Network effects and Network goods

Please evaluate the utility of the following applications for yourself. How much would you miss these applications in case you would not be able to use them any longer.

Evaluate the utility assuming that a total of 50 people use the same application (they are all friends & family)

Now evaluate the utility if you were the only user of the application.

	Utility	Utility	Utility
eBay			
Adobe Acrobat			
Spotify			
Wikipedia			
Learning Campus TH RO			
Instagram / Snapchat etc.			

0 = No utility ↔ 10 = Very high utility

Network goods

Sometimes not the best product gains the highest market shares.
Sometimes products that are technically equal generate very different value for the user.
Sometimes volume is more important than quality.

=> Network effects change known market rules.

t3n News > Digitale Wirtschaft > Netzwerkeffekt erklärt: Warum es nur ein Facebook gibt

Kolumne

Netzwerkeffekt erklärt: Warum es nur ein Facebook gibt

(https://t3n.de/news/netzwerkeffekt-erklaert-728589/)

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Network goods are a special category of digital goods which include an interaction with users of the same or a compatible good.

A network good is a good (product or service) that has higher value the more customers use it.

Value of the good if noone else uses it

Value of a good =

Autarky value

\+

Synchronization value

Value of the good generated by the interaction with other users

„**Network effect**“:
If the synchronization value changes with the number of network participants.

Network effects

Value of a good	=	Autarky value / „Base value“
		+
		Synchronization value / „Derived value“

The **network effect factor** (Q) describes the proportion of the autarky value (a) and the synchronization value (s). A higher Q indicates a strong network effect:

$$Q = s/(s + a), \text{ with } 0 \leq Q \leq 1$$

$Q = 1$: „**Pure network good / System good**“: No autarky value

$0 < Q < 1$: „**Network good**“ : Autarky value and synchronization value

$Q = 0$: „**Singular product**“: No synchronization value = No network effects

Network effects

Many applications in the internet show network effects and therefore are considered network goods:

- Sharing networks for music or video files
- Instant Messaging Apps,
- Document exchange applications
- Electronic payment systems
- Digital market places
- Wikis,
- Social networks

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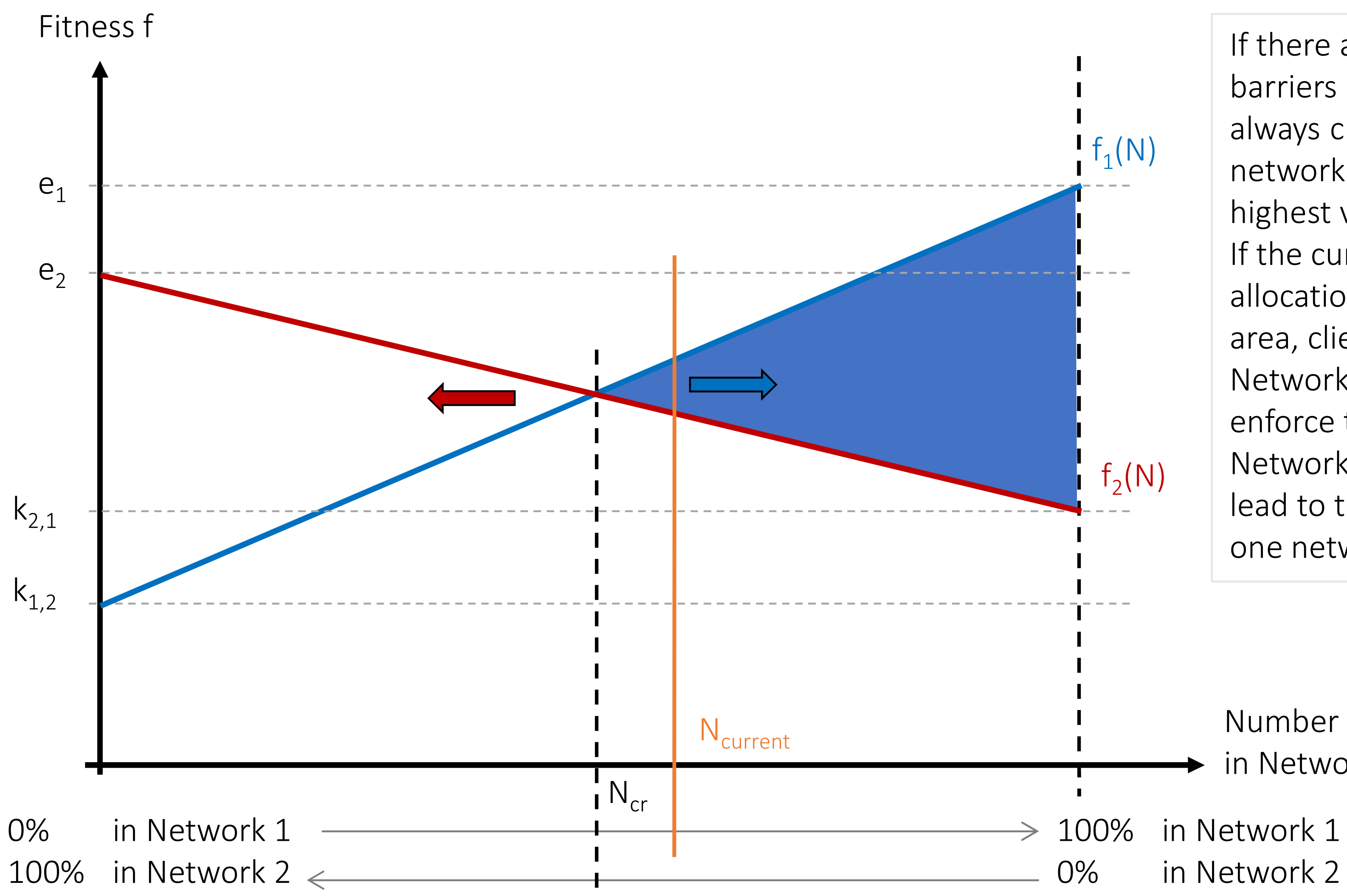
The market for network goods is very instable. Small changes to market allocation can cause a market dynamic that is very difficult to control, that is self-reinforcing and can lead to monopoly. This can be shown in a simple economic model:

Definitions and assumptions:

- On a market there are two competing goods (e.g. communication networks) 1 and 2.
- Users can communicate within the own network free of charges. An interaction within the own network creates a utility without extra costs. This utility is called Efficiency e of a network good. It is abbreviated as e_1 (for network 1) and e_2.
- Users of one network can also interact with users of the other network. However, there are costs incurred in that case, that reduce the utility for the user. The reduced utility of the network when interacting with users from other networks is called Compatibility value k bezeichnet. $k_{1,2}$ reflects the utility of an interaction from within network 1 into network 2, $k_{2,1}$ is the utility when interacting from within network 2 into network 1.
- Both networks show positive network effects: $e_1 > k_{1,2}$ and $e_2 > k_{2,1}$
- The interaction partners are random selected = There is no rational choice of specific interaction partners for individual interactions.
- The expected utility of a network for a user depends on his own network assignment as well as the market share of his network. This expected utlity depending on the market share of a network is called Fitness f.
- Users know the utility of the own and the other network.

Market mechanics for network goods



If there are no change barriers or costs, users will always change to the network that offers the highest value.
If the current market allocation is in the blue area, clients will move to Network 1. This will enforce the advantage of Network 1. This effect will lead to the monopoly of one network.

