From Conventional Networks to NFV/SDN Enabled Ones

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27.FFV – Workshop, Bremen

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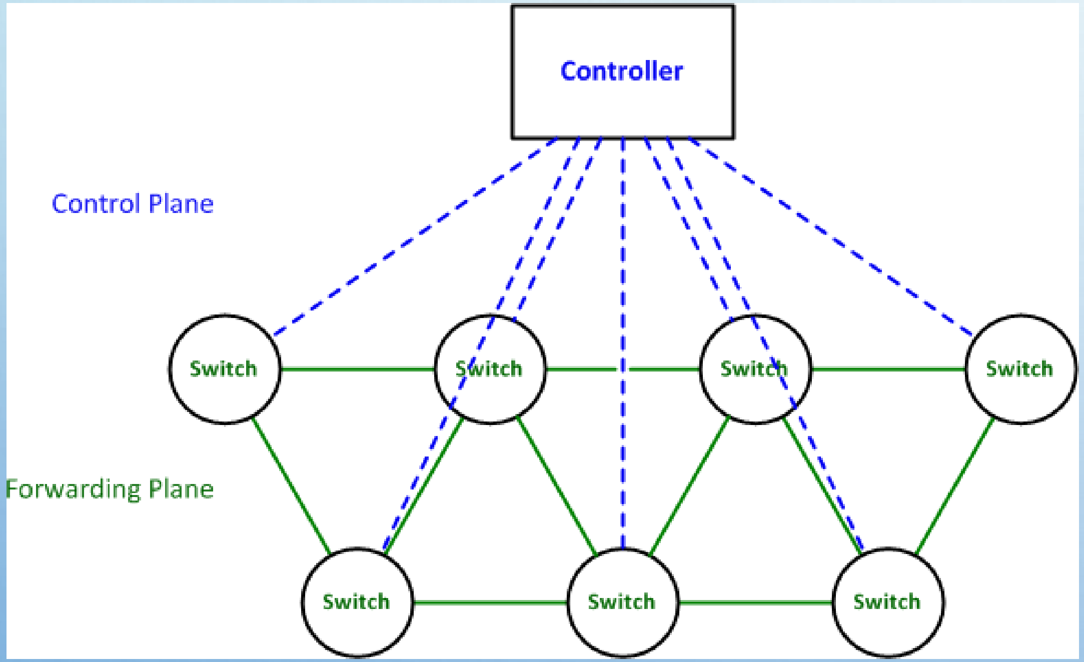
Software Defined Networking (SDN)



- *Decoupling of the control plane from the forwarding plane*
- *Offloading its functions to a centralized controller*
- *Centralized software-based controller*
- *Instructing subordinate hardware nodes on how to forward traffic*

