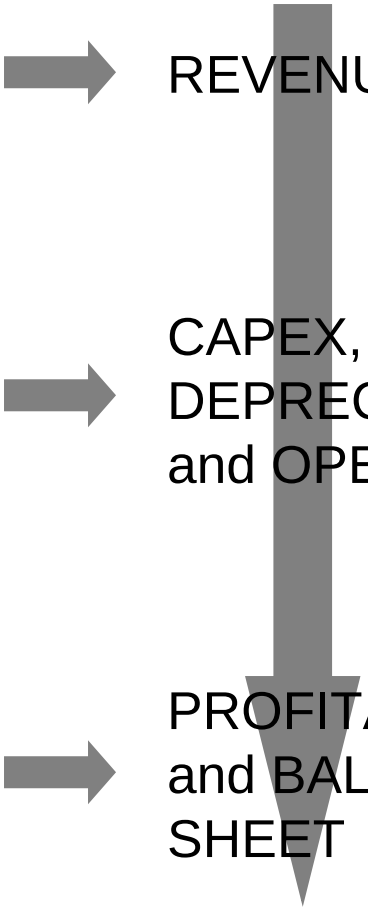


Business-Modelling software

Consistent financial framework

Measuring future profitability

- Service elements capture demand and tariff assumptions → REVENUE
- Resource elements represent unit costs and build constraints for hardware, software, licences, buildings and human resources → CAPEX, DEPRECIATION and OPEX
- Connection, traffic and location-based dimensioning rules are shown as graphical links → PROFITABILITY and BALANCE SHEET



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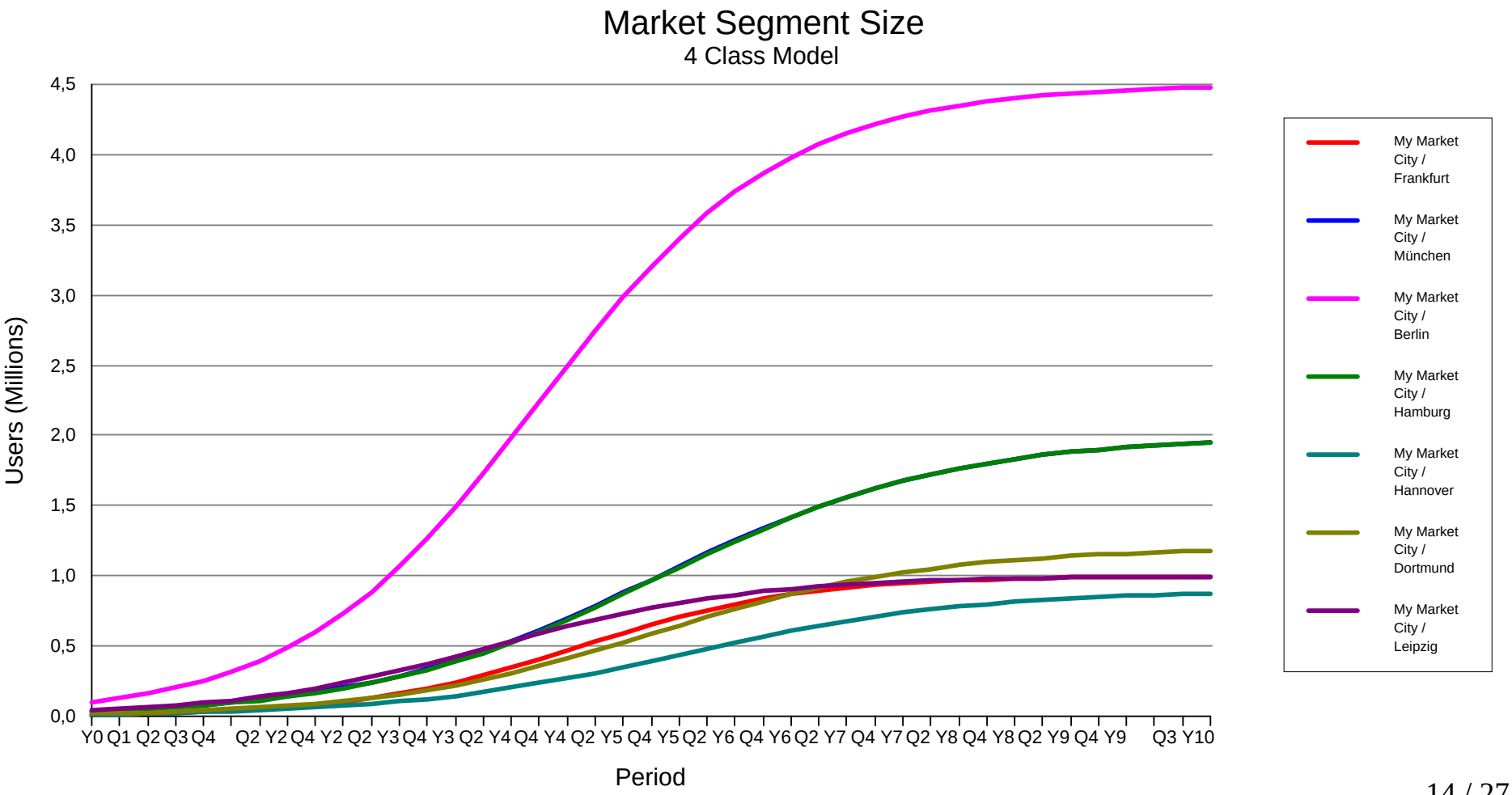