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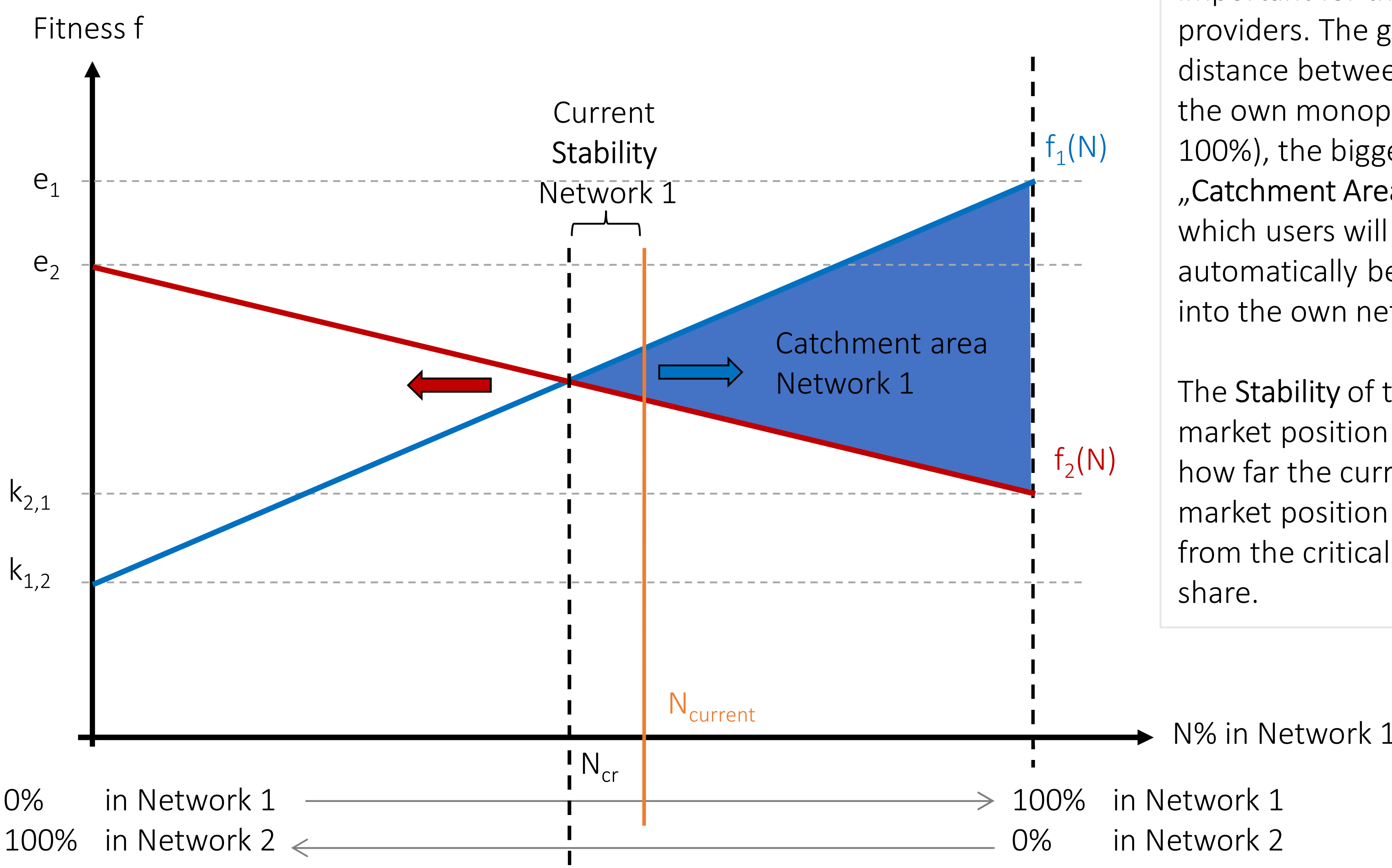
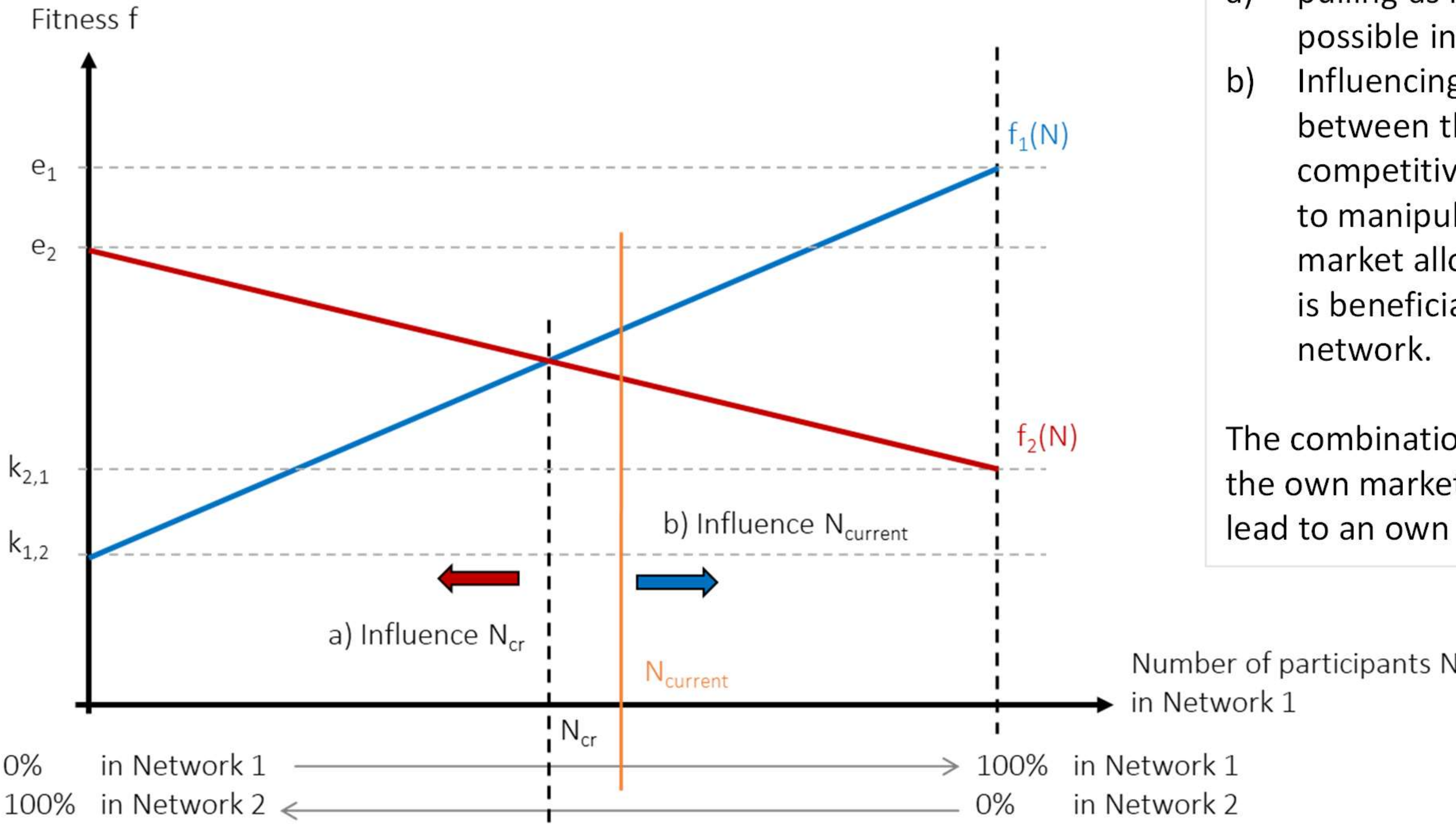


The position of N_{kr} is very important for the network providers. The greater the distance between N_{cr} and the own monopoly (N = 100%), the bigger the „**Catchment Area**“, in which users will automatically be changing into the own network.

