A Deep Learning Approach to Maximising the Utility of 5G Backhaul Networks

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5G Networks
• Ramified use cases and distinct performance requirements
• Network virtualisation and densification
• Millimetre-wave (mm-wave) technologies
  • Multi-Gbps link rates -> Tangible backhauling solution

Utility Framework
• Application scenarios -> utility functions
• Combing all known types of utility functions

Finding the Optimal Rate Allocation
• High-dimensional highly non-convex problem
• Global search can be time consuming
• Heuristic method can solve but sub-optimal

The Deep Learning Approach
• Supervised learning with convolutional neural network (CNN)
  • 10 stacks of convolutional layers + batch normalisation + SeLU
  • Input: Flow demands \(d_{ij}\) and minimum service rates \(\delta_{ij}\)
  • Output: Predicted flow rate \(r_{ij}\)

Numerical Analysis
• 10,000 data points \(\{d_{ij}, \delta_{ij}, r_{ij}\}\)
  • Optimal solutions obtained from Global Search (GS)*
  • Benchmark: Light-weight greedy solution

Performance
• Total network utility distributions over 2k instances

Per type utility allocation in a single instance
• CNN: close to optimal in terms of median, quartiles, etc.
  • Achieves up to 62% total utility gain over greedy

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