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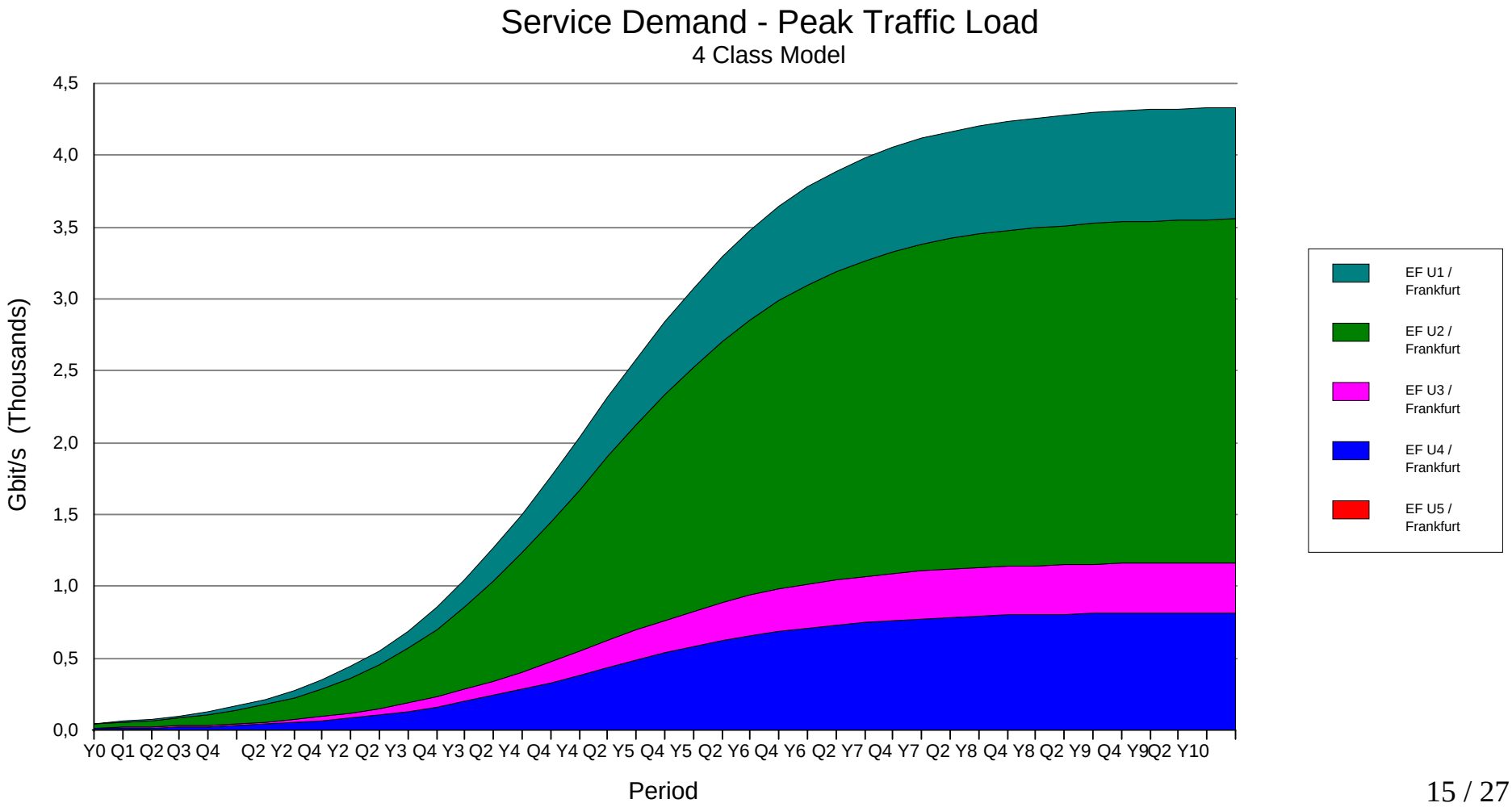

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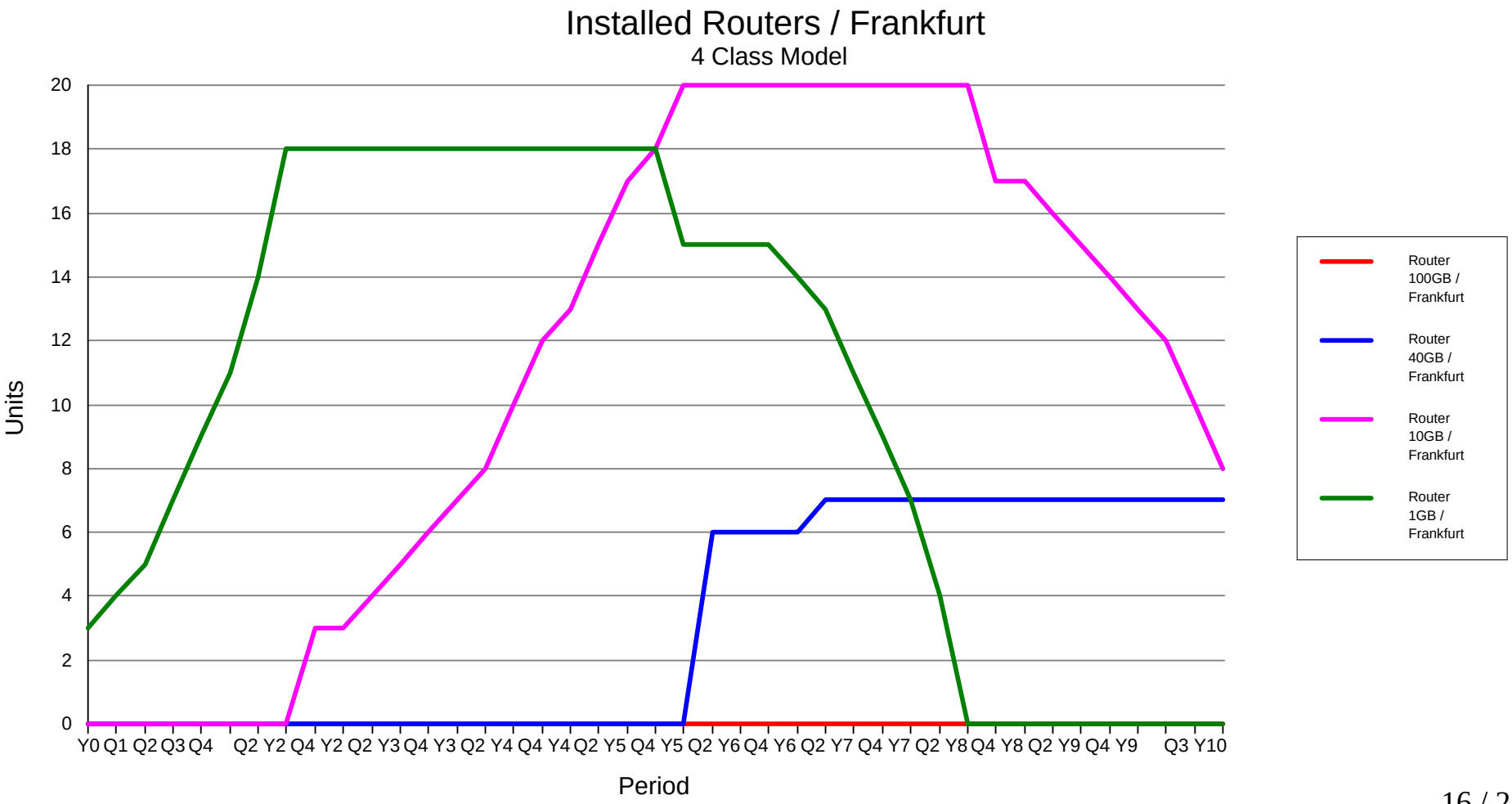