The **Stability** of the own market position explains how far the current market position is away from the critical market share.

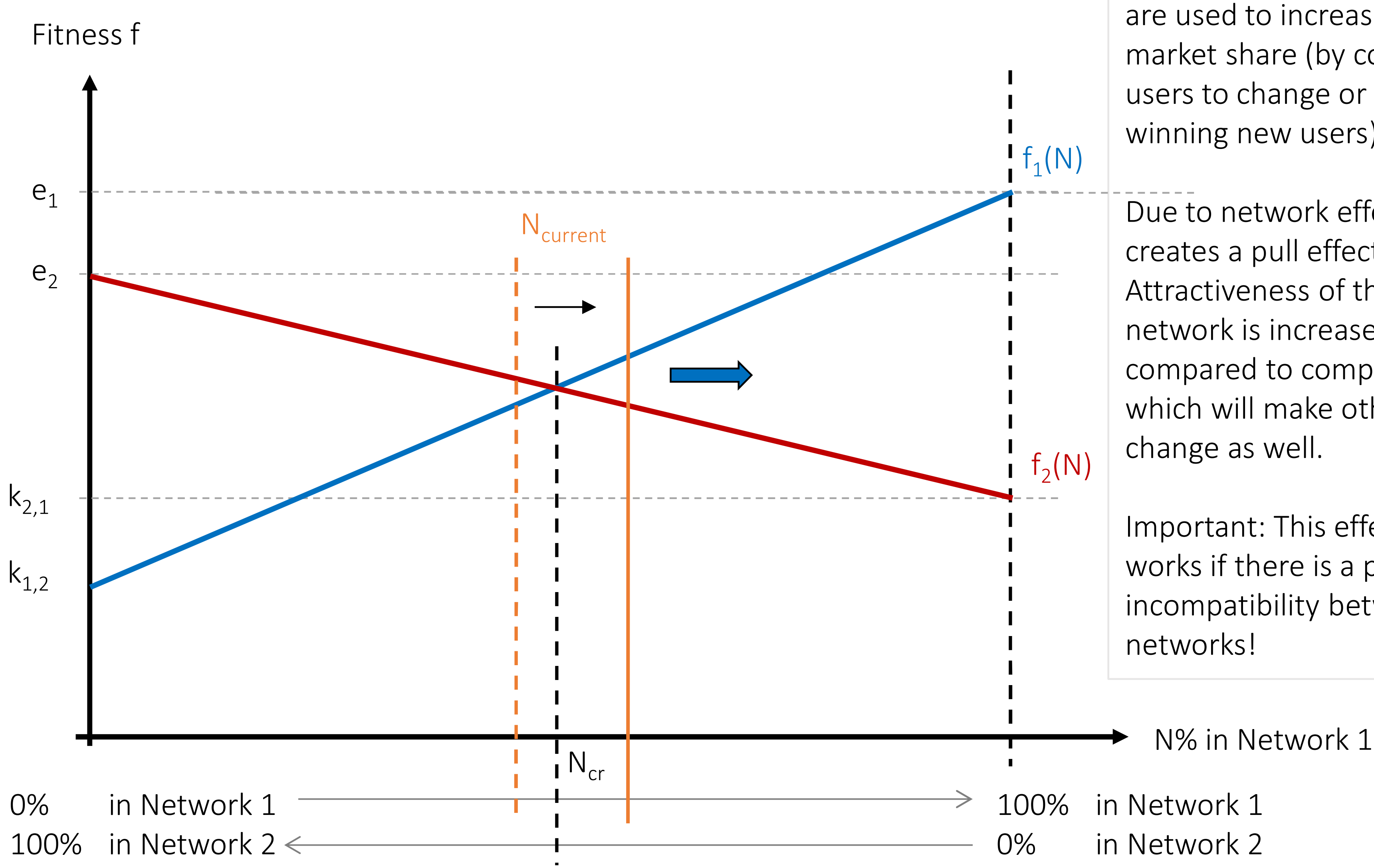
Network goods – competitive strategies



Competitive strategies can aim at …

a) pulling as many users as possible into the own network
b) Influencing the relation between the own and the competitive network in a way to manipulate the critical market allocation in a way that is beneficial for the own network.

The combination of both improves the own market stability and can lead to an own monopoly position.

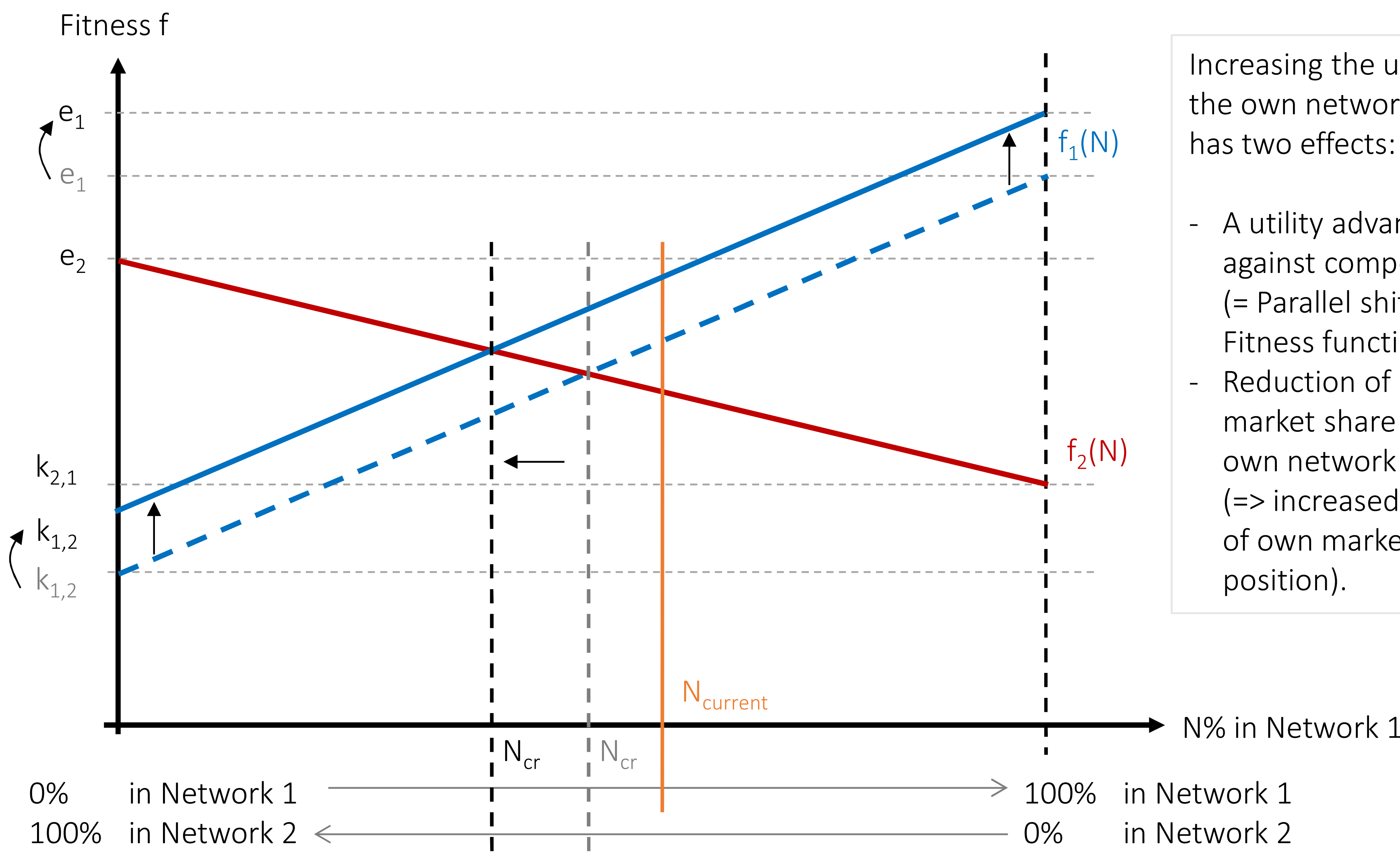


Sales&Marketing activities are used to increase own market share (by convincing users to change or by winning new users).