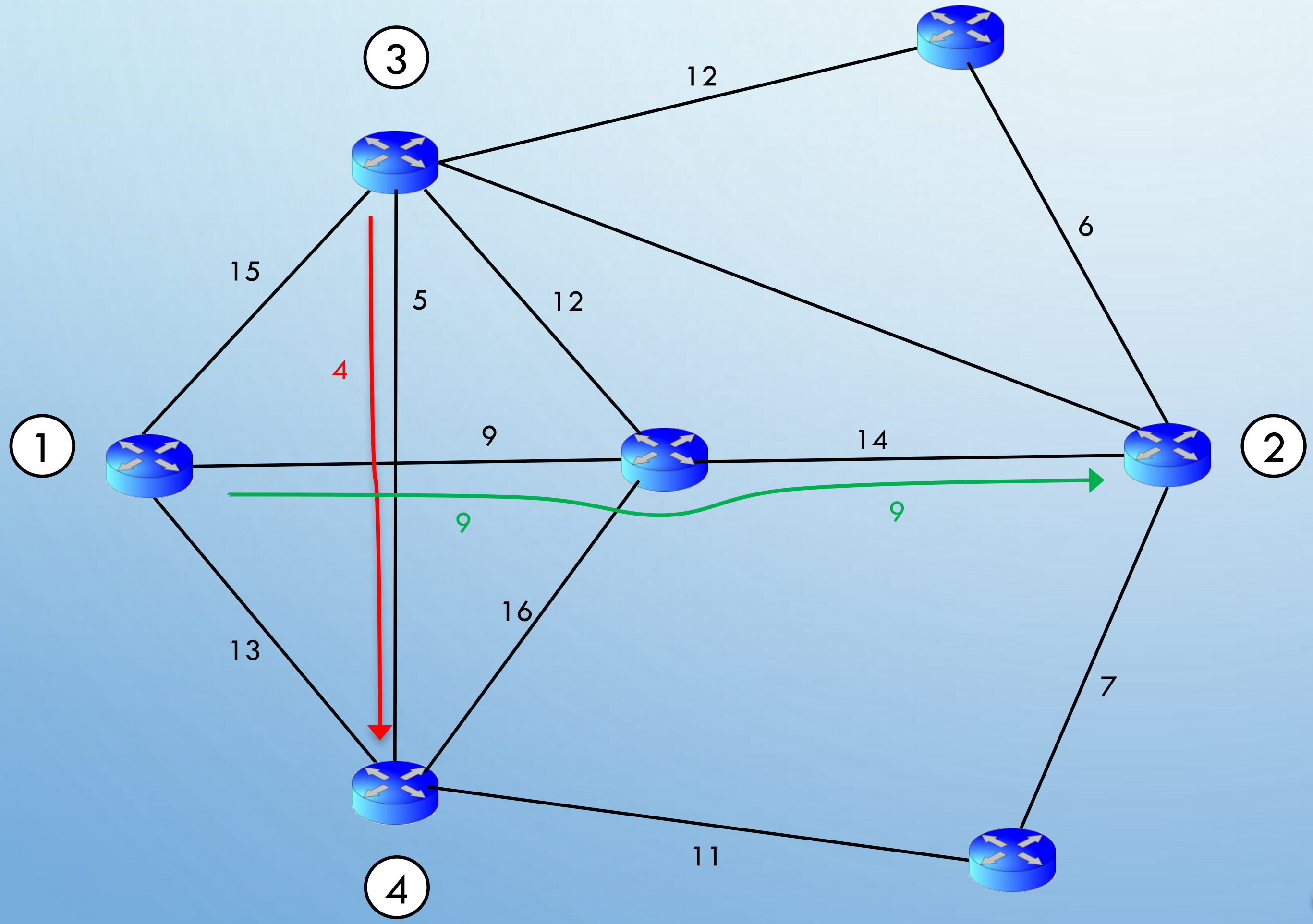
Challenges?

- *Migration costs from conventional nodes to SDN nodes*
- *Time depending traffic demands*

Problem:

