

Analyzing and Realigning Incentives

Sriganesh Lokanathan

www.LIRNEasia.net, [sriganesh\[at\]lirneasia.net](mailto:sriganesh@lirneasia.net)

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Incentives – Why drive on the left side of the road?

- Why do you drive on the left side of the road?

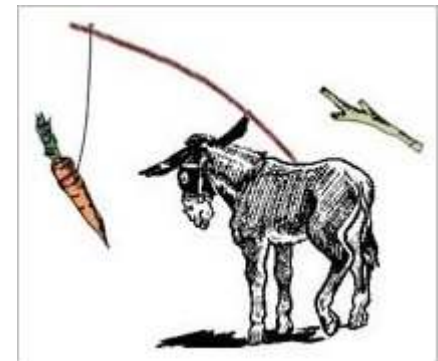
How do I use incentives for dividing a slice of cake?



- Tania has two teenage children who don't like each other, and who don't trust her either. She has one slice of cake to give them for dessert. How does she divide it so that both children are happy with the piece that they get.

Carrots, Sticks and Sermons

- In the previous example what are some options?
 - Tania tells her children that if they don't fight and share the cake, they will get another piece to share the next day.
 - Tania tells her children to behave and share the cake, otherwise they will not be able to watch TV
 - Tania tells her children the importance of sharing.
 - Tania cuts the slice in two and gives a piece to each child
 - Other options??



How do I use incentives for dividing a slice of cake? (cont.)



- There is a more optimal solution:
 - The mother asks one child to cut the slice of cake into two and the other to pick the first piece
- Is this situation similar in anyway to real life? Yes to a certain extent
 - The mother is a regulator
 - The two children are operators (in telecom-speak)
 - The cake is the common resource pool that they need to share (for e.g. spectrum, numbers)

Working Example

Illegal bypass of International Incoming Voice calls – the case of Gangapura

What is the problem?

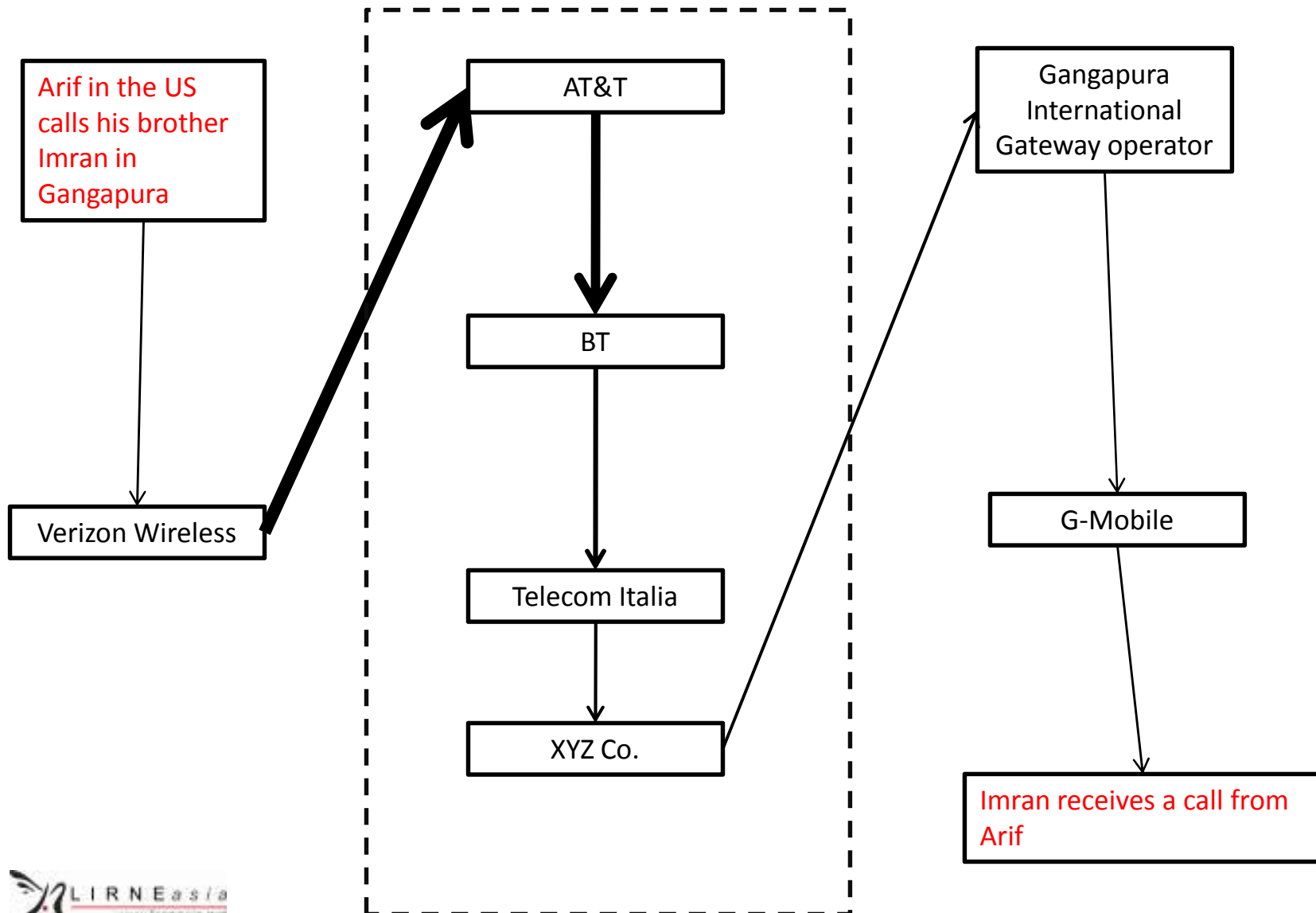
- A significant problem with international incoming voice calls via illegal bypass
 - 32 million minutes/day come through a legal channel
 - 15 million minutes/day coming illegally (estimate)
- This means...
 - Reduced voice quality
 - Government is losing revenue (millions of Singapore dollars a day)