Due to network effects this creates a pull effect. Attractiveness of the own network is increased compared to competition, which will make other users change as well.

Important: This effect only works if there is a partial incompatibility between networks!

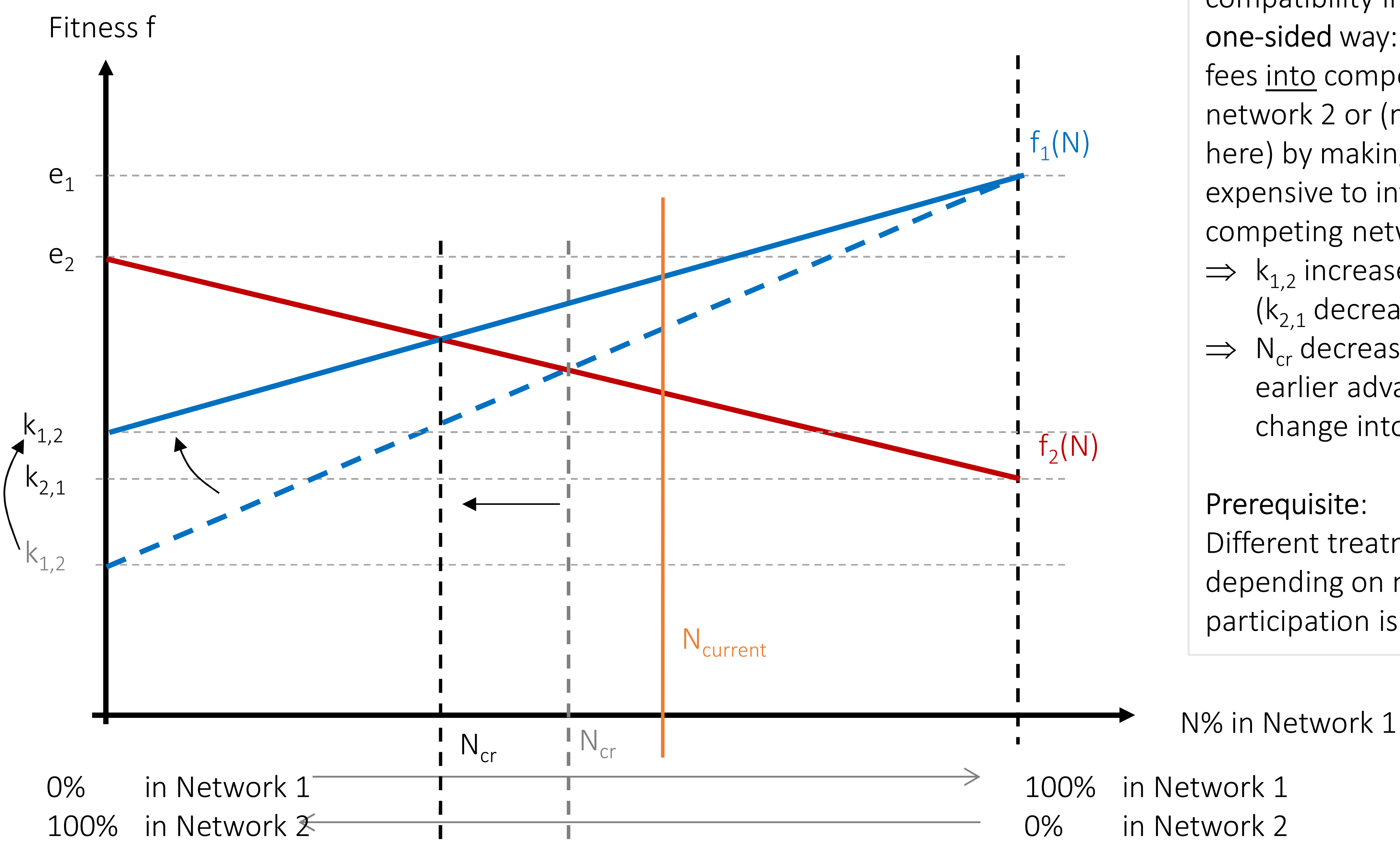
Network goods – Effect of product improvements



Increasing the utility of the own network good has two effects:

- A utility advantage against competition (= Parallel shift of Fitness function)
- Reduction of critical market share for the own network (=> increased stability of own market position).

Network goods – one-sided compatibility improvement



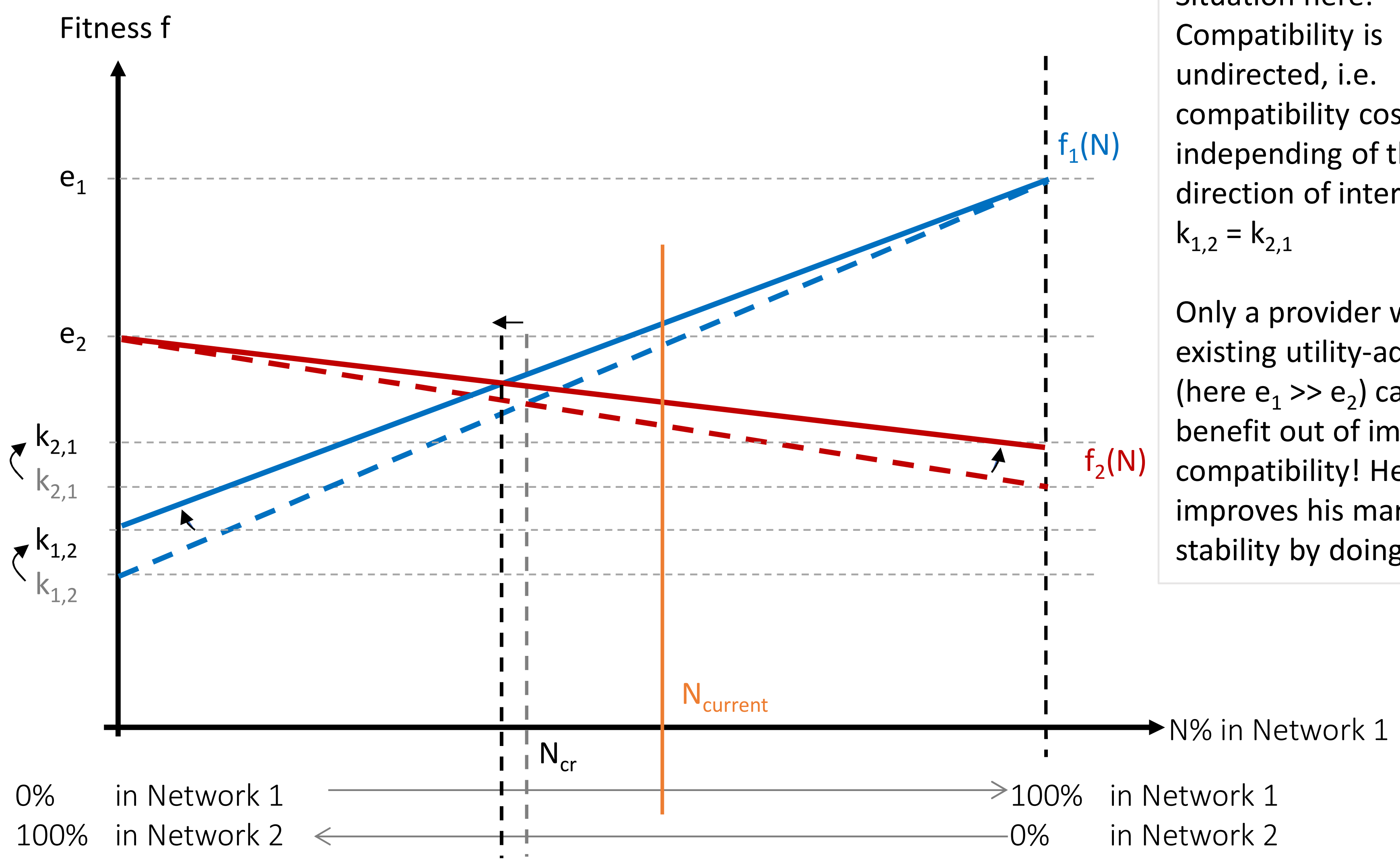
Provider 1 change compatibility in a **direted one-sided** way: by reducing fees <u>into</u> competing network 2 or (not shown here) by making it more expensive to interact <u>out of</u> competing network 2.