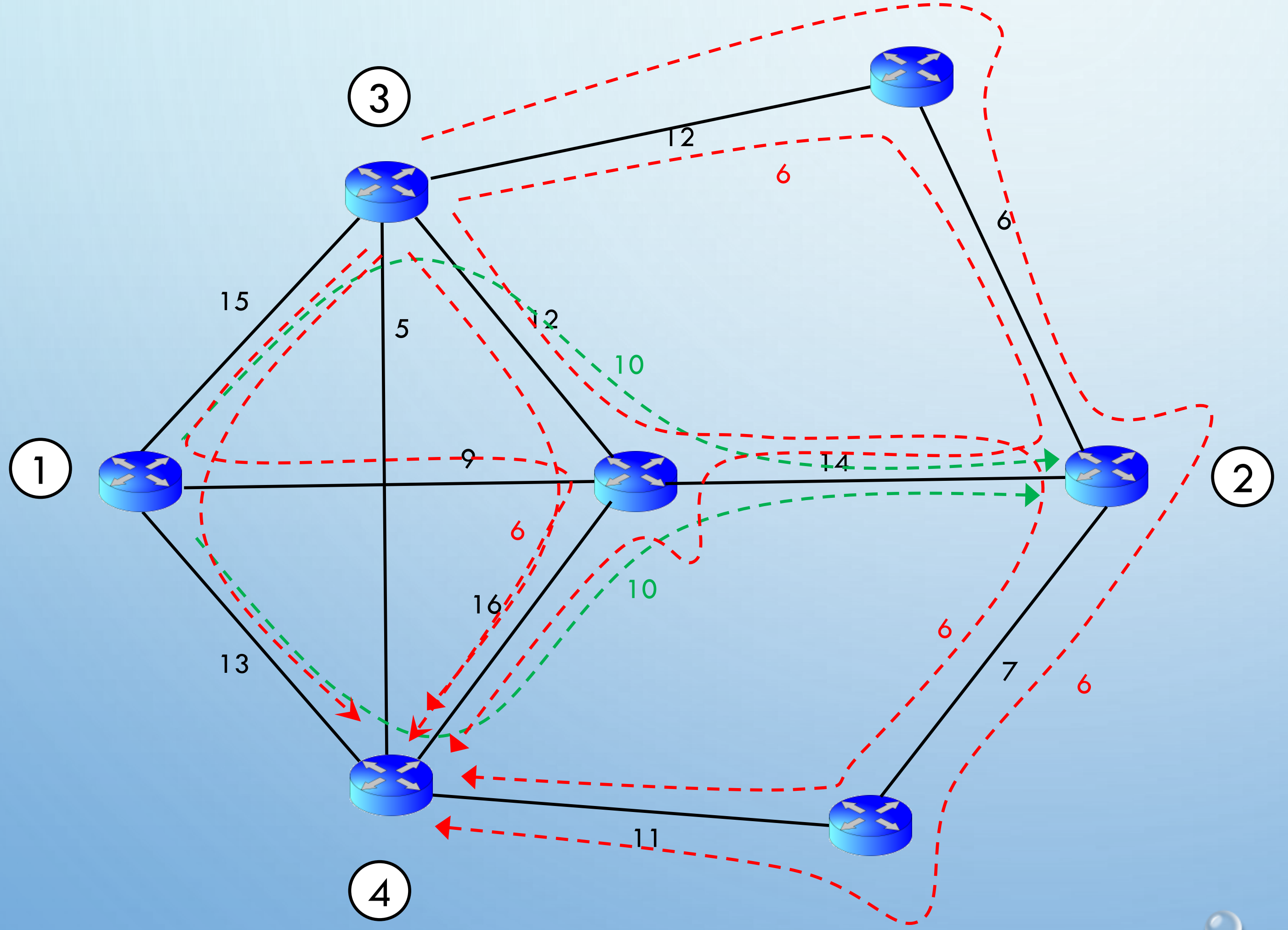
- ***Consider a network topology with a first routing scheme.***
- ***The demand matrix changes, and some demands cannot be satisfied with the previous scheme.***
- ***It's desired to find the minimum number of SDN nodes, such that all the traffic demands are satisfied.***