Illegal bypass in Gangapura – how do I analyze the problem?

Illegal bypass in Gangapura – how do I analyze the problem?

1. Understand how bypass occurs.
2. How can you monitor and prevent bypass by technical means?
3. Who are the relevant stakeholders?
4. Who are the winners and losers when bypass occurs?

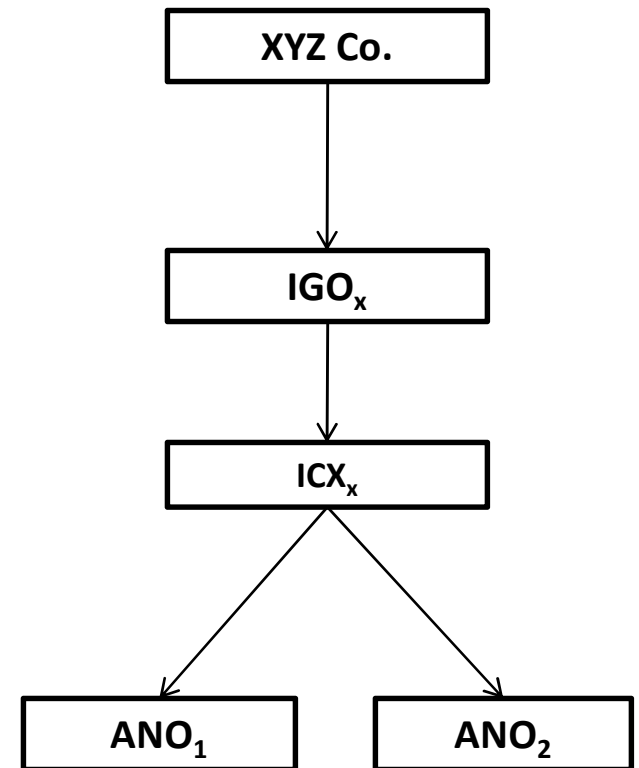
1. Understand the problem - How do calls normally come into Gangapura from other countries?



1. Understand the problem – the legal path in Gangapura

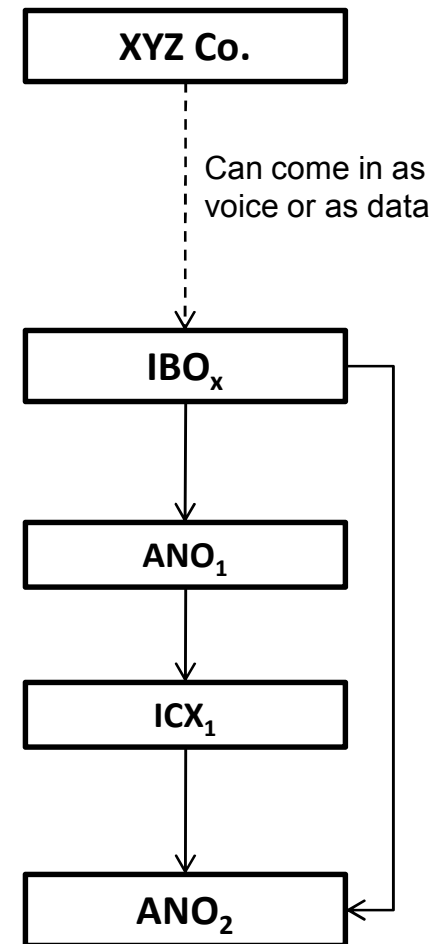
- All external carriers bringing traffic into Gangapura have to hand over the call to an International Gateway Operator (IGO) in Gangapura
- An IGO has to hand over the call to an Interconnection Exchange (ICX)
- An ICX has to then hand over the call to the appropriate Access Network Operator (ANO)
- The ANO then terminates the call on the phone of the person receiving the call.