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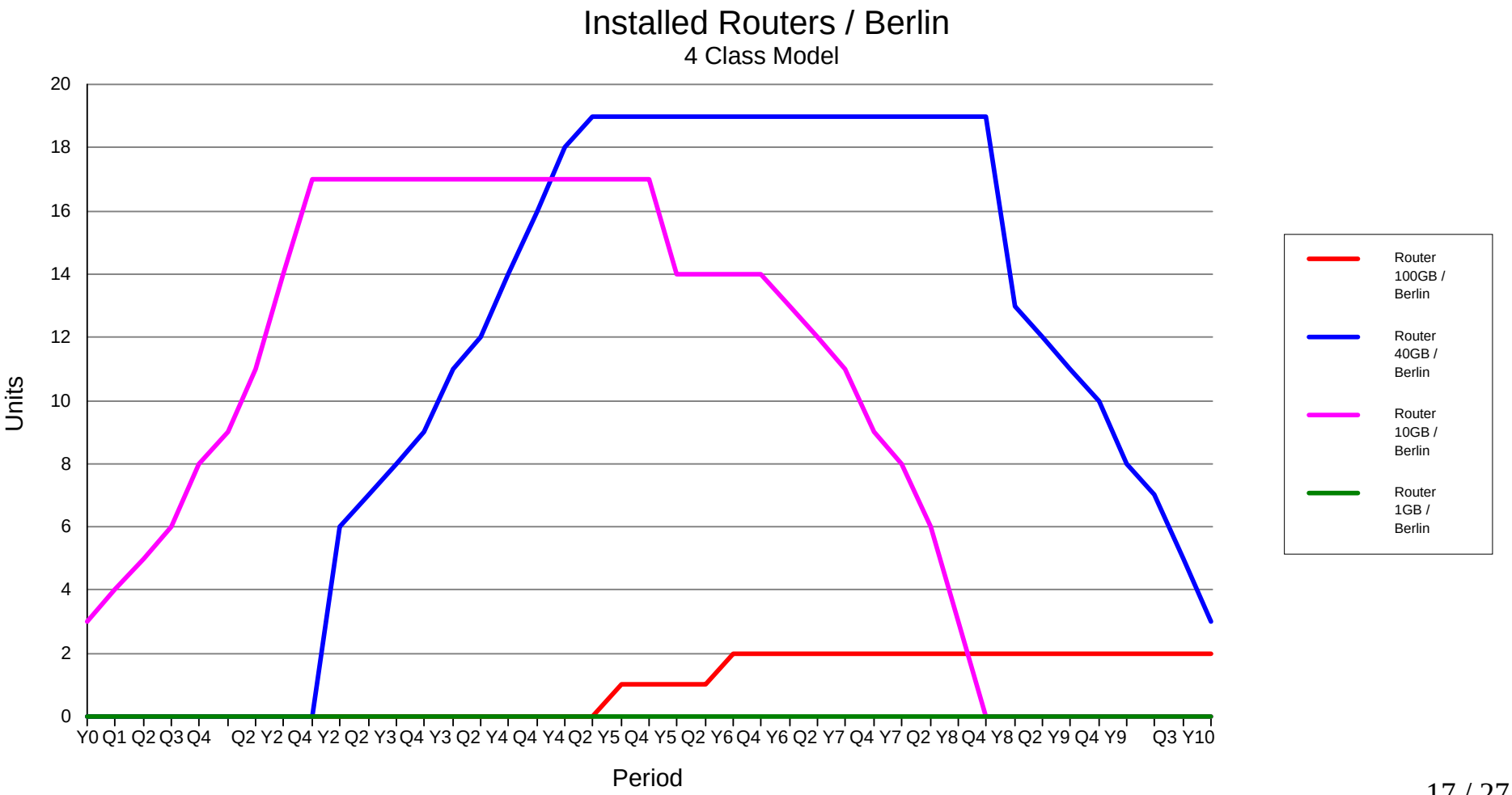

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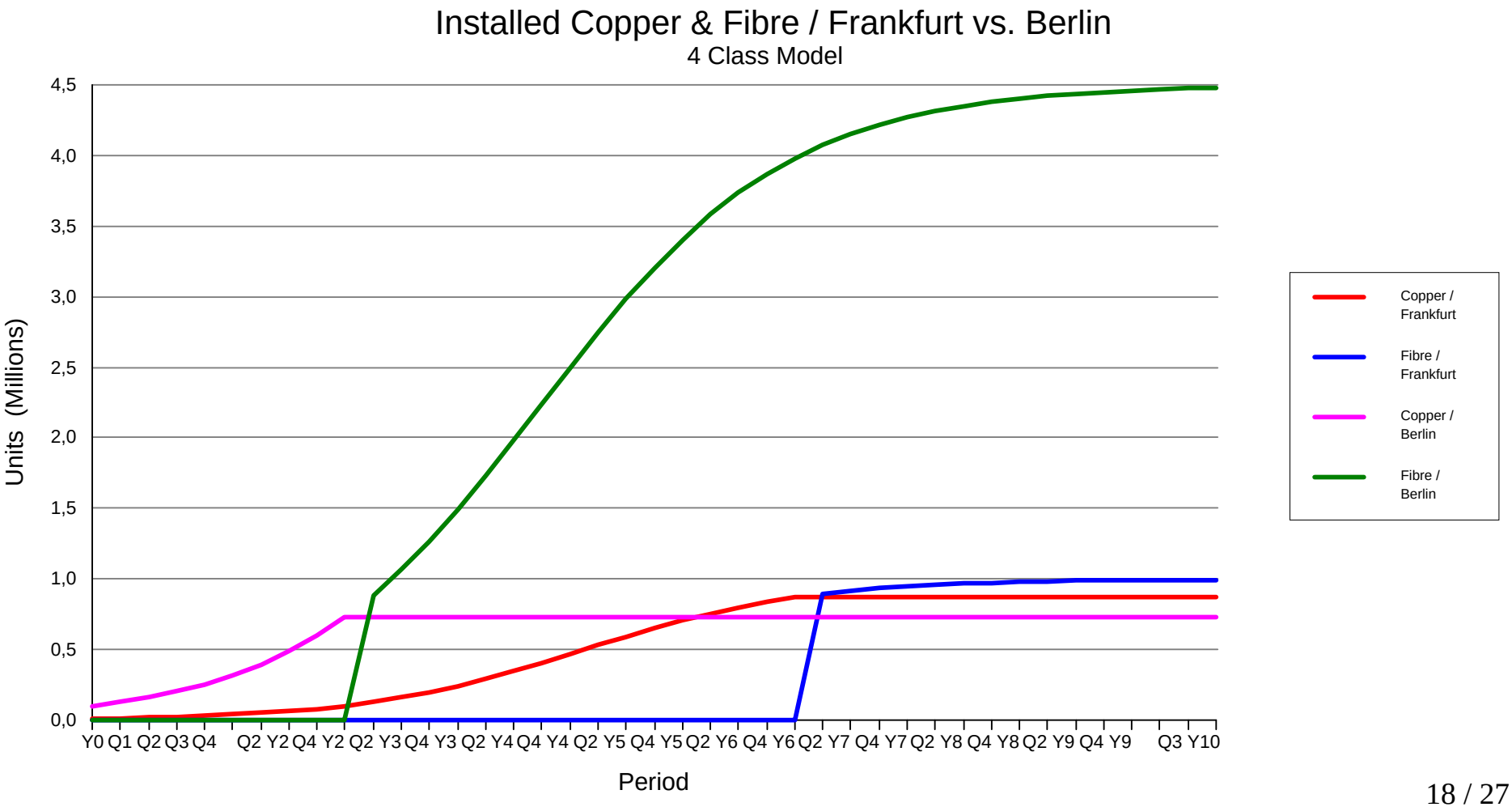