$\Rightarrow$ $k_{1,2}$ increases ($k_{2,1}$ decreases)

$\Rightarrow$ N_{cr} decreases, i.e. it is earlier advantageous to change into network 1

Prerequisite:
Different treatment depending on network participation is possible.

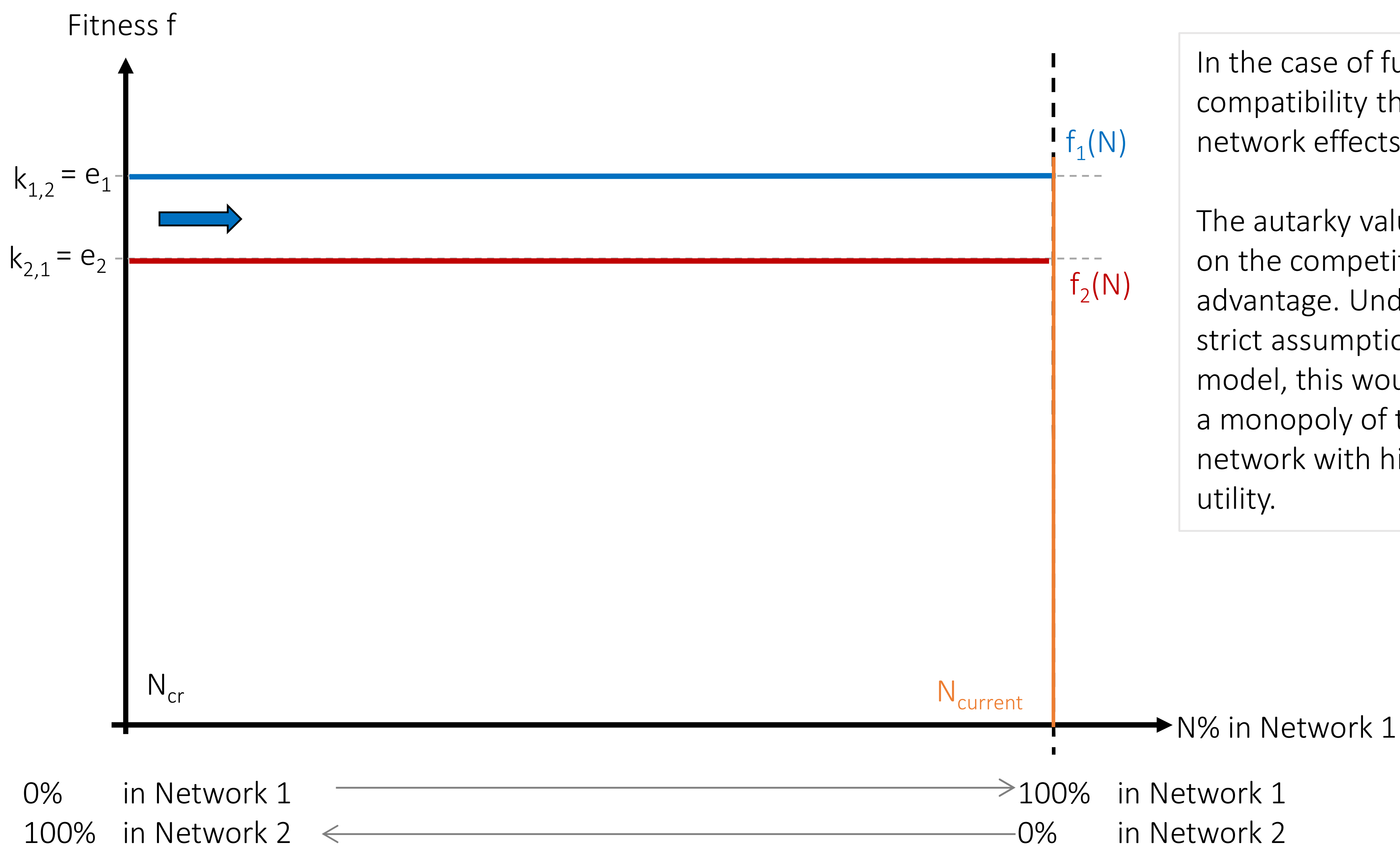
Undirected compatibility improvement



Situation here: Compatibility is undirected, i.e. compatibility costs are independing of the direction of interaction: $k_{1,2} = k_{2,1}$

Only a provider with a big existing utility-advantage (here $e_1 >> e_2$) can take a benefit out of improving compatibility! He improves his market stability by doing so.

Full compatibility



In the case of full compatibility there are no network effects anymore.

The autarky value decides on the competitive advantage. Under the strict assumptions of this model, this would lead to a monopoly of the network with higher utility.