All data traffic into and out of Gangapura has to come through an International Information Gateway (IIG) in Gangapura



1. Understand the problem – the illegal path in Gangapura

- An external carrier bringing traffic into Gangapura hands traffic over to an Illegal Bypass Operator (IBO)
 - May bring in as voice traffic or as data traffic
- An IBO then has two options if he wants to terminate the call on a mobile network:
 - Purchase a SIM card for the network he wants to terminate on and convert the call to a local on-net call
 - Purchase a SIM card for some network and terminate the call to the recipient's phone as an off-net local call.
- An ICX has to then hand over the call to the appropriate Access Network Operator (ANO)
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- If it comes as a voice call through and IGO
 - Monitor the traffic coming through an IGO
- If it comes as a VOIP call (i.e. data) through an IIG
 - Install Deep Packet Inspection (DPI) software to “sniff” out VOIP calls
- In addition:
 - Monitor the traffic through the ANOs (traffic pattern analysis)

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 - Monitor the traffic through the ANOs (traffic pattern analysis)
- **Would the above work?**
 - **Who does the monitoring?**
 - **What is the cost of monitoring?**

3. Stakeholders - Gangapura Telecom overview

- Population: 160 million
- Telecom penetration
 - Fixed : 24 million
 - Mobile: 40 million
- Players:
 - 16 telecom operators in total
 - 8 Mobile operators
 - 1 incumbent government owned fixed line operator
 - 7 fixed wireless operators
 - 4 International Gateway Operators (IGOs) – can only handle voice
 - 3 Interconnection Exchanges (ICXs)
 - 2 Internet Information Gateways (IIGs) – can only handle data
 - 20 ISPs

3. Stakeholders – current Gangapura regulations related to international incoming voice calls

- Path: IGO -> ICX – ANO
- Government sets the termination rate for an incoming international call as GD 2.06/ minute divided between:
 - IGO: 65%
 - ICX: 15%
 - ANO: 20%
- Government's share of revenue of:
 - IGO: 51.75%
 - ICX: 65.75%
 - ANO: 5.5%

4. Winners and losers

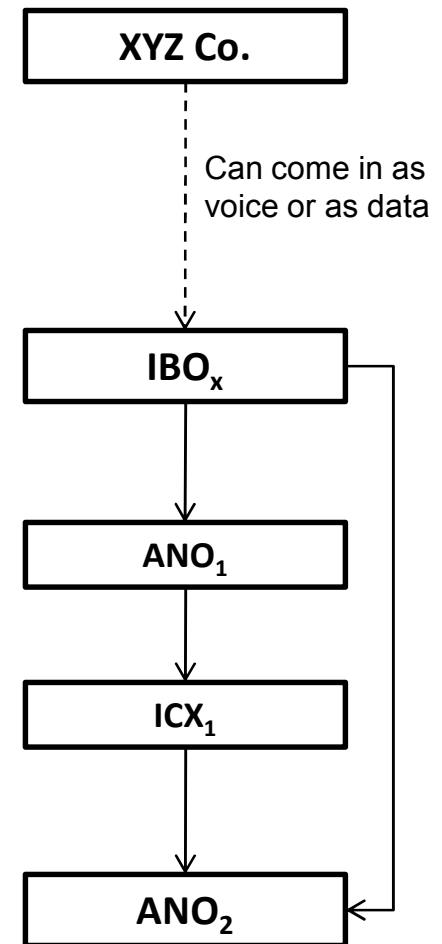
- Winners:
 - Illegal bypass operator (GD 2.06 – per minute cost of connecting a)
- Losers:
 - IGO (65% x 48.25% of GD 2.06) = GD 0.65
 - ICX (15% x 34.25% of GD 2.06) = GD 0.11
 - ANO (20% x 94.5% of GD 2.06) = GD 0.39
 - Government (GD 2.06 – IGO_{share} – ICX_{share} – ANO_{share}) = GD 0.91

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- BUT do the losers make anything when an international call is illegally terminated?

