Report to Independent Satellite Transaction Committee

Final Report
13 February 2017

בנוסח זה בוצעו מחיקות ספורות של מידע מסחרי רגיש, וככל שהדבר רלוונטי ונדרש לצורך הבנת חוות הדעת התווסף לצד המחיקות מידע משלים ו/או מסביר.

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1. EXECUTIVE SUMMARY

COMSYS has been retained by the Independent Satellite Transaction Committee of the Bezeq Board of Directors (the "Committee") to perform an independent commercial and technical evaluation of the satellite alternatives to support the transmission of the "*yes*" DTH services, following the failure of the AMOS-6 satellite. In support of this effort, COMSYS provided the following services as requested by the committee:

1. Evaluation of the complexity and costs of the following satellite alternatives for the transmission of its DTH services:

    a) Entering into a deal with Spacecom which includes the following aspects:
        i) Utilisation of the AsiaSat-8 satellite (to be designated AMOS-7) which will be re-located to the 4° West orbital slot in combination with AMOS-3.
        ii) Replacement of the AMOS-7 satellite in 4-5 years with a new satellite.
    b) Alternative satellite to the Spacecom satellite(s) to be located at a different orbital location requiring a re-point of the customer antennas.
    c) Alternative satellite which could be re-located to the Spacecom orbital slot at 4° West, thus eliminating the need to re-point customer antennas.

2. Analysis of the current technical status and functioning evaluation of the AMOS-2, AMOS-3 and AMOS-7 satellites.

3. Analysis of the possibility of "*yes*" migrating its service from satellite to a terrestrial streaming service (IPTV).

The following sections describe our key findings. Sections 4 through 8 provide our detailed analysis of the above issues.

1.1. Key Findings

Our key findings are as follows:

1. We have analysed the proposed agreement between Spacecom and "*yes*"[1] from both a technical and commercial view and conclude that on the basis of accepted standards customary in the satellite communications industry it represents a good deal for "*yes*". In particular, "*yes*" has increased in-orbit backup capacity under the proposed new arrangements[2] (as compared to the existing agreement). On the basis of "*yes*"s current and immediate commercial and technical needs following the loss of AMOS-6 the deal is fair and reasonable, and we recommend the adoption of the proposed agreement as a prudent and appropriate course of action.

2. Given the fact that "*yes*" has more than 600,000 subscribers with approximately [redacted] antennas pointed at the 4° West orbital position, we believe that the combined AMOS-7 / AMOS-3 and the replacement of AMOS-7 with a new AMOS-8 satellite while keeping the original term of the Agreement is the best of the three alternatives for "*yes*". Specifically, our analysis of the three alternatives makes the following conclusions:

[1] Dated 2 February 2017.
[2] For the purposes of convenience the terms "*new arrangements*" and "*amendment*" are used interchangeably in this report, referring to the new agreement to be entered into between "*yes*" and Spacecom.

a) Moving to an alternative satellite at a different orbital position would require a complete re-pointing of the all subscriber antennas at a cost of approximately [redacted] million.[3] Furthermore, there is no guarantee that moving to another satellite at a different orbital slot will provide any recurring cost savings or improvements in back-up scenarios.

b) Moving an alternative satellite to the 4° West orbital position (to be co-located with both AMOS-3 and AsiaSAat-8) is impractical as there would be no available spectrum (unless parts or all the transponders on AMOS-3 and AMOS-7 were shut down) and it would require regulatory approval from the Government of Israel (GOI) to use the slot that has already be provided to Spacecom.[4]

c) Given the fact that Spacecom has agreed with AsiaSat to commit to move the AMOS-7 satellite into the 4° West orbital position,[5] and that Spacecom will continue to provide the same basic capacity pricing to "*yes*", and that it intends to procure and launch an AMOS-8 satellite to replace AMOS-6, COMSYS has concluded that utilising the AMOS-7 satellite in combination with AMOS-3 in the short term (and replacing it with AMOS-8 in 4-5 year's time) is the best alternative for "*yes*".

d) COMSYS has contacted a number of unrelated satellite operators and spacecraft manufacturers to ascertain whether there might be any alternative options for other service providers or procurement of a new satellite for "*yes*". Whereas there are a number of options in theory, the time that it would take to negotiate such as deal means that in practice this is not currently a prudent or reasonable option for "*yes*".

3. COMSYS has concluded that the technical plan developed by Spacecom and "*yes*" to transition services from the current AMOS-2 / AMOS-3 operation to the AMOS-3 / AMOS-7 operation will work with negligible impact (if any) to customer services (assuming that the AMOS-7 transition and replacement plan proceeds successfully). Spacecom has taken what we would consider reasonable steps consistent with industry practices to provide a replacement satellite in the 4° West orbital position.

4. We believe the segment pricing ([redacted] million per segment per year) is consistent with industry pricing for this type of capacity (performance, coverage, etc.) with the level of back-up proposed.