A simple example



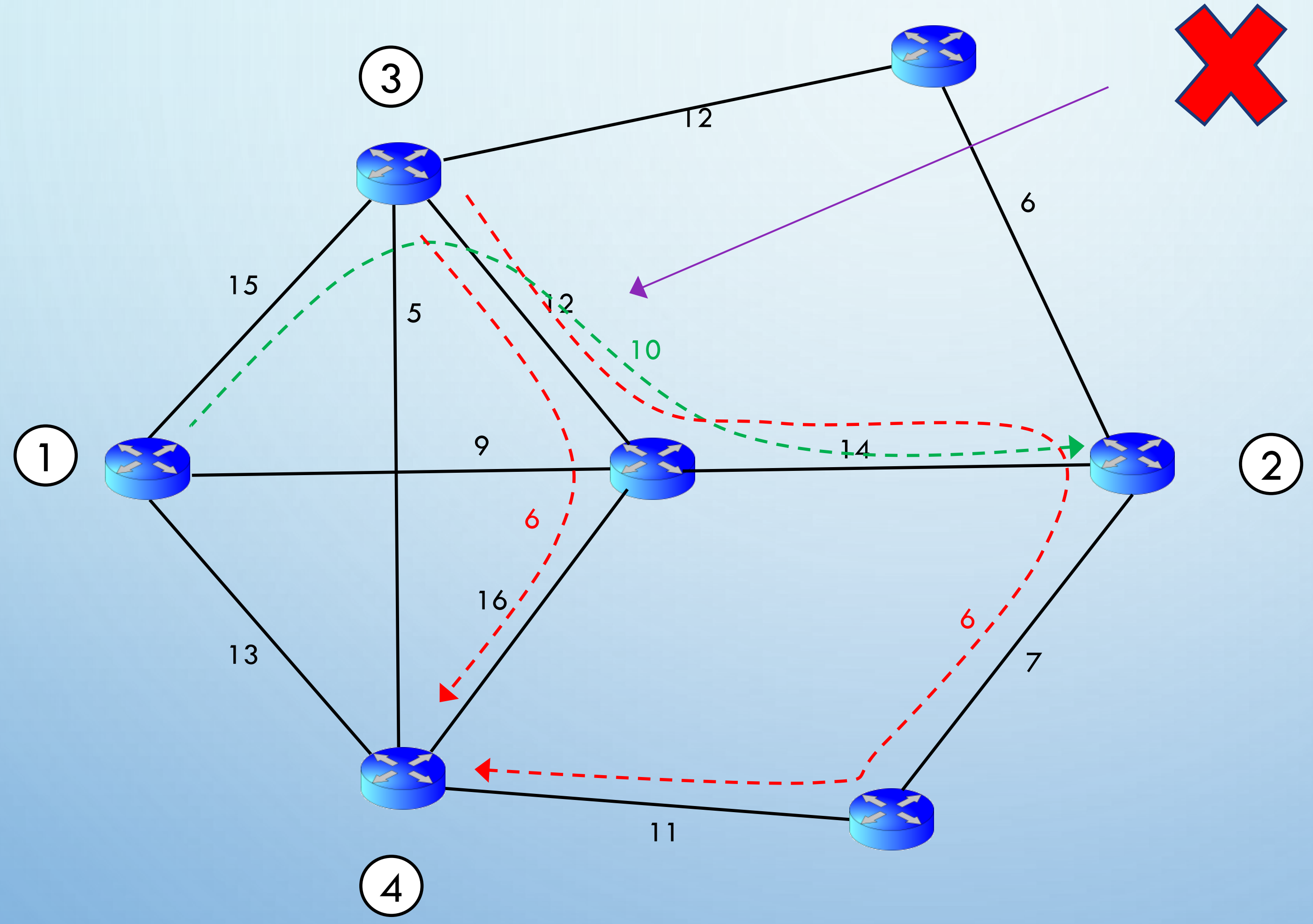
$$D(0) = \begin{array}{c} \\ \textcircled{1} \\ \\ \textcircled{3} \\ \\ \\ \end{array} \begin{array}{c} \begin{array}{cccccc} & \textcircled{2} & & \textcircled{4} & & \end{array} \\ \begin{bmatrix} 0 & 9 & 0 & 0 & & \\ 0 & 0 & 0 & 0 & & \\ 0 & 0 & 0 & 4 & \cdots & \\ 0 & 0 & 0 & 0 & & \\ & \vdots & & & \ddots & \end{bmatrix}_{7\text{x}7} \end{array}$$