4. Winners and losers (contd.)

- Clearly an ANO and to some extent the ICX make some money when the illegal call enters the legal space
- **Next step: Model the scenario**



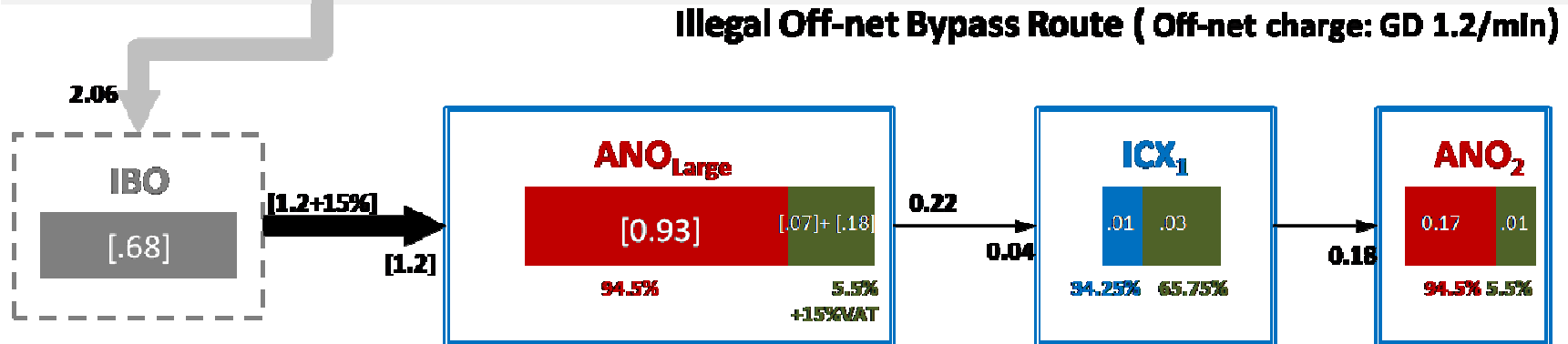
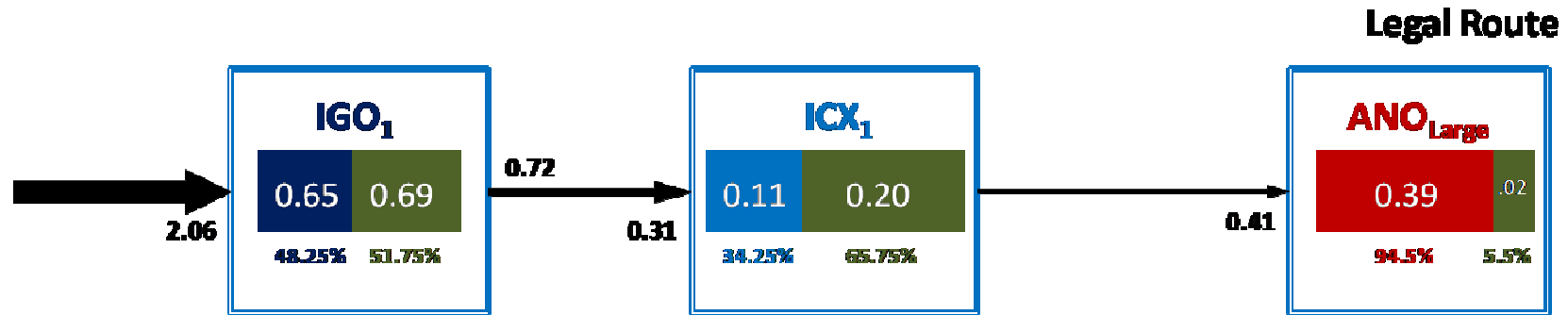
Modeling the scenario – Overview of ANOs