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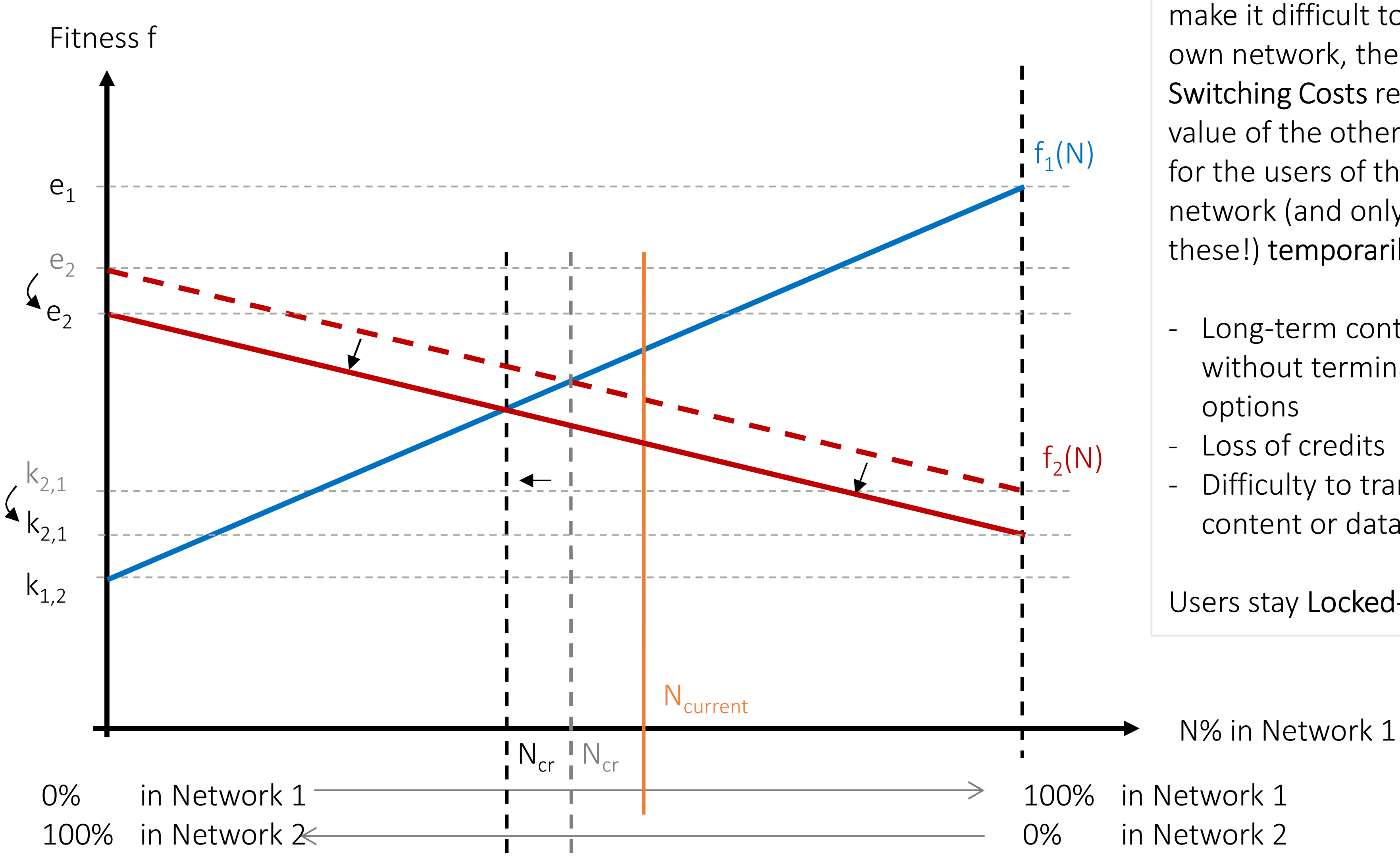
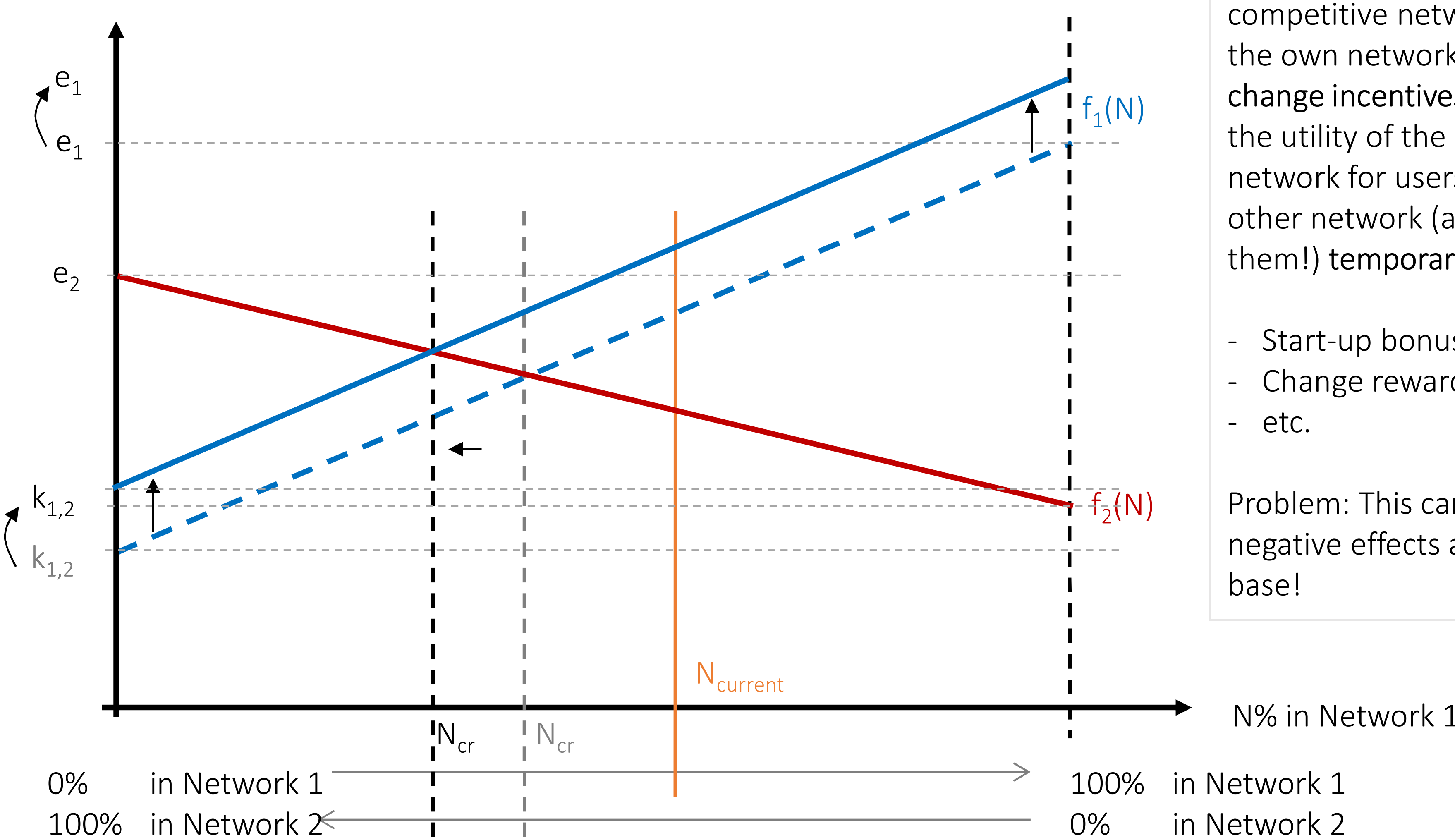


If one provider manages to make it difficult to leave the own network, these **Switching Costs** reduce the value of the other network for the users of the own network (and only for these!) **temporarily.**

- Long-term contracts without termination options
- Loss of credits
- Difficulty to transfer content or data …

