

S1: Appendix A - Indonesian Telecommunication Regulation and Government Action

First of all, to unlock/enable rural coverage, government action/initiative is necessary. It needs regulatory principles, spectrum policy, taxation policy, roll-out regulation at a local level, and infrastructure sharing [18]. There are fewer perceived risks for investments, like ensuring policies and rules align with the country's goals for connectivity and giving investors certainty about their past and future investments. But we also need to be aware that we can expect a higher return on our investments (RoI). We need to avoid spending money on deployment that isn't necessary, cut down on the amount of paperwork/administrative burden, as well as give the Mobile Network Operators (MNOs) and investors the freedom to use capital, technology, and spectrum in the best way possible. When risk and return on investment (ROI) are taken into account, MNOs will have more reasons to invest in telecom network infrastructure in order to improve network coverage.

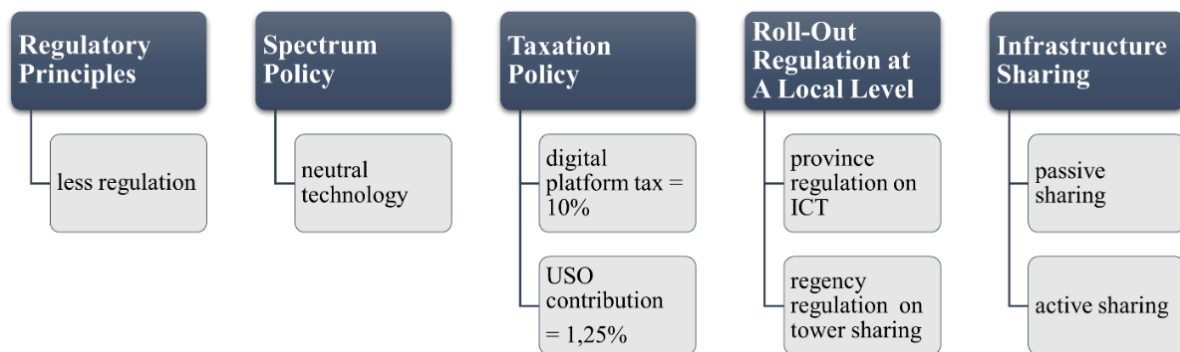


Figure S1. Existing Government Action in Indonesia

As indicated in Figure S1, the Ministry of Communication and Informatics in Indonesia adheres to fewer rules. Many items allow freedom or flexibility for the industry or business actors to accomplish achievements. Most of the government's preparations are focused on corridors. In a context defined by constant and rapid technological change, neutral technology [19-22] for wireless communications are utilized to make regulations future-proof. The government collects spectrum fees [23] as non-tax revenue (PNBP) but also implements a 10% (of gross revenue) trade tax through electronic systems [24] (e-commerce, over-the-top platforms (Netflix, etc.) and a 1.25% (of gross revenue) universal service obligation contribution that can be used to build telecommunications infrastructure [25]. There are regulations governing infrastructure and telecommunications at the local level (province [26] and regency [27]). Active (radio access network) and passive (non-radio element: tower, land, etc.) infrastructure sharing are then utilized to cut costs. Furthermore, Figure S2 illustrates how spectrum regulation is

modernized in reference to the Omnibus Law on Job Creation (Act No.11 Year 2020).