Operators	Subscribers	Overall Market	Package details	Outgoing	
				On Net	Off net
Kisaan Phone Ltd. (KP)	26,150,000	43.31%	Post Paid	1.30	1.30
			Pre paid	1.50	2.00
Telecom Gangapura Limited (Gangalink)	14,270,000	23.64%	Post paid	0.69	0.69
			Pre paid	0.99	1.75
GangaTel	10,900,000	18.05%	Post Paid	0.68	0.68
			Prepaid	0.88	0.88
Orid Telecom International L.L.C (Orid)	3,610,000	5.98%	Prepaid		1.19
			Post Paid		0.94
GSTL (Gangacell)	2,960,000	4.90%	Prepaid	0.25	0.98
			Post Paid	0.60	1.20
Talk Gangapura Ltd.	1,080,000	1.79%		0.25	0.98
GTCL (Incumbent)	872,409	1.44%		0.60	1.20
Sticks Telecom Ltd.	189,752	0.31%	Post and Pre		0.65
National Telecom Ltd.	98,314	0.16%	Calling a Mobile	0.89	0.89
			Selected districts	0.30	0.30
Central Telecom Ltd.	87,578	0.15%	Post Paid	0.30	0.30
			Pre paid	0.30	0.30
Dashing Telephone Co. Ltd.	68,930	0.11%		0.66	0.66
True Communication Ltd.	39,021	0.06%		0.15	0.15
EastEc Ltd.	17,000	0.03%		0.80	0.80
BST Telecom Ltd.	16,373	0.03%		0.99	0.99
Neena Phone Ltd.	10,680	0.02%	Local Call(PSTN)	0.15	0.15
			NWD Call	0.80	0.80
			All Mobiles	0.99	0.99
Zinda Telecom Ltd.	5,053	0.01%	Prepaid Any mobile	1.50	1.50
TOTAL	60,375,110	100%			

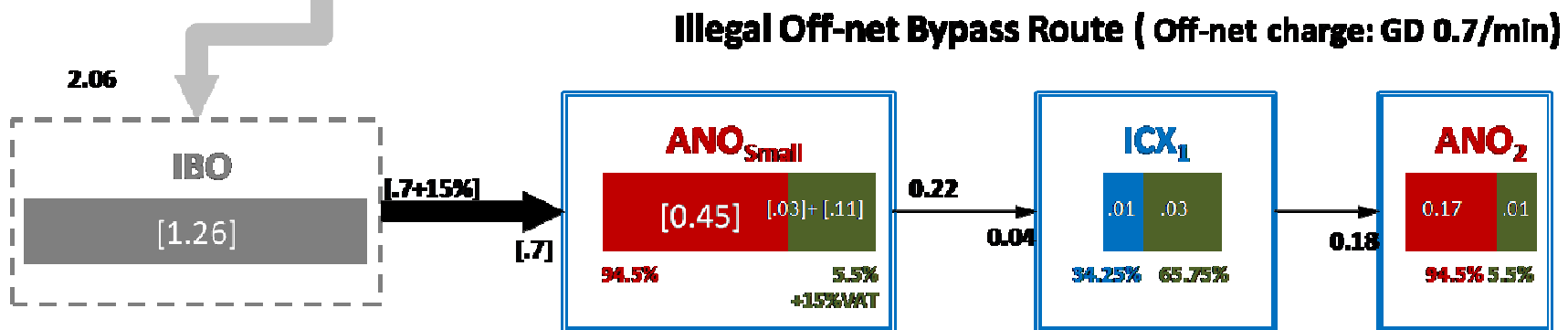
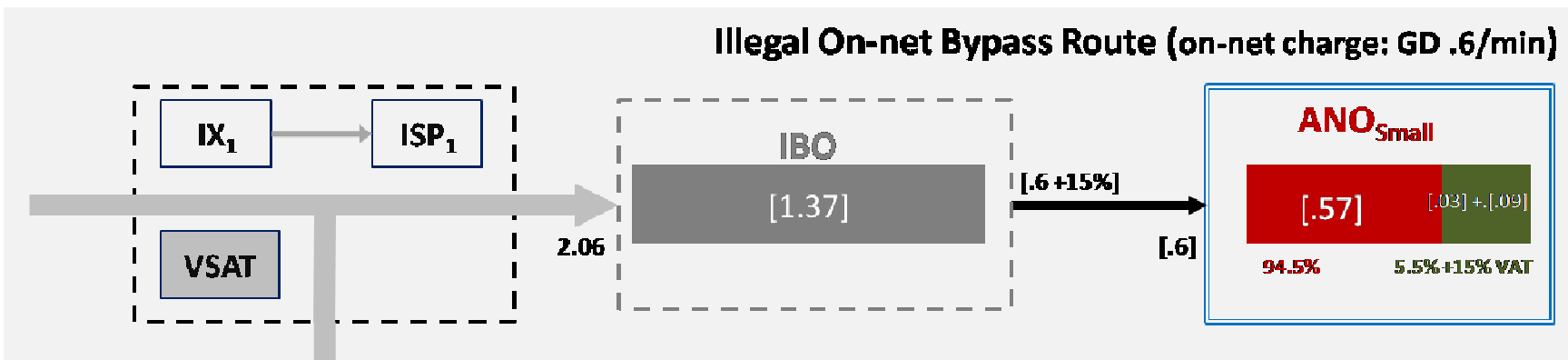
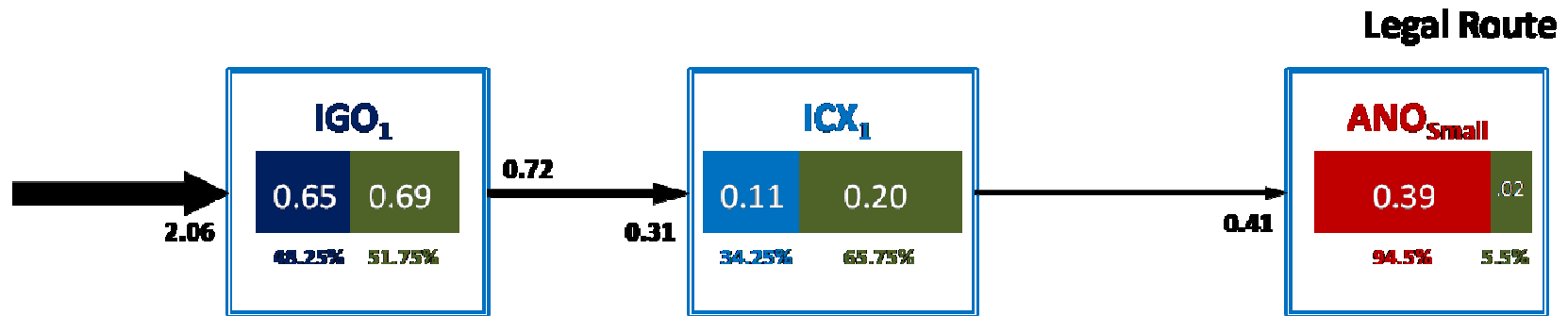
Modeling the scenario (cont.)