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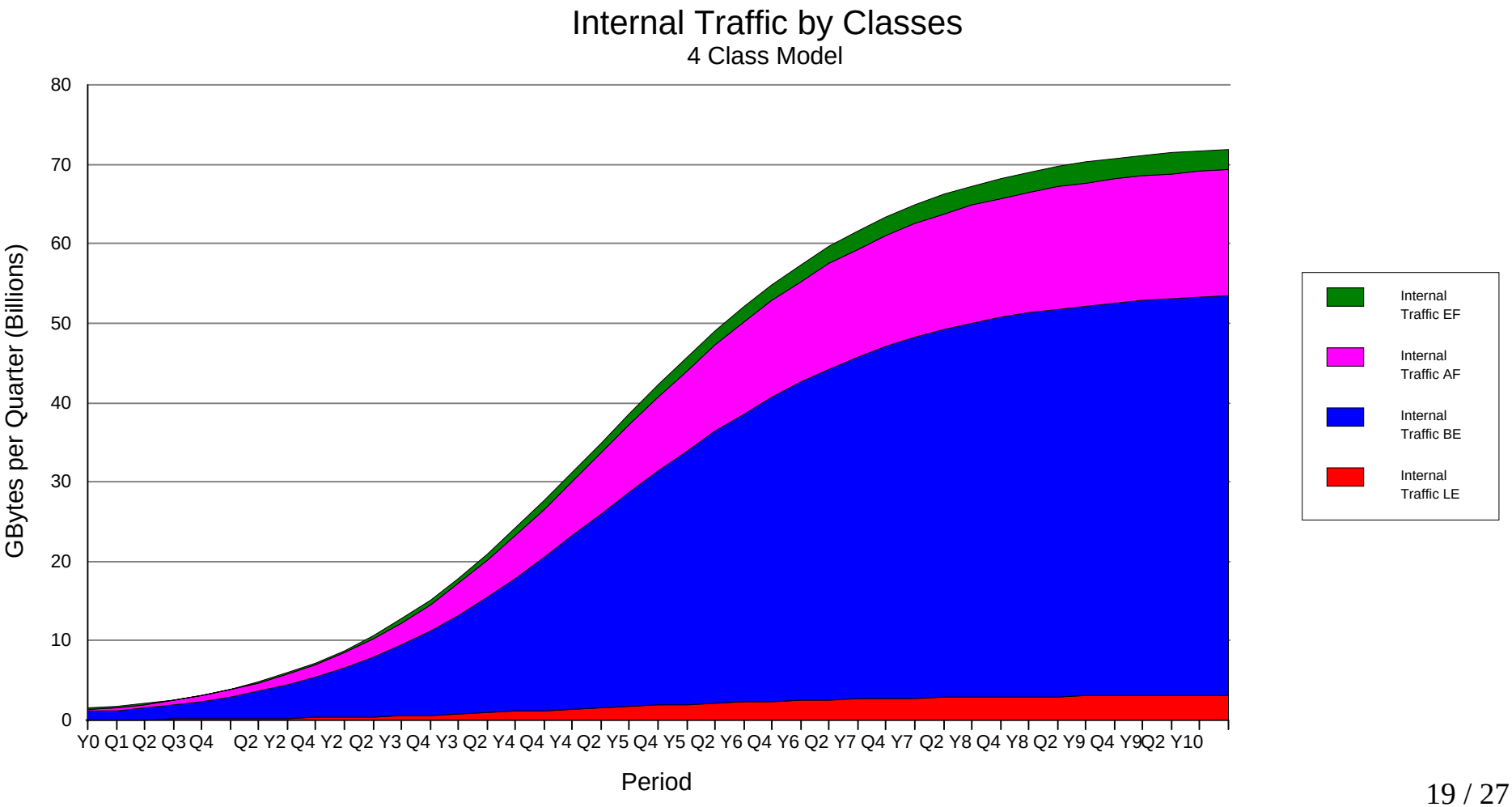

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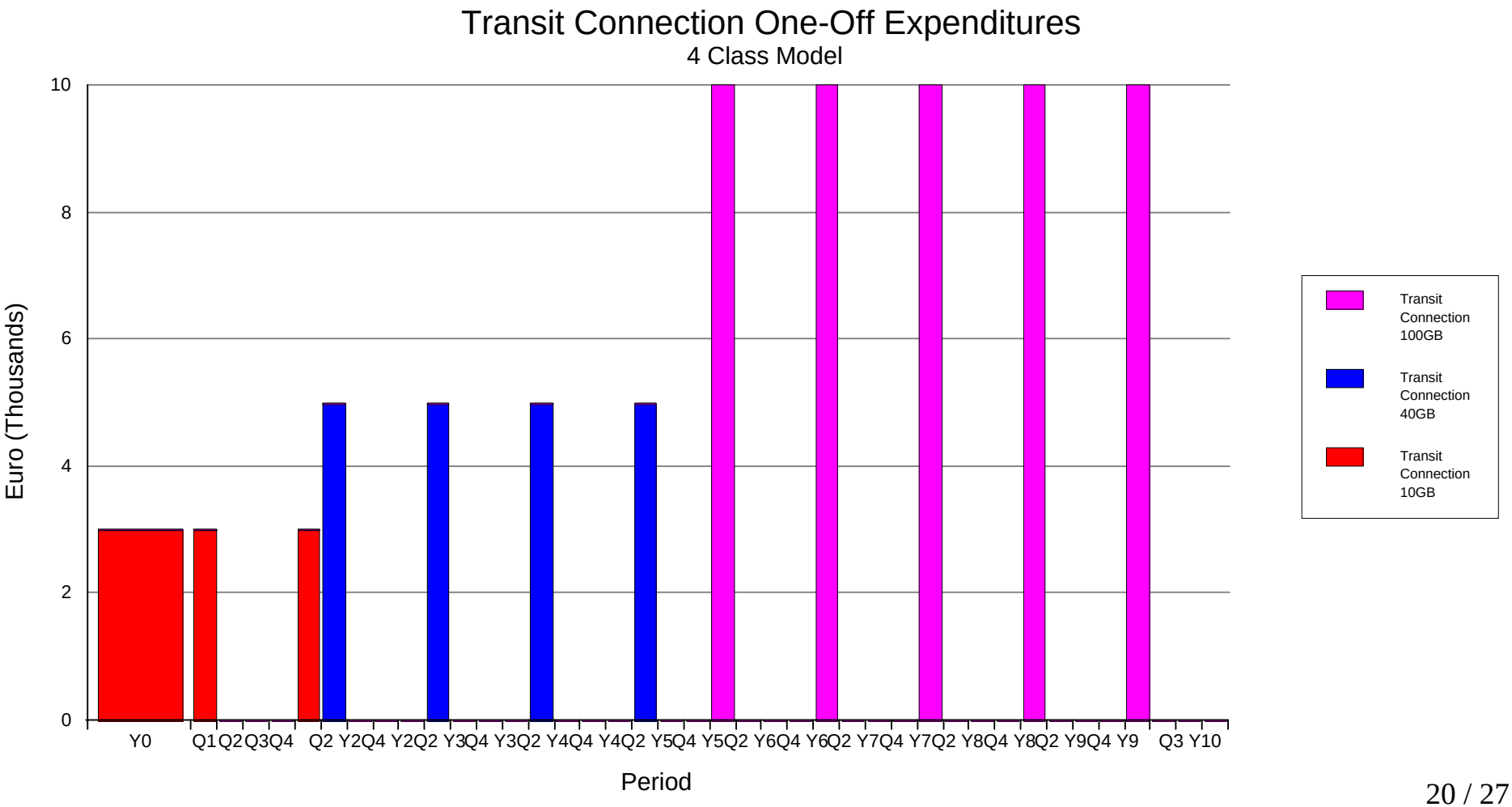