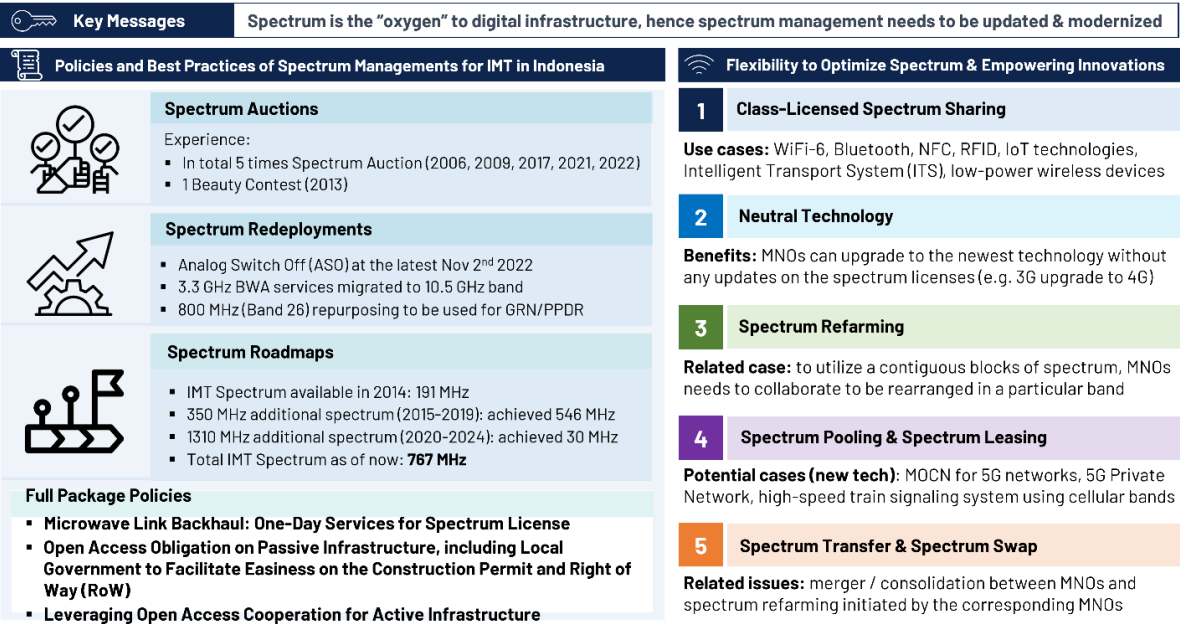


Figure S2. Modernizing Spectrum Regulation in Omnibus Law on Job Creation (Act No.11 Year 2020)

In 2021, there were approximately 345,3 million mobile phone subscribers (market penetration of 125,6%) [28], the majority of whom had multiple subscriptions. There were 202,6 million internet subscribers in the country, and 96.4% of them prefer to use mobile devices to access the internet. Six public service providers in Indonesia were deploying 2G, 3G, and 4G network infrastructure. Figure S3 depicts the percentage of Indonesian subscribers for each service provider [10, 17].

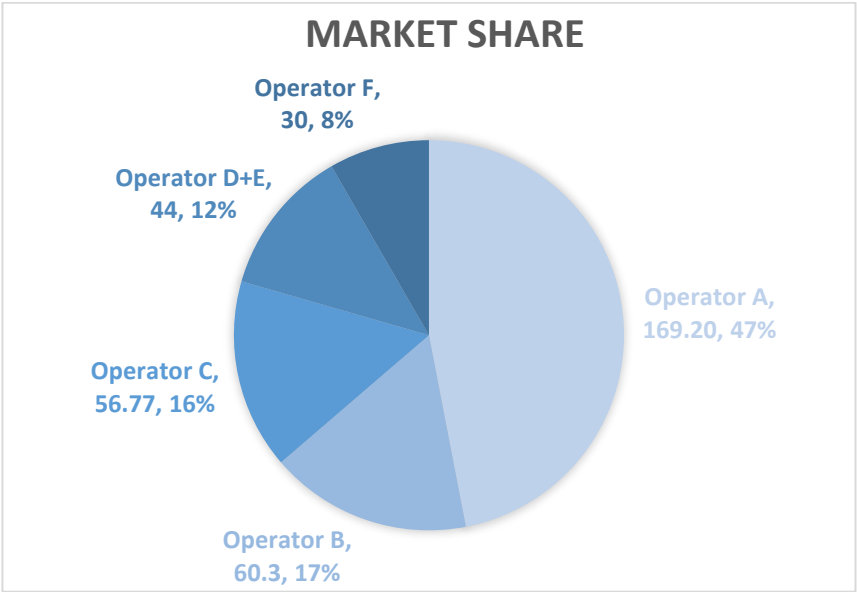


Figure S3. The Proportion of Indonesian Subscribers for Each Service Provider (in Millions), Redrawn from [28]

Moreover, in general, the business or private sector's policy is to seek maximum profit. However, when they use the Red Ocean strategy to compete on the same cake and content it results in a bloody combination of Free Cash Flow (FCF) and profitability (Return on Investment (ROI) and Net Profit Margin (NPM)) as shown in Figure S4 until S6. From the financial indicators, only one operator is in good health, the other operators experience difficulties in generating cash flow due to high costs, difficulty generating profits from their operations, not generating good returns on their investments, and inefficient use of capital.