- Assume:
 - Large ANO operator (30% market share, on-net rate of GD 0.8/ min and off-net rate of GD 1.2/min. This is a hypothetical operator which roughly averages market share and call charges based on the 3 largest operators in Gangapura.
 - Small ANO operator (6% market share, on-net rate of GD 0.6/ min and off-net rate of GD 0.7/min. This is a hypothetical operator which roughly averages market share and call charges based on the smallest operators in Gangapura.

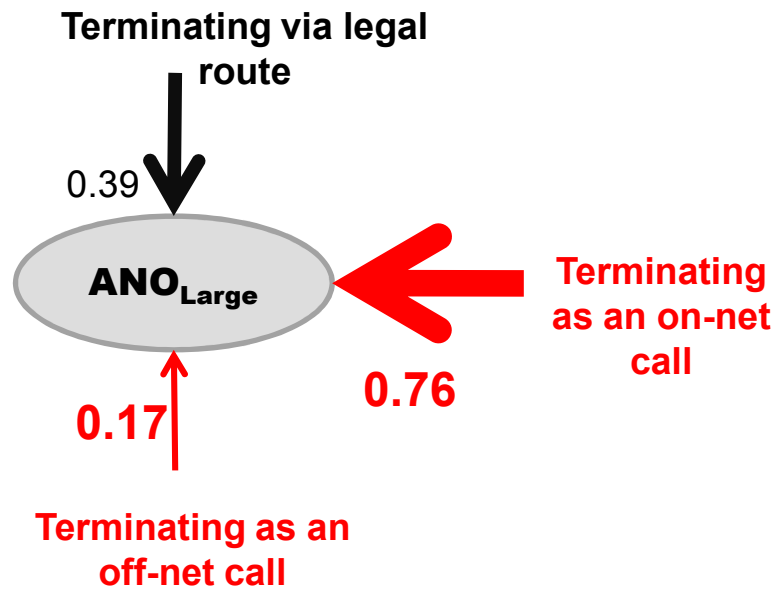
How illegal bypass affects a large ANO operator