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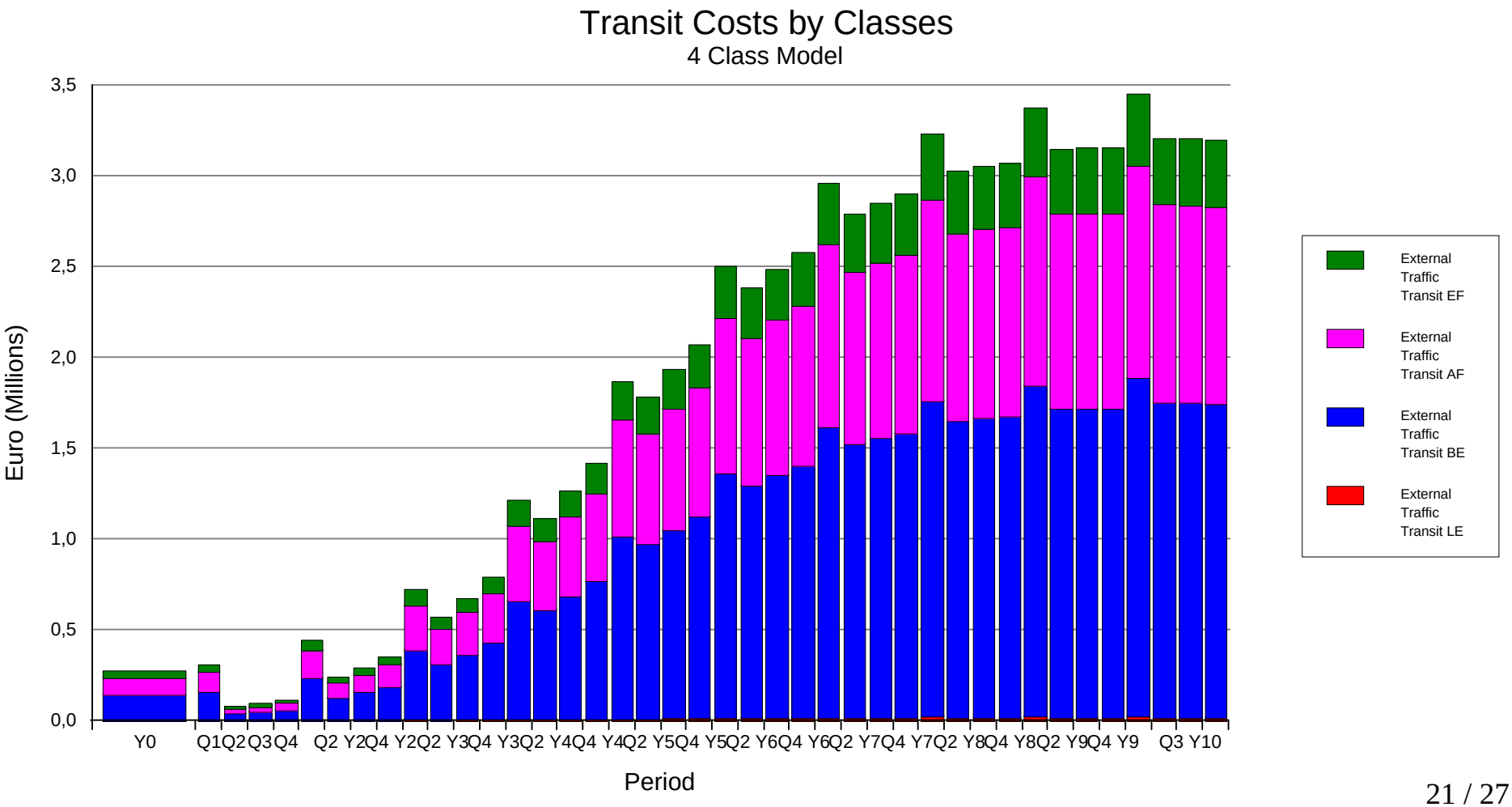

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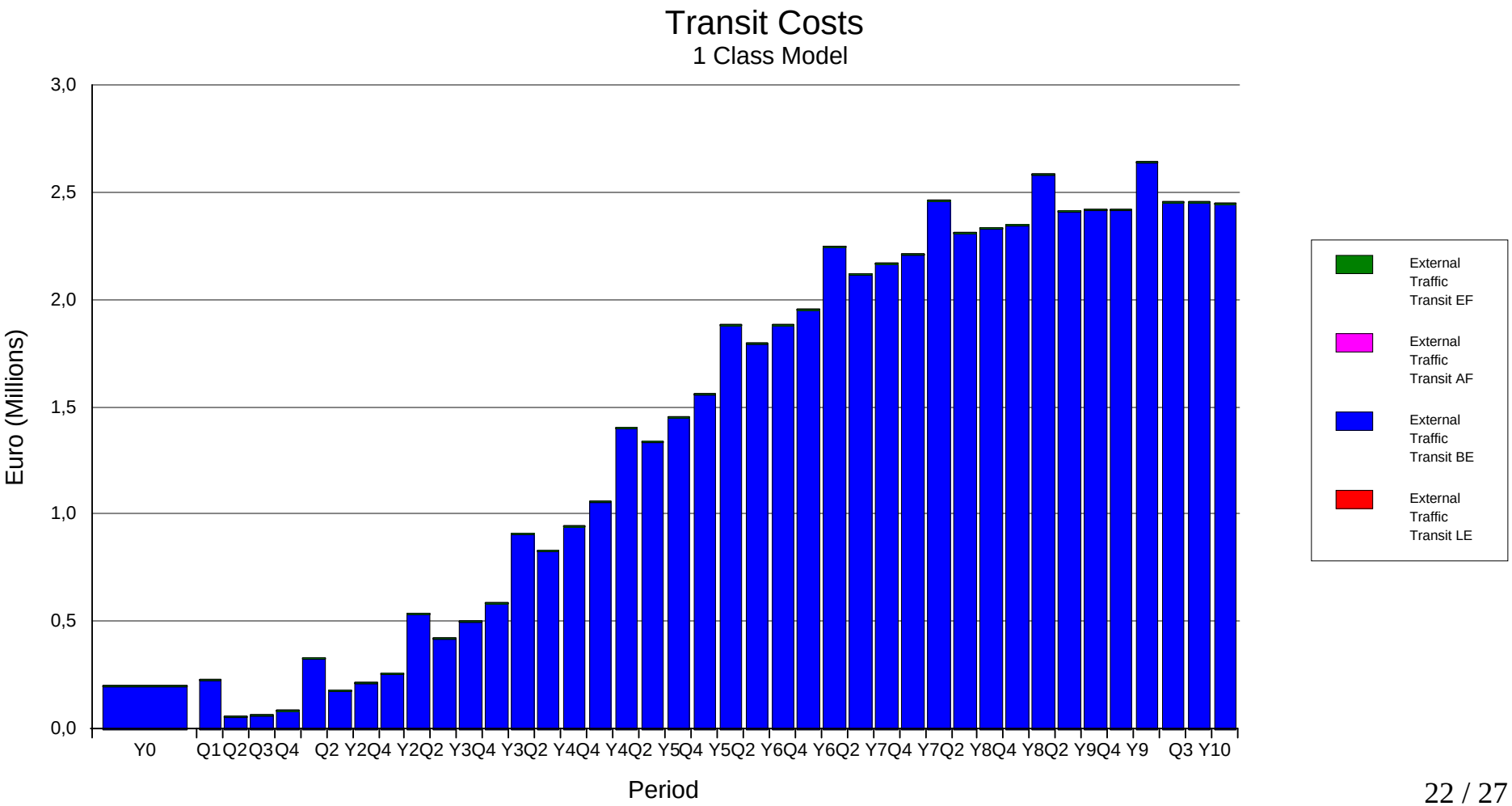