initial routing scheme



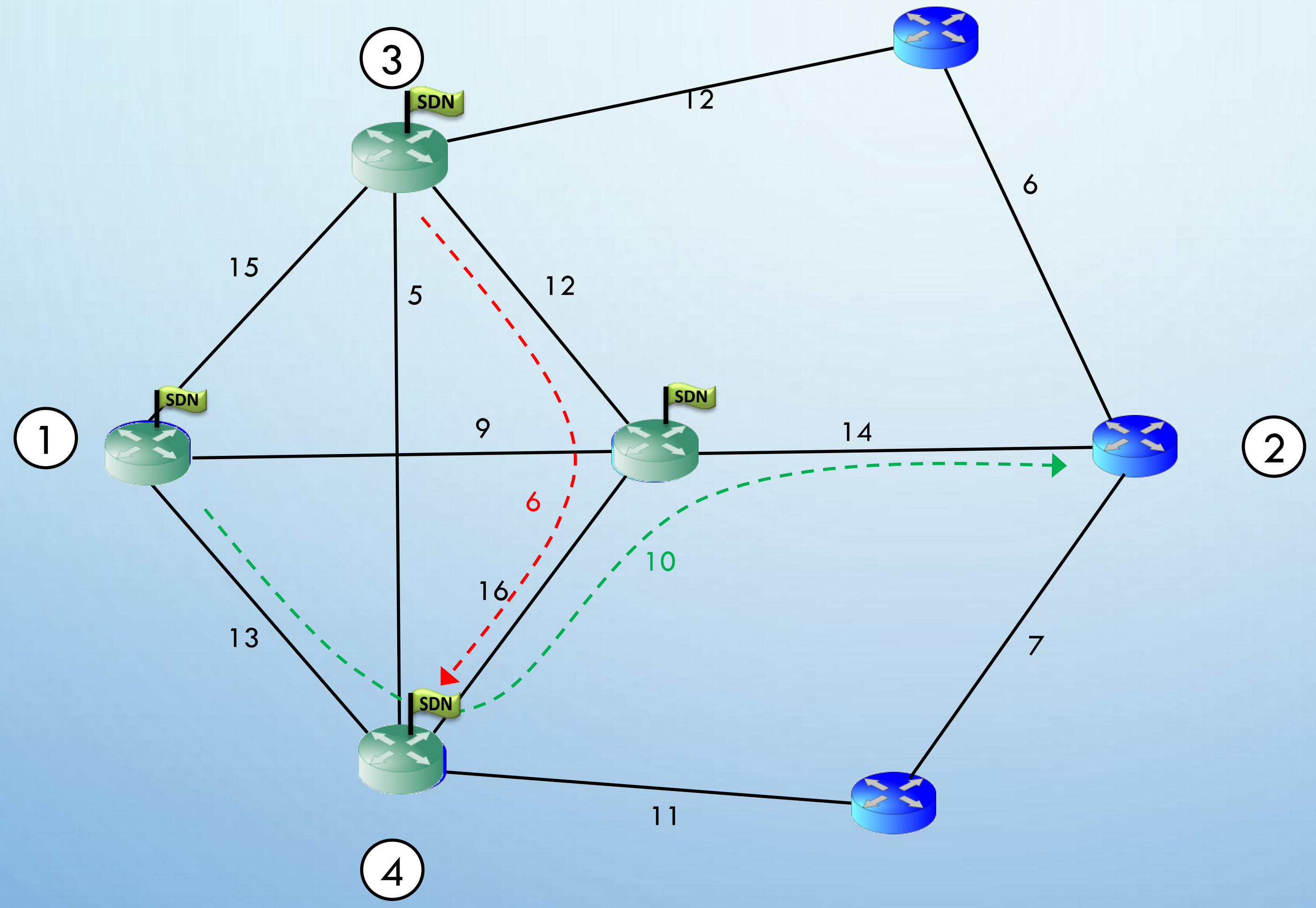
Pay attention to the changes

$$D(1) = \begin{bmatrix} 0 & 10 & 0 & 0 & \\ 0 & 0 & 0 & 0 & \\ 0 & 0 & 0 & 6 & \cdots \\ 0 & 0 & 0 & 0 & \\ & \vdots & & & \ddots \end{bmatrix}_{7x7}$$