How illegal bypass affects a small ANO operator

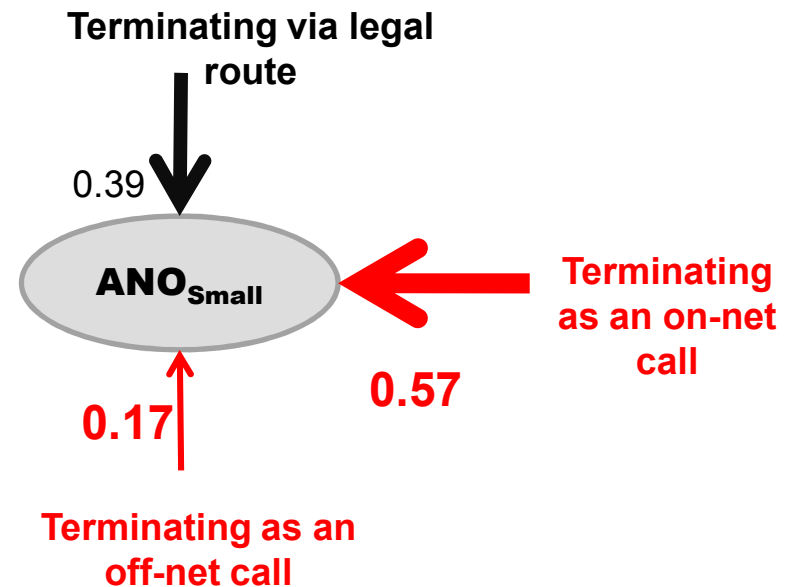


Incentives for an ANO receiving an international call



Large Operator

- The numbers are amounts received per minute by each route after taxes
- Has strong incentives for calls to be terminated as illegal on-net calls



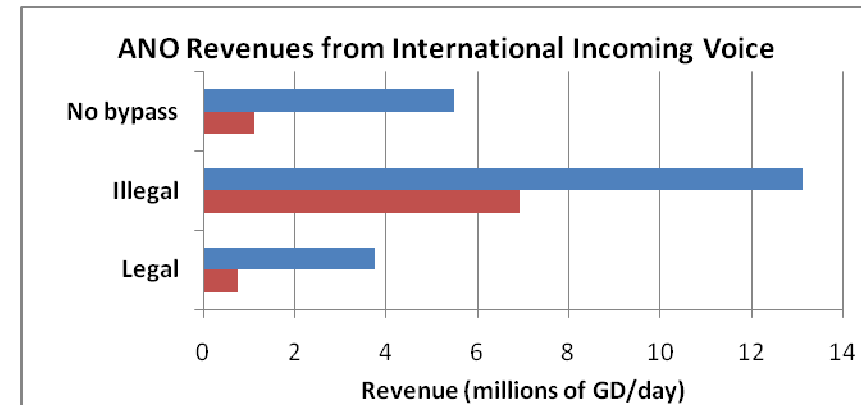
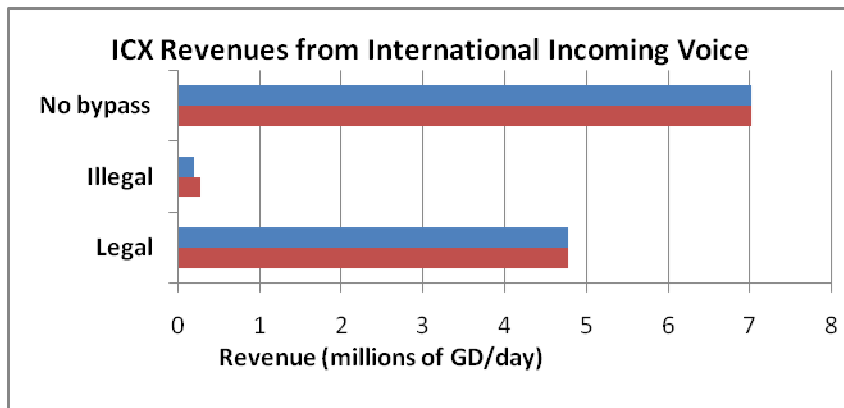
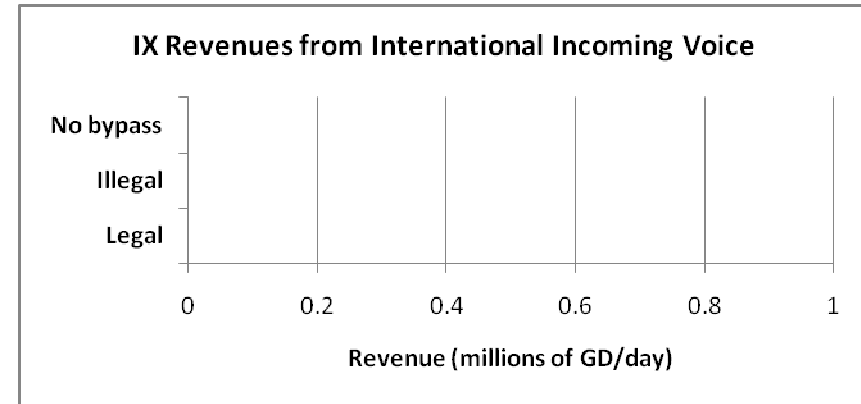
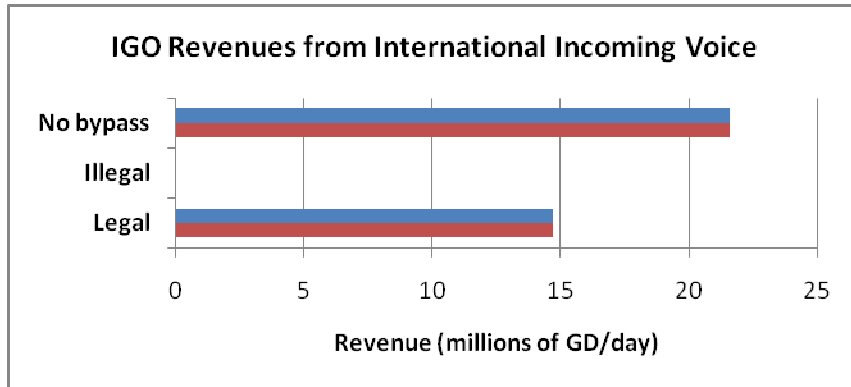
Small Operator