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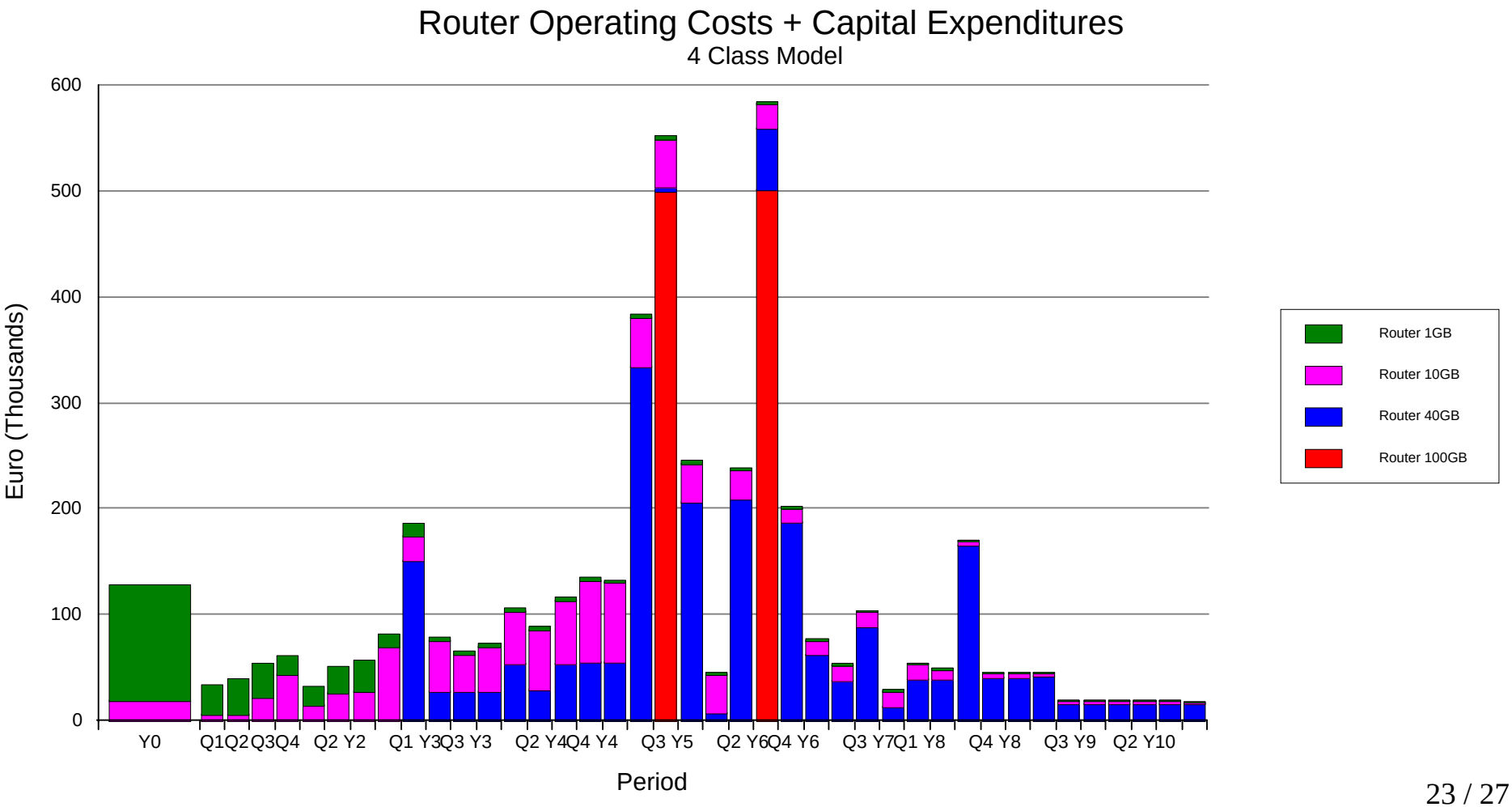