Users stay **Locked-In**

Change incentives

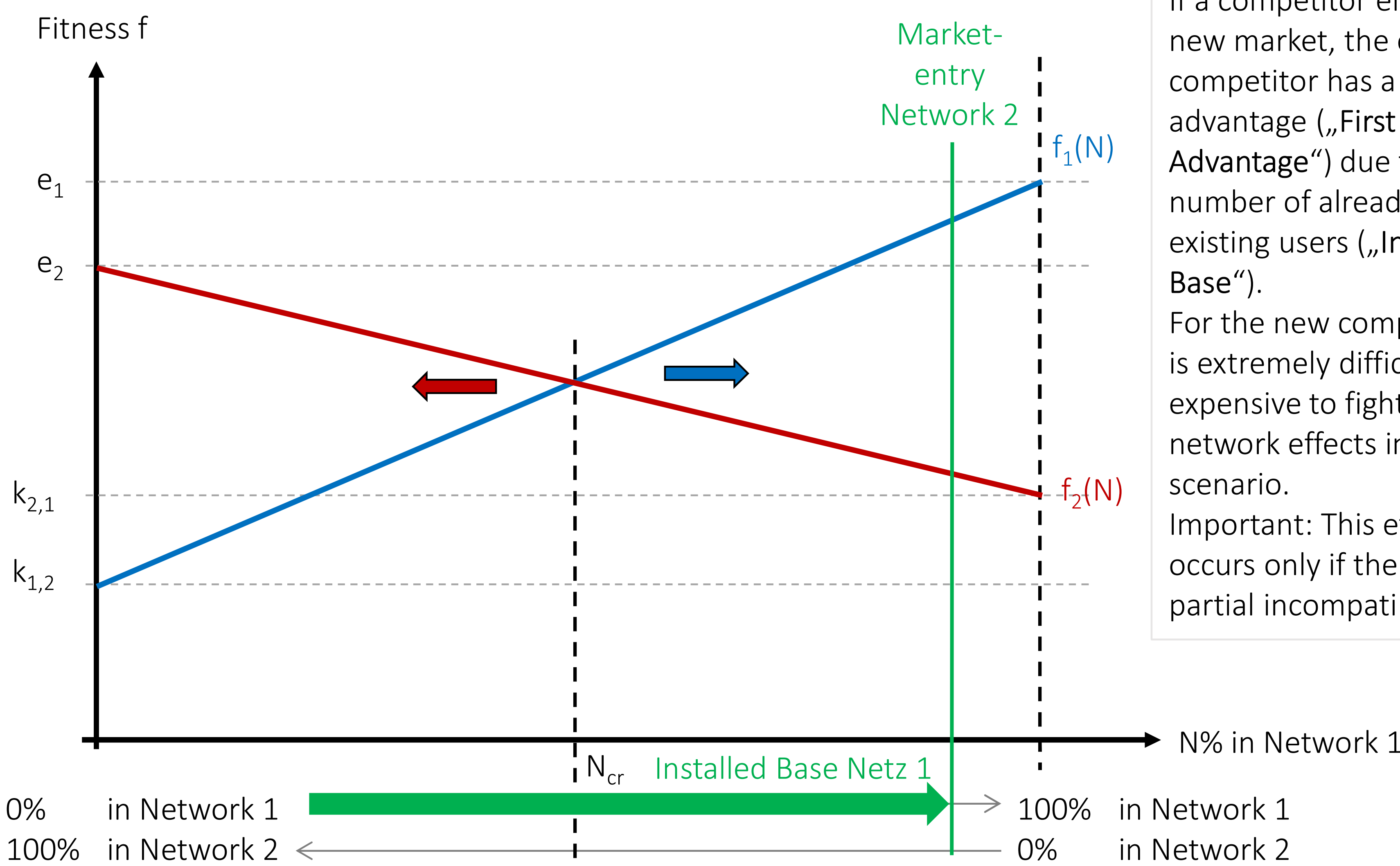


If one provider incentivizes the change from the competitive network into the own network, these **change incentives** increase the utility of the own network for users of the other network (and only for them!) **temporarily:**

- Start-up bonus
- Change rewards
- etc.

Problem: This can have negative effects at own user base!

Installed Based und First Mover Advantage



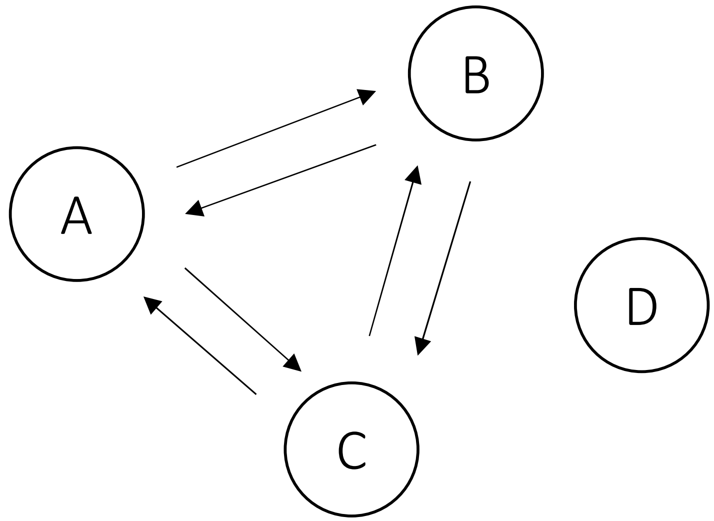
If a competitor enters a new market, the existing competitor has a big advantage („First Mover Advantage“) due to the number of already existing users („Installed Base“).
For the new competitor it is extremely difficult and expensive to fight against network effects in such a scenario.
Important: This effect occurs only if there is partial incompatibility!

Direct network effects and value of networks

A network effect is a special form of an external effect. In economic theory, an external effect is a side-effect in the sense that an economic activity of one participant causes a postive or negative consequence for other participants.

In a network good, the extension of a network to new users will have side-effects to existing users. Example:

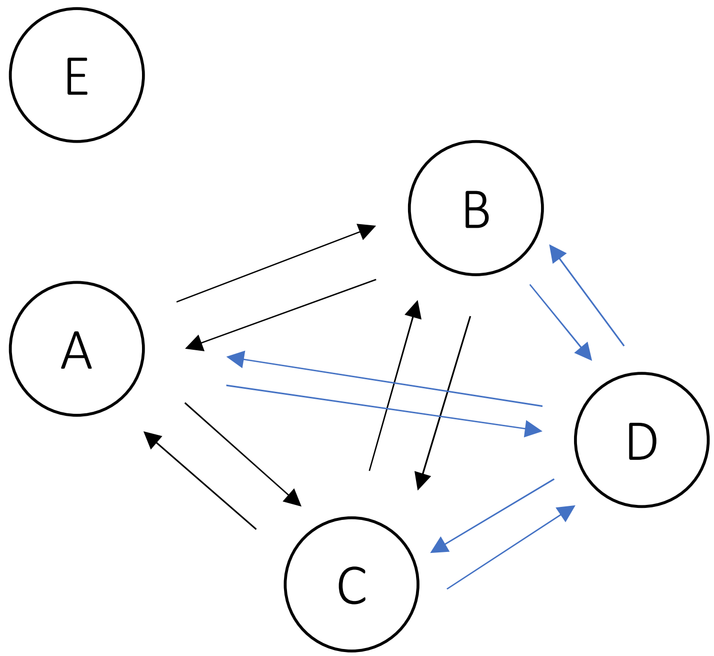
A network with three participants offers a total of 6 interactions.
How many interactions are possible if another person joins the network?



Direct network effects and value of networks

A network with three participants offers a total of 6 interactions.
A network with four participants offers a total of 12 interactions.

What happens if another person joins?



Direct network effects and value of networks

A network with three participants offers a total of 6 interactions.
A network with four participants offers a total of 12 interactions.
A network with five participants offers a total of 20 interactions.