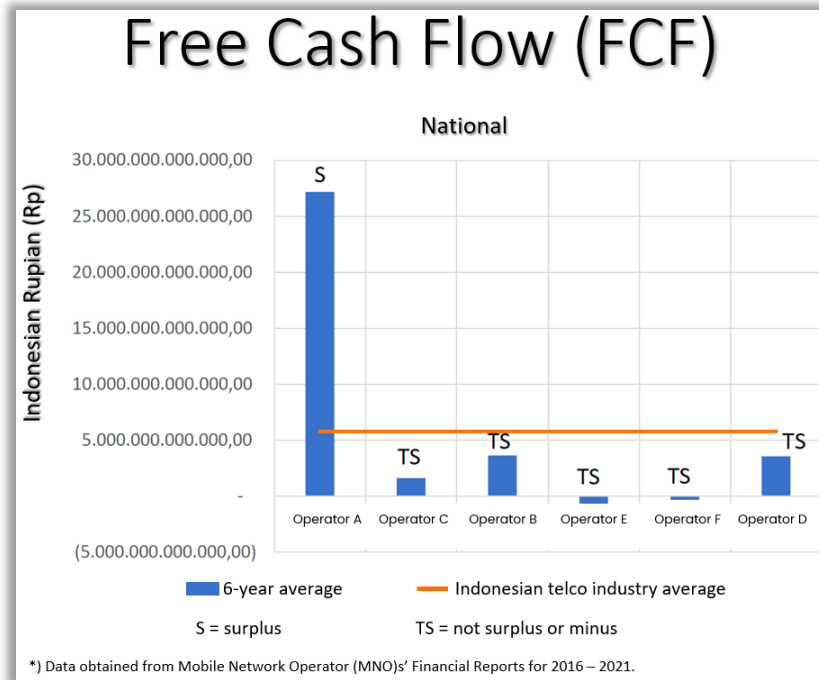


Figure S4. Indonesian MNOs Free Cash Flow (FCF)

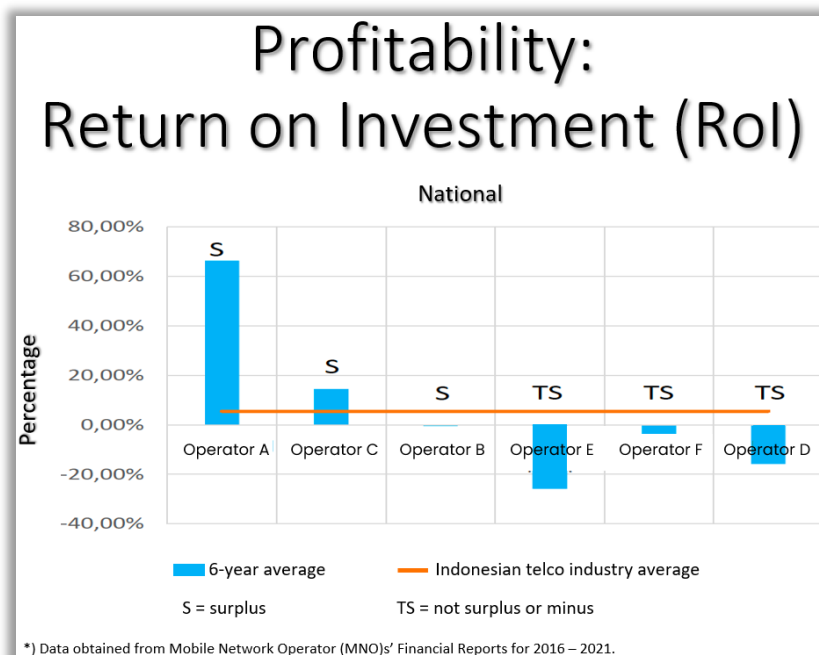


Figure S5. Indonesian MNOs Profitability of Return on Investment (RoI)