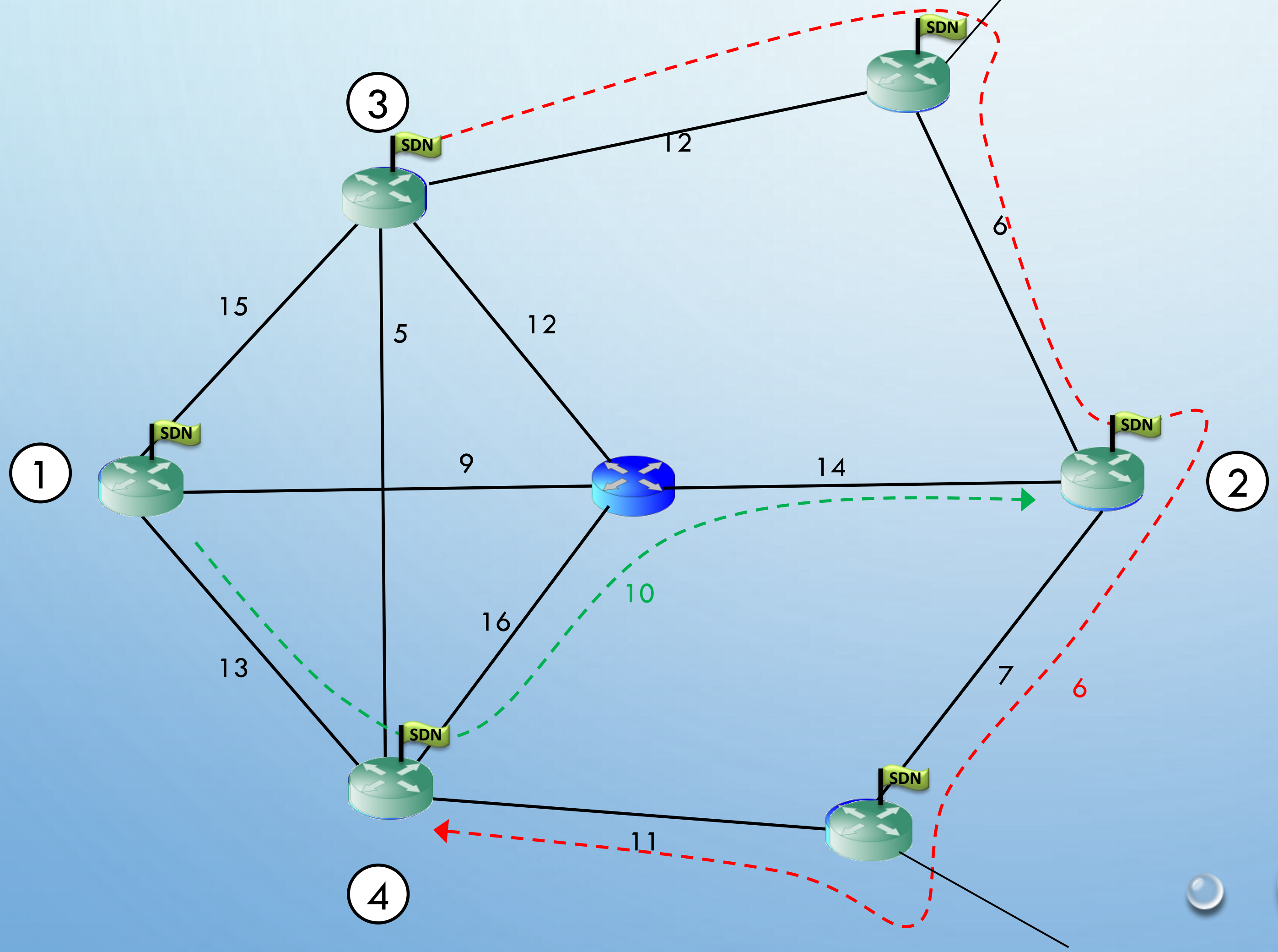
$$6 + 10 > 12$$

$$D(1) = \begin{bmatrix} 0 & 10 & 0 & 0 & \\ 0 & 0 & 0 & 0 & \\ 0 & 0 & 0 & 6 & \cdots \\ 0 & 0 & 0 & 0 & \\ & \vdots & & & \ddots \end{bmatrix}_{7x7}$$