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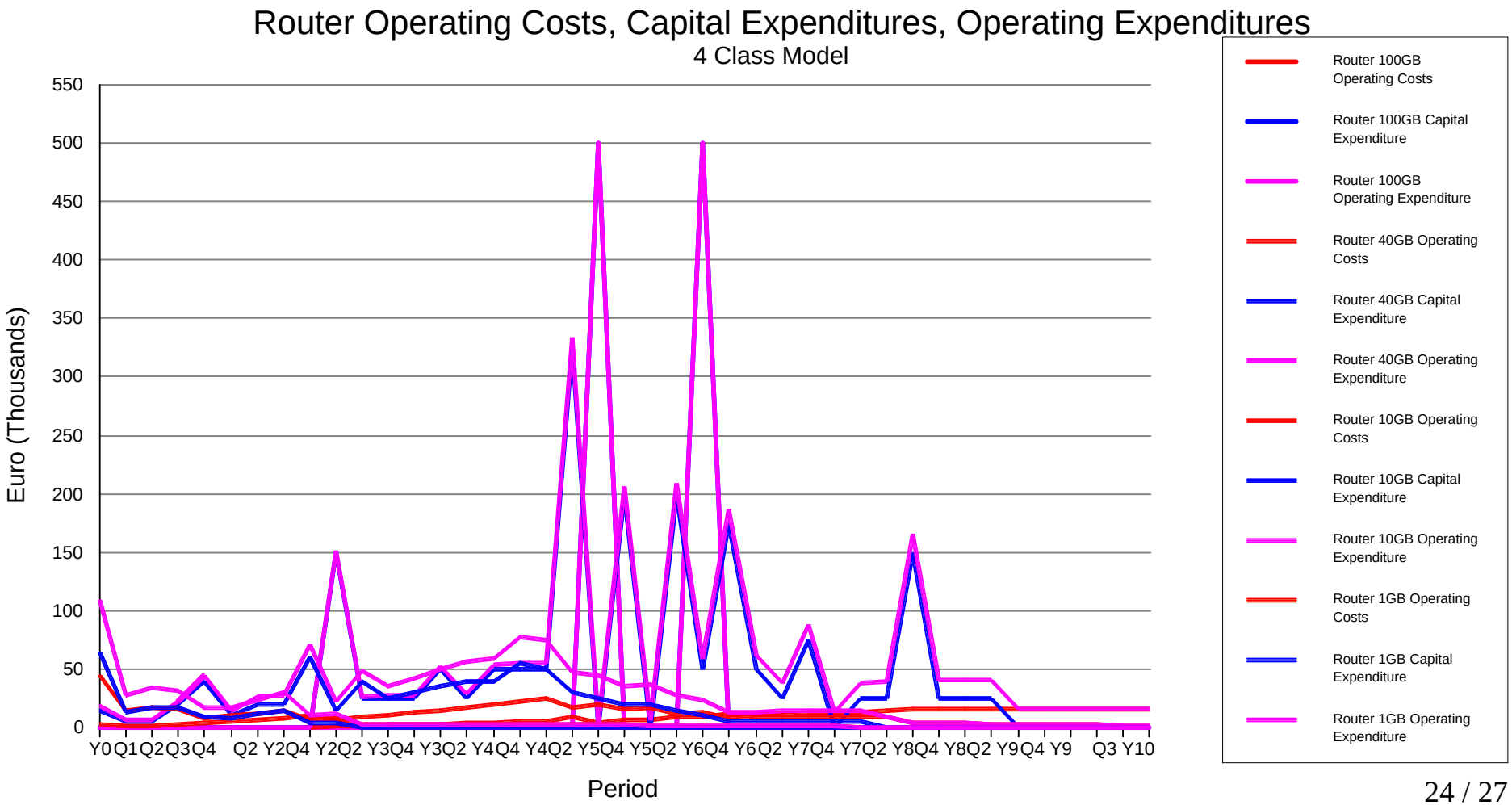

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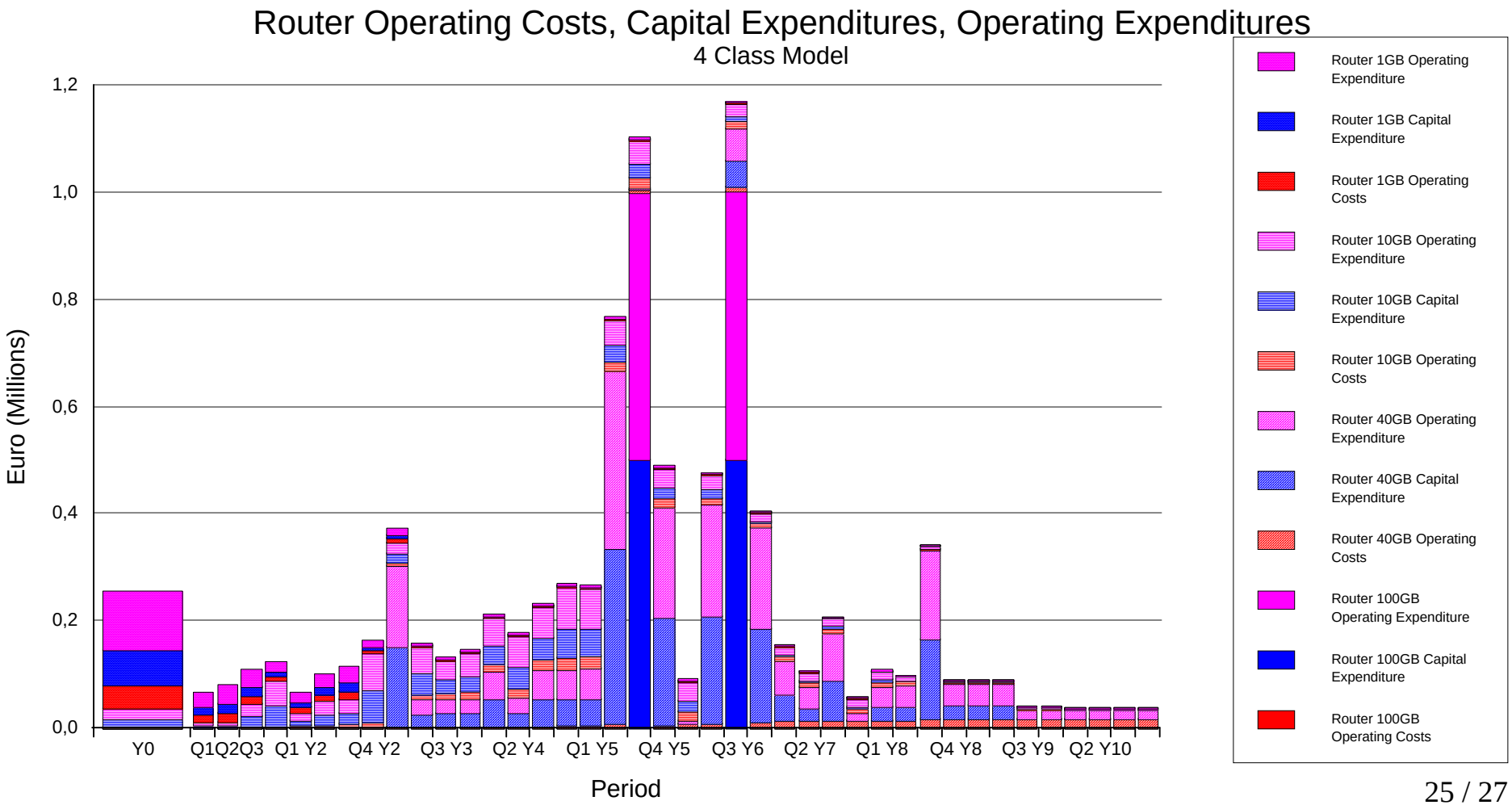