5. Spacecom is currently developing plans for the replacement of the failed AMOS-6 satellite (to be called AMOS-8). While the proposed agreement specifies the replacement satellite will have performance at a level not less than AMOS-6, we believe there is an opportunity for "*yes*" and Spacecom jointly to explore designs which will provide improved performance (improved coverage over Israel) which could provide economic, operational or

[3] COMSYS believes this cost could be [redacted] million lower than this amount depending on where the alternative satellite would be located (satellites close to the 4° West orbital position would require minimal re-pointing effort whereas satellites further away would require a re-pointing plus a possible re-location to avoid obstructions) and what discounts the alternative satellite operator would be willing to provide to "*yes*" during the transition period. However, such an effort would typically require 1-2 years for planning and negotiation, together with implementation risk and churn.

[4] There is no guarantee that these approvals can be obtained.

[5] Spacecom has executed a contract for the lease of AsiaSat-8 for a period of four years with an option to extend an additional year, for a total of five of years. Spacecom informed us that AsiaSat has received approval from the regulatory authorities in Hong Kong to move the satellite and operate it at 4° West, and that the Israel Ministry of Communications (MOC) has written formally to the Office of the Communications Authority (OFCA) in Hong Kong confirming that Spacecom is licensed to use the Israeli satellite networks at 4° West and that Spacecom intends to use AsiaSat-8 at 4° West as an interim solution following the AMOS-6 loss. This letter was issued as a pre-condition for the start of Asiasat-8's relocation to 4° West. Spacecom has also provided information to the MOC so that a formal adjustment can be made to Spacecom's licence to operate a satellite at 4° West. Spacecom also informed us that the MOC process is proceeding and that no problems are expected in that part of the process.

performance benefits to "*yes*". This might include increased capacity for additional services (such as additional channels and / or the use of HD, 4K), plus improved rain fade margin.

6. "*yes*" has been and will continue to gradually replace the older SD set-top-boxes with the newer high definition (HD) STBs over the next [redacted] years. The newer HD STBs will allow "*yes*" to take advantage of possible improvements in satellite performance mentioned above – and the availability of additional segments as part of the new arrangements makes this easier to implement.

7. The terms in the contract related to the technical performance and operational performance are consistent with good industry practices.

8. Based on our review of the terrestrial broadband infrastructure and the installed STB capabilities, we do not believe it is feasible in the short to medium term to make a transition to an all IPTV distribution solution for "*yes*". There are a number of reasons for this opinion, including significant additional costs, implementation and market risks and industry trends and experience worldwide (as we describe in Section 8). We note that plans by Sky and DirecTV to use IPTV / OTT will be in addition to, and not instead of, their primary delivery method using satellites and that Airtel has made a decision to reverse their plans to offer full IPTV delivery and concentrate on satellite delivery.

2. METHODOLOGY

In preparing this report, and during this study we have augmented our knowledge base built up over many years with a brief programme of primary research involving desk research and telephone interviews with relevant industry contacts. We have relied on this information provided by Spacecom, "*yes*" and third parties although we have not been able to independently verify any of such information and we can assume no responsibility for nor give any representations with respect to the accuracy or completeness of any such information. Notwithstanding this, we are not aware of any information that might indicate that our input data are inaccurate.

The analyses and conclusions contained in this report are based on various assumptions that we have developed which may or may not be correct, being based upon factors and events subject to uncertainty, although we believe that our assumptions are reasonable and well-founded. Future results could be materially different from any forecast or estimates contained in the analyses.

We had a series of meetings with Spacecom and "*yes*" during December 2016 and January 2017, as well as numerous calls. We also reviewed and analysed the documents listed in Section 3.1 below.

3. SPECIFICATION OF WORKS

At the request of the Committee, Bezeq, the 100 per cent owner of DBS Satellite Services (1998) Limited) - henceforth referred to by the brand name "*yes*" - has engaged COMSYS to undertake a short programme of work to perform an independent commercial and technical evaluation of the satellite alternatives to support the transmission of the "*yes*" DTH services. In support of this effort, COMSYS provided the following services (Table 1, in relevant parts) as requested by the Committee.