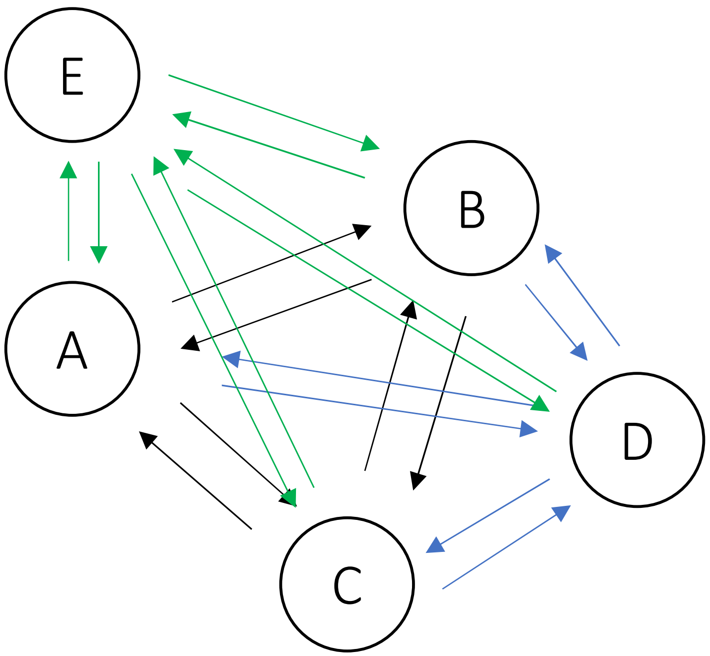
Interactions/edges in a network = $n\,(n-1)$

If all interactions are undirected: $\frac{n\,(n-1)}{2}$

In large networks, the number of edges becomes proportionate to n^2

If the value of a network U is defined by the interactions it offers, we can say:

Metcalfe's law:
The value of a telecommunications network is proportional to the square of the number of connected users of the system:
$U = A \cdot n^2$



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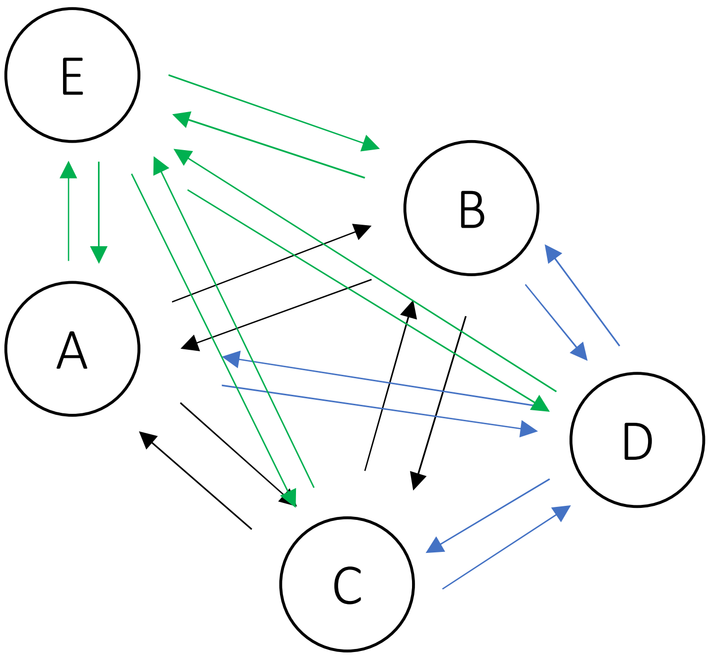
Metcalfe's law:
The value of a telecommunications network is proportional to the square of the number of connected users of the system (n^2).

The cost of a network is linear to the number of nodes: $C_{network} = c \cdot n$

Therefore, there is a break-even point of network participants in which the value of the network exceeds its costs.

Question:
Does a network value really grow like that??



Tab. 3.1 Metcalfes Gesetz

Users (n)	Value of the network: $U = n^2 - n$	Average value: $U/n = n - 1$
1	0	0
2	2	1
3	6	2
4	12	3
5	20	4
10	90	9
100	9900	99
1000	999.000	999

	One-to-Many network (Sarnoff's law)	Many-to-Many network (Metcalfe's law)	Many-to-Many network (Reed's law)
			
Users	How does the value of the network (U) develop depending on the number of particpants n?		
2			
4			
5			
10			
100			
1.000			
…			
Examples	Radio, TV	Phone, Fax, E-Mail	Social Networks

Other network laws

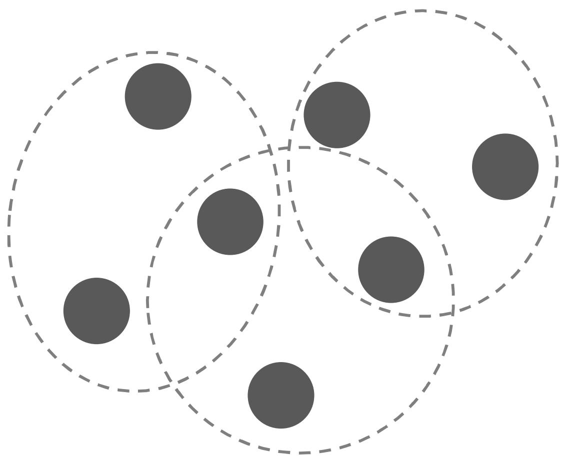
	One-to-Many network (Sarnoff's law)	Many-to-Many network (Metcalfe's law)	Many-to-Many network (Reed's law)
			
Users	$U = n$	$U = n\,(n-1)$	$U = 2^n - n - 1$
2	2	2	1
4	4	12	11
5	5	20	26
10	10	90	1.013
100	100	9.900	$1{,}2677 \cdot 10^{30}$
1.000	1.000	999.000	$1{,}072 \cdot 10^{301}$
...			
Examples	Radio, TV	Phone, Fax, E-Mail	Social Networks

Positive and negative external effects

External Effects

Positive

- Network effects
- Social interaction (shared experiences, reviews, tips)



Negative

- Virus / malware infections
- Communication effects (shitstorms, reputation damage)
- Data abuse (e.g. Identity theft)

Indirect network effects are caused when the value of a good is depending on the proliferation of <u>complementary</u> goods.

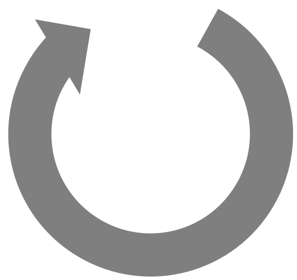
Example: DVD player / Media companies:

- ⇨ The growing number of DVD that were sold in the market had positive effects on media companies.
- ⇨ Media companies produced many DVDs to benefit from this technology
- ⇨ Due to the increasing number of movies that were available on DVD, the utility of DVD players for users increased as well.
- ⇨ DVD players spread even further…..

Indirect network effects

Indirect network effects are frequently triggered on the supply side (whereas direct network effects are typically demand-sided):

⇨ The more complementary products a basis product has, the more attractive it is for the consumers = the higher the demand.



⇨ A high demand for base products makes it attractive for providers to offer additional complementary products.

Network goods - summary

1. The utility a network good offers for an individual user is positively depending on the number of users of the network good.

2. Direct and indirect network effects can be distinguished. In addition to network effects also other positive and negative external effects can be seen in network goods.

3. The market of a network goods is very dynamic. It is crucial to know the critical market allocation and market stability. The current market allocation can cause a positive or negative self-enforcing effect that can work in favour or against a competitor.

4. Competitive strategies can aim at manipulating the market dynamics as well as in lock-in effects and switching costs / incentives.

5. The value of a network good can be explained with different laws, depending on the kind of network.