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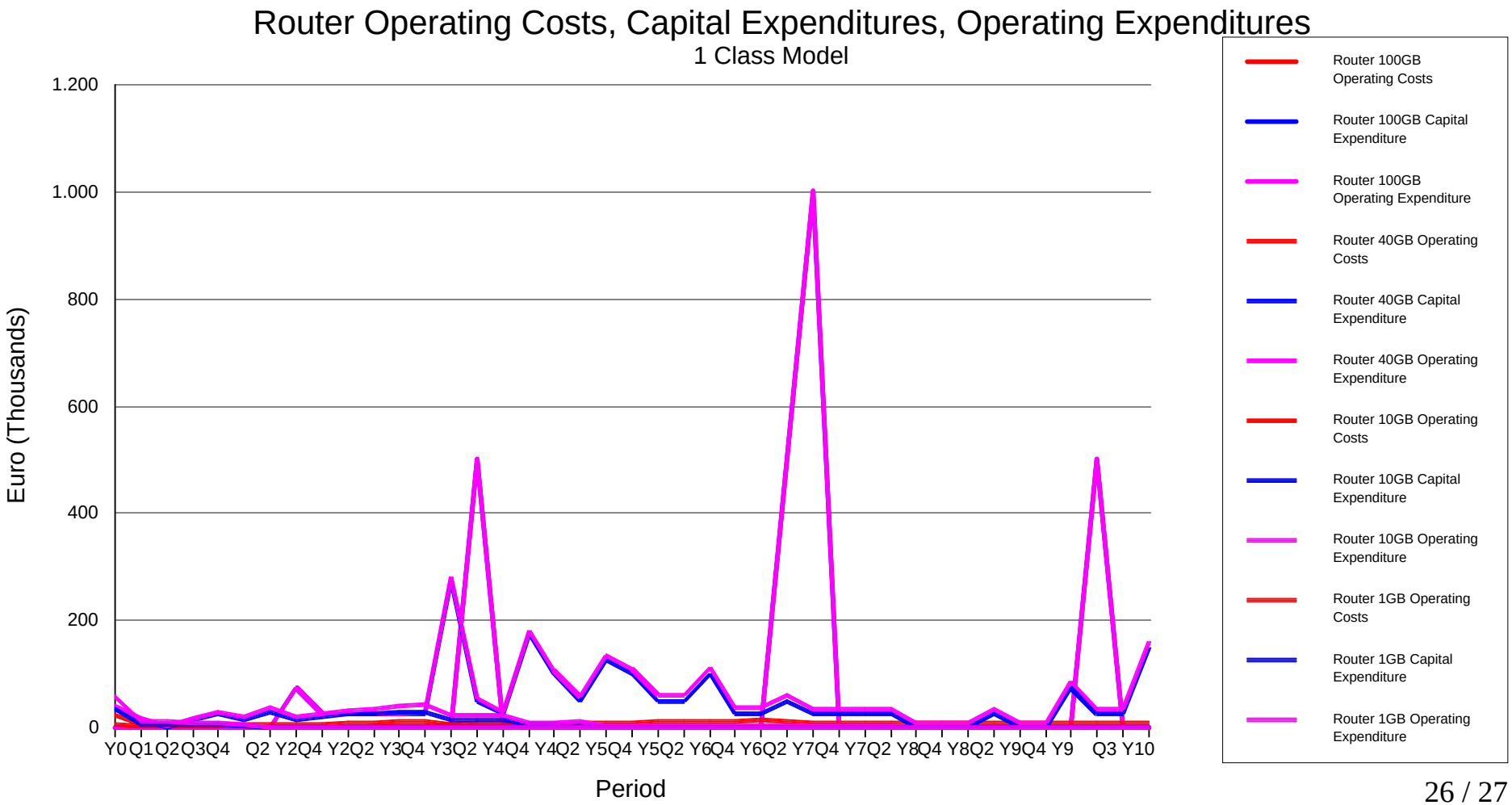

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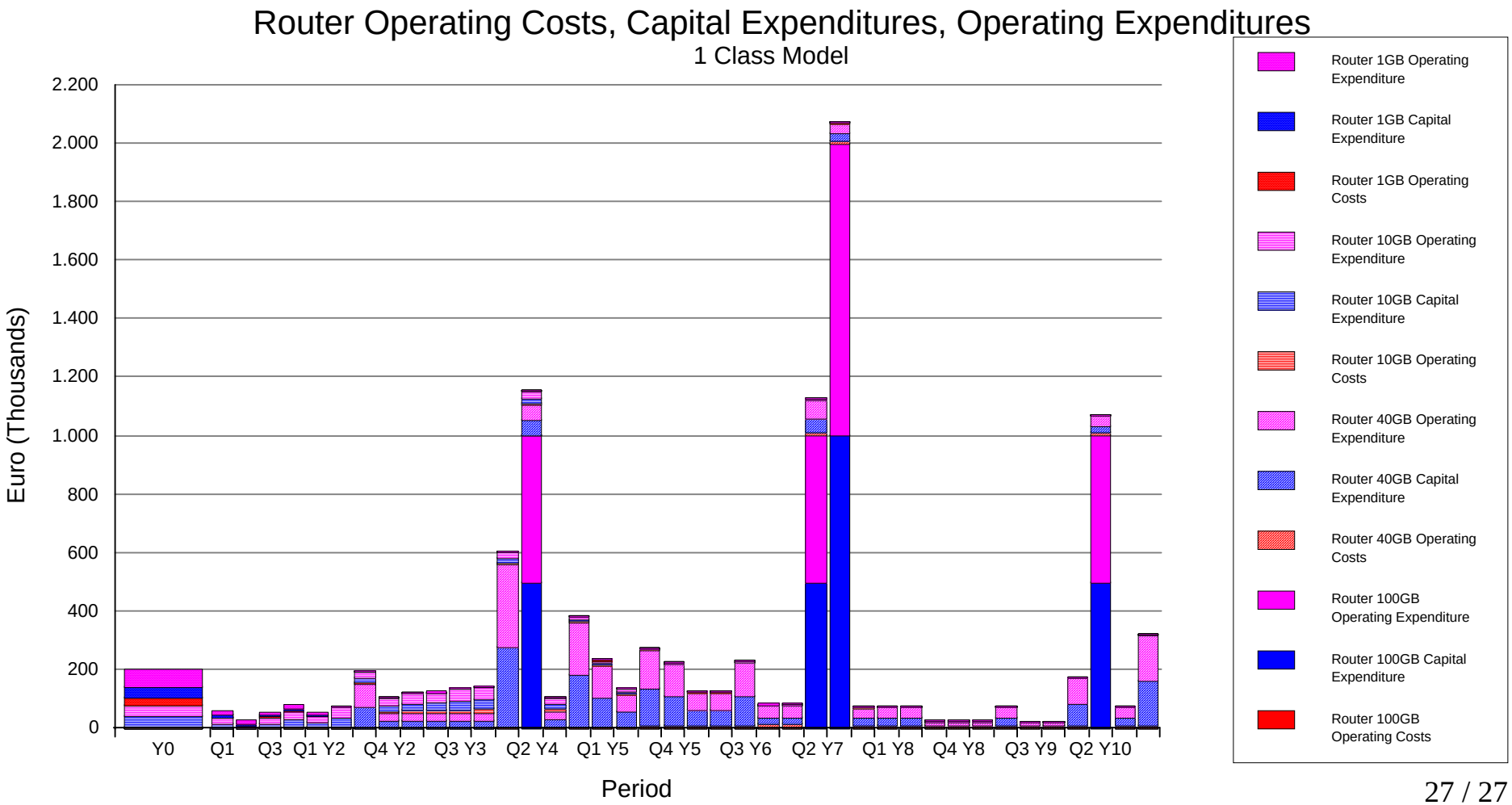

Survey

- Is this **model** approach **acceptable?**
- **What is missing** in terms of:
  * network **structure** (geographically and technically)
  * **market share assumptions** and development
  * **profile tailoring** and penetration
  * **technology base** installation and **transition plans**
  * **interconnection** modelling
- **Which reports and analysis statements are of interest?**
- Further hints and criticism

Feel free to send questions, simulation ideas or hints for improvement to knoll@etit.tu-chemnitz.de .

Thank you