

Annex A: Implications of Options for 4G Spectrum Reallocation

Consideration	Policy Objective	Greenfield Allocation	First Right of Refusal	Remarks
Technical & Consumer	Ensure sufficient spectrum available to the industry for optimal 4G deployment	X	✓	<p>a) Sufficient spectrum is required to realise the full potential of 4G in Singapore and to facilitate expansion of radio capacity to meet escalating demands in mobile data usage. This is necessary to provide flexibility for future growth and development in the info-communications sector, and to position Singapore as a leading global info-communications hub.</p> <p><u>Minimum</u> FDD spectrum needed by each existing operator for optimal 4G deployment is:</p> <ul style="list-style-type: none"> i) 2x20 MHz in 1800 MHz band; and ii) 2x20 MHz in 2.5GHz band <p>b) Insufficient spectrum will:-</p> <ul style="list-style-type: none"> ➢ Translate to lower speeds, congestion and user experiences will be compromised, particularly for tunnels and in-buildings. The maximum attainable speed, using Single-Input Single-Output (“SISO”) deployment, for in-buildings/tunnels is 75 Mbps for contiguous 2x20 MHz 4G spectrum. This will be significantly reduced to 37.5 Mbps if only contiguous 2x10 MHz spectrum is secured. Based on 3GPP R10, 100 MHz spectrum is required to deliver maximum speeds of up to 1 Gbps. Hence, insufficient spectrum will “limit” the benefits of 4G technology; ➢ Limit service deployment options for operators; and ➢ Derail ongoing efforts in 4G deployment/rollout. <p>c) IDA’s proposal to reserve 2x20 MHz FDD spectrum for a potential new entrant:-</p> <ul style="list-style-type: none"> ➢ Creates artificial supply constraint for existing 4G Operators; ➢ Hinders growth potential of 4G in Singapore; ➢ Disrupts competition dynamics ➢ Results in higher capital costs if reserved spectrum is only released at a later timeframe e.g. reservation of 3G spectrum till Y2010.

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Technical & Consumer	Minimise unnecessary spectrum churning, network adjustments, integration, and inter-dependency issues	X	✓	<p>Unnecessary spectrum churning and network adjustments will occur when existing 4G Operators lose/swap out <u>some or all</u> of their existing frequency assignments.</p> <ul style="list-style-type: none"> ➤ Network design and upgrades have always been evolutionary. Hence, extensive efforts will be required to address network integration and inter-dependency issues to ensure seamless connectivity where spectrum churning is required. ➤ Lead time will be required for the necessary network adjustment and re-optimisation efforts, and some measure of service issues (e.g. drop call, call set-up failures, lack of mobile coverage etc.) will be inevitable.
	Service continuity without disruption	X	✓	<p>Spectrum churning will require major frequency re-tuning efforts. However, there are insufficient available frequencies in Singapore to facilitate any migration. Operators will be required to coordinate and cooperate to switch off their networks to permit reconfiguration for the frequency changes and perform re-optimisation of their networks. These changes will seriously negate the progress that existing 4G Operators have made in 4G deployment and adversely impact end user experience:-</p> <ul style="list-style-type: none"> ➤ Existing networks are designed using different cell grids and network planning assumptions. All designs/assumptions would have to be revised in the event of any spectrum churning; ➤ Considerable re-optimisation efforts will be required to ensure seamless inter-systems handover i.e. with 3G technology etc.; ➤ Significant costs will be incurred to replace mobile equipment in order to support new spectrum assignments; and ➤ Lead time will be required to carry out the necessary network migration and adjustments. Specifically, for in-building/tunnels the lead time will be dependent on obtaining access approvals from the relevant authorities. Hence, there will inevitably be service issues for in-building/tunnels during the transition period.

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Technical & Consumer	Avoid unnecessary replacement of 4G equipment and stranded assets	X	✓	The vast majority of existing network equipment (e.g. base stations etc.) does not support multi-band operations. A large-scale and costly replacement exercise will be required to replace equipment running on 2.5 GHz if existing operators only secure sufficient spectrum on 1800 MHz for 4G deployment, and vice versa.
	Efficient and effective network planning and roll-out	X	✓	Evident from the above, any spectrum churning will require significant network reconfiguration and re-optimisation efforts for network migration. Such changes will seriously derail ongoing 4G deployment efforts and result in wastage of valuable resources.
National/ Public Interest	Ensures timely 4G nationwide deployment in Singapore	X	✓	All existing 4G Operators are already in the midst of 4G rollout. By 2015/2017, there should be extensive “live” 4G networks in Singapore. Hence, IDA’s proposal for greenfield reallocation of existing spectrum rights will only hamper ongoing deployment efforts. <ul style="list-style-type: none"> ➤ Any spectrum churning will require significant network migration and adjustment; and/or ➤ If operators fail to secure sufficient spectrum, investment incentives will be undermined. This will limit the full potential of 4G technology.
	Minimise disruption of mobile services in the MRT network and road tunnels, including rollout of Thomson Line	X	✓	Issues arising from any change in spectrum assignment will be more pronounced due to the complexities and constraints associated with access/deployment of telecom infrastructure in MRT stations/lines and road tunnels. Operators have no control over access or timeframe for works to be carried out as these are largely dependent on multiple 3 rd parties e.g. appointed contractor, SMRT, LTA etc., taking into account their operational priorities and work schedules. During the transition period, coverage of the entire MRT network and road tunnels will be affected, and thus, adversely impact end users experience.
	Ensure efficient use of scarce spectrum resources	X	✓	“Greenfield allocation” would likely result in operators with fragmented spectrum in 2.5 GHz band that are not ideal for supporting 4G.

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Economic	Cost efficient from overall perspective	X	✓	<p>a) IDA's proposal is likely to result in unnecessary spectrum churning, which will require significant network migration and adjustments efforts (e.g. network reconfiguration/re-optimisation, replacement of 4G equipment etc.). Such resources could potentially be used to optimise/enhance networks to deliver more innovative and advanced services to end users.</p> <p>b) Greenfield allocation tends to artificially inflate and distort the cost of spectrum, maximising revenue at the expense of assuring efficient and effective use for the consumers and the industry.</p>
	Provide stable investment environment	X	✓	Existing 4G Operators are committed and have already invested heavily in the provisioning of mobile services (2G, 3G and 4G) in Singapore. The implementation of mobile coverage requires substantial capital outlay. Hence, a grant of "first rights of refusal" will serve to accord existing 4G Operators some measure of certainty for their continued operations and instil investor confidence.
	Provide flexibility for future growth, development and opportunities	X	✓	Please refer to comments under sufficient spectrum for all existing 4G Operators
	Position Singapore as a premier digital and info-comm hub	X	✓	
Competition	Effective and sustainable competition	X	✓	Please refer to comments under sufficient spectrum for all existing 4G Operators.
	No risk of forced exit of operators and reduced market competition	X	✓	