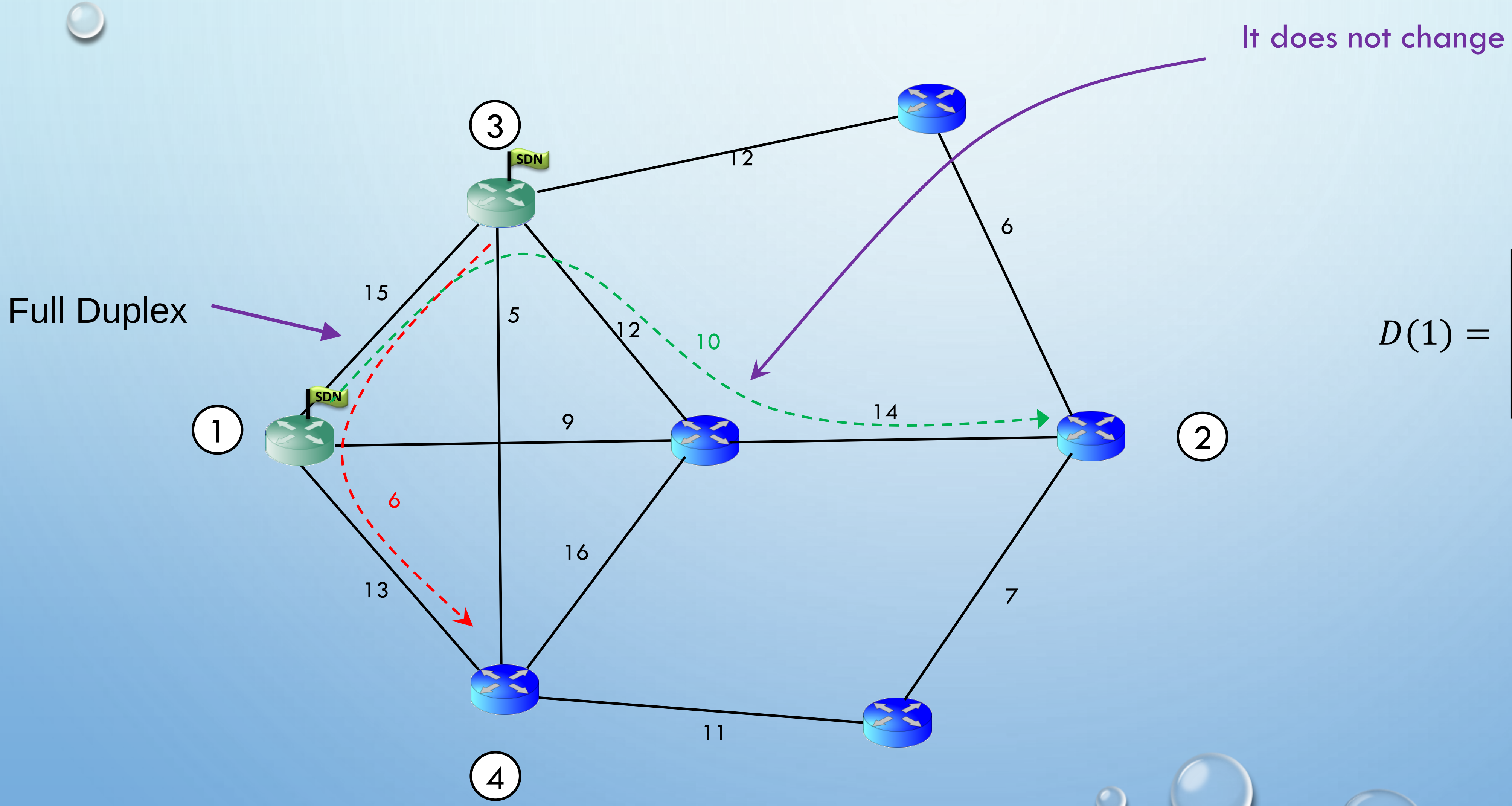
$$D(1) = \begin{bmatrix} 0 & 10 & 0 & 0 & \\ 0 & 0 & 0 & 0 & \\ 0 & 0 & 0 & 6 & \cdots \\ 0 & 0 & 0 & 0 & \\ & \vdots & & & \ddots \end{bmatrix}_{7x7}$$

A bad solution



$$D(1) = \begin{bmatrix} 0 & 10 & 0 & 0 & \\ 0 & 0 & 0 & 0 & \\ 0 & 0 & 0 & 6 & \cdots \\ 0 & 0 & 0 & 0 & \\ & \vdots & & & \ddots \end{bmatrix}_{7x7}$$

The optimal solution



$$D(1) = \begin{bmatrix} 0 & 10 & 0 & 0 & \\ 0 & 0 & 0 & 0 & \\ 0 & 0 & 0 & 6 & \cdots \\ 0 & 0 & 0 & 0 & \\ & \vdots & & & \ddots \end{bmatrix}_{7x7}$$

Next Steps

- Formulating and solving as an Integer Linear Program (ILP)
- Energy saving through shutting down unnecessary nodes and links for dynamic demand matrix
- Evolving Linear Programs, and developing heuristic algorithms
- Network Function Virtualization (NFV)
- Research project together with it vision
- 27 months
- BMWi ZIM funded