- The numbers are amounts received per minute by each route after taxes
- Has strong incentives for calls to be terminated as illegal on-net calls

Current situation: International incoming voice

■ Revenues when bypass is through a large ANO

■ Revenues when bypass is through a small ANO



4. Winners and losers revisited

- Winners:
 - IBO
 - ANO
 - IIG
- Losers
 - Government
 - IGO
 - ICX

4. Winners and losers - Incentives to monitor bypass & ability to monitor

Operator	Incentive to monitor?	Ability to monitor?
IGO	<p>√ Yes More bypass means less revenues</p>	<p>× No Illegal bypass enters Gangapura as data which IGOs do not have access to</p>
IIG	<p>× No An internet exchange's revenues are based on the volume of data.</p>	<p>√ Yes Deep Packet Inspection can allow IIGs to monitor illegal bypass in real time.</p>
ICX	<p>√ Yes More bypass means less revenues</p>	<p>× No (marginal possibility)</p>
ANO	<p>× No Currently an ANO can make more revenues by turning a blind eye to illegal bypass since an ANO can make more when an international incoming call is terminated as an on-net call on its network or when its network is used to make off-net calls to terminate on other networks</p>	<p>√ Yes ANO can monitor traffic patterns on their networks to identify sources of illegal bypass. However this can only be done after the fact.</p>

So what is the solution?

- Incentive stakeholders to monitor and clamp down on illegal bypass
- How do I do that?

Discussion – How to align incentives

A possible solution

1. Merge voice and data so an IGO can carry voice + data and same for IIG:
 - Aligns incentive to monitor with ability to monitor
2. Increase an ANO's share of a legal international incoming call such that:
 - $(ANO_{Share} - ANO_{Illegal})$ is minimized so as to increase incentive to monitor and curb illegal bypass
 - ANO_{Share} is the per minute share of international termination charge that is received
 - $ANO_{Illegal}$ is the per-minute on-net call or off-net call charge
 - For e.g.:
 - Allowing an ANO to receive GD 0.77 per minute on the international incoming call which is greater than the revenue from an on-net call (GD 0.76)

A possible solution (cont.)

3. Mandate Deep Packet Inspection at the IGO level
 - IGO, who now have incentive to monitor illegal incoming calls, now have the ability to monitor the data traffic
 - If total legal incoming minutes do not meet targets, additional licences will be issued, creating additional incentives for monitoring
4. Mandate ANO operators to monitor illegal bypass
 - Deploy traffic monitoring programs (for illegal on-net, and off-net calls from other networks as well as off-net calls to other networks) and provide findings on a monthly basis to BTRC for further action
 - Reward call recipients to report calls they suspect to be illegally terminated international incoming voice calls. If illegality established, caller is credited with GD 50 of talk time on the subscriber's network.
 - Service to be operated by each ANO, with monthly reports submitted to the GTRC
 - ANOs' increased revenue from legally terminated calls aligns their incentives to monitor with their ability to monitor.
5. Disallow networks from accepting calls with masked CLI
 - Ensuring all calls can be traced.

Key takeaways

- Before coming up with a policy prescription to solve a problem:
 - Understand the problem:
 - Who is winning who is losing
 - Understand all stakeholder's interests & incentives
 - Can we utilize incentives to bring about the desired behavior?
 - Economic incentives vs. Mandating & Monitoring
 - Sticks as a last resort
 - Continuously ask the question, what is the cost of this prescription.

Questions