Profitability: Net Profit Margin (NPM)

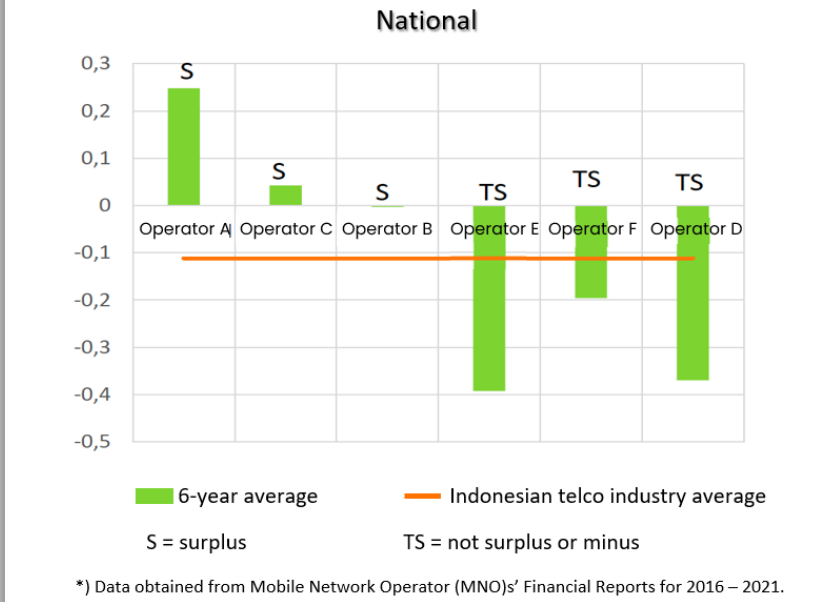


Figure S6. Indonesian MNOs Profitability of Net Profit Margin (NPM)

MNOs' income tends to be stagnant from year to year, but regulatory costs are increasing, as shown in Figure S7. Then, regulatory incentives are needed. Regulatory incentives are an effort to encourage operators to improve their performance.

MNOs	Revenue ¹⁾ 2021	Regulatory Cost 2021 ²⁾ (Billion Rp)				Regulatory Cost to Revenue Percentage 2021
	(Billion Rp)	BHP IPFR	BHP ISR	BHP Tel & USO ³⁾	Total	
Operator A	87.505,84	6.481,03	237,71	1.312,59	8.031,33	9,18%
Operator B	26.754,05	3.536,15	392,32	401,31	4.329,79	16,18%
Operator C	31.388,31	4.014,29	560,55	470,82	5.045,67	16,07%
Operator D	13.207,03	1.854,67	614,04	198,11	2.666,82	20,19%
Operator E	10.508,51	1.777,16	389,18	157,63	2.323,97	22,12%
Industry	169.363,73	17.663,30	2.193,81	2.540,46	22.397,56	13,22%

BHP = Spectrum Usage Fee, IPFR = Bandwidth License, ISR = Radio Station License, Tel & USO = Telecommunication and Universal Service Obligation

¹⁾ Data obtained from Mobile Network Operator (MNO)s' Financial Reports for 2017 – 2021.

²⁾ The data is processed from the Ministry of Communication and Informatics Non-Tax State Revenue of Frequency Usage Rights Fees receipts.

³⁾ Calculation of Telecommunication and Universal Service Obligation Spectrum Usage Fee is 1.5% of the MNOs' revenue.

Figure S7. Indonesian MNOs Regulatory Cost are Increasing

At the moment Government has initiated a plan to provide incentives for Indonesian MNOs. It could be in the form of Spectrum Usage Fee Payment Relief to the MNO who conducts special obligations from the Government, such as deploying service coverage in non-economic areas. The government also provides incentives to regions that build the ICT ecosystem, by rolling out the annual competition so-called ICT Pura (ICT Pura is a mapping movement, index calculation, and awards for digital cities/regencies in the Republic of Indonesia [29]). It is expected that it shall trigger active collaborations among operators, including mobile and non-mobile, as well as backhaul and backbone providers.

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