Table 1 - COMSYS Statement of Work

Task	Description / Comment
1	Evaluation of the following satellite alternatives for the transmission of its DTH services: a) Entering into a deal with Spacecom which includes the following aspects: i. Utilisation of the AsiaSat-8 satellite (to be designated AMOS-7) which will be re-located to the 4° West orbital slot in combination with AMOS-3. ii. Replacement of the AMOS-7 satellite in 4-5 years with a new satellite. b) Alternative satellite to the Spacecom satellite(s) to be located at a different orbital location requiring a re-point of the customer antennas. c) Alternative satellite which could be re-located to the Spacecom orbital slot at 4° West, thus eliminating the need to re-point customer antennas. For each of these alternatives, COMSYS will evaluate the complexity and costs. Complexity will be analysed in terms of re-locating of satellite, frequency / polarisation issues that may affect ground station equipment, re-pointing of customer antennas, satellite coverage issues (EIRP differences that may require larger customer antennas in certain locations), frequency coordination and regulatory issues.
2	Analysis of the current technical status and functioning of the AMOS-2, AMOS-3 and AMOS-7 satellites. Specific attention will be paid to how this status and health of these satellites might affect any of the above satellite scenarios. Particular attention will be paid to the remaining lifetime of the AMOS-2 satellite as well as the battery problems experienced on the AMOS-3 satellite.
3	As part of analysing the satellite alternatives in Task 1, COMSYS will evaluate the back-up scenarios and alternatives in the event of satellite failures (partial or full).
4	Analysis of the possibility of "*yes*"" migrating its service from satellite to a terrestrial streaming service (IPTV). This will include an analysis of the pros and cons of each option, drawing from comparisons with other satellite-delivered and IPTV networks in other countries – contrasting, where appropriate, with the specific situation in Israel (relating to terrestrially-delivered Internet services available today or in the foreseeable future). In addition, the comparison of satellite and terrestrial delivery will be different in most countries, due to a number of factors, including the available of space segment capacity (and co-located backup capacity), the capacity and quality of terrestrial networks (currently and for the foreseeable future) and regulatory and competitive issues.

An independent view is of particular importance, as the new deal constitutes an interested party transaction.

3.1. Input Documents

In the preparation of this report, our study included a review of the following documents:

1. COMSYS report to "*yes*" (Version 1.73) as filed with Tel Aviv Stock Exchange (dated 3 January 2013) - ("Satellite Capacity for "*yes*"").
2. "*AMOS-2 Satellite Technical Information*" (undated, but provided to COMSYS on 6 December 2016).
3. "*AMOS-3 Satellite Technical Information*" (undated, but provided to COMSYS on 6 December 2016).
4. "*General Health Status*" report on AMOS-2 and AMOS-3 (dated December 2016) from IAI.
5. AMOS-7 Coverage Patterns and Contours and EIRP levels in Word format (undated, but provided to COMSYS on 7 December 2016).
6. "*AMOS-2 Agreement*", dated 16 May 2000.
7. "*Bezeq-AMOS-Space Agreement*", dated 4 November 2013 (Translated to English).
8. Final draft version of Amendment 3 to the November 2013 Agreement (including appendices), provided to COMSYS on 2 February 2017.

3.2. Basis of our Work

This report was commissioned by the Committee in December 2016 and has been prepared for the Committee on the basis set out below, and is addressed to them only. This report is commercially confidential and save as provided below (and in our Letter of Engagement), is for use by the addressees and no one else. Save as provided below, no other person is entitled to rely on this report for any purpose whatsoever and we accept no responsibility, duty or liability to any other person in respect of the contents of this report.

This report should not be provided, without our prior written specific consent, to anyone other than Bezeq and its shareholders and their professional advisers, and to "*yes*", and then only on the basis that it is strictly confidential, we accept no liability to the other recipients, they should not rely on it and prior to receiving it they provide to us a non-reliance letter in respect thereof, and they should not provide copies of it to any other person.

Notwithstanding the above, and for the avoidance of doubt, we acknowledge that the report may be submitted to the Tel Aviv Stock Exchange, the Israeli Securities Authority (for general publication to Bezeq's shareholders) and any third party advising institutional organs in Israel without requiring our further consent.

All references to currency are in US dollars unless otherwise indicated.

3.3. Scope of Work

This report is delivered on the basis set out in the previous section, and also on the following basis:

a) This report relates only to the position as of the date of this report (13 February 2017) based on the information with which we had been provided by the Committee, Spacecom and "*yes*".

b) Other than the tasks defined in our Statement of Work we have not attempted to comment on or make any assessment of the business, commercial, financial, legal, insurance, tax (of any kind), accounting, employment and pensions, or health and safety implications of the contents (or any omissions from the contents) of "*yes*" or its business.

c) The accuracy of this report necessarily depends on the Input Documents being true, complete, accurate and not misleading.

d) We have assumed the legal capacity of all signatories, the genuineness of all signatories, the conformity to original documents and the completeness of all documents submitted to us as copies or received by us by electronic transmission and the authenticity and completeness of the originals of those documents and of all documents submitted to us as originals.

e) Where this report reproduces or summarises any information derived from a third party or any opinion of a third party, we do not accept any responsibility, duty or liability for the truth, accuracy or completeness of such information or opinion in any way whatsoever (including whether or not such information or opinion is misleading, by omission or otherwise). We have not conducted any verification on such information or opinions. Notwithstanding the above, our experience of the satellite industry does not indicate that there are any errors in this information provided.

4. BACKGROUND

4.1. Background to our Engagement

Following the approval of Bezeq's shareholders DBS Satellite Services (1998) Limited entered into a long-term contract with Spacecom on 3 November 2013 for satellite transponder services to support its "*yes*" Direct-to-Home (DTH) multi-channel pay television services. The key aspects of this contract were as described in Table 2 below.

Table 2 - Summary of Original Spacecom / "*yes*" Contract Terms

Contract term:	1 January 2013 to 31 December 2028 (16 years).
Capacity:	• From 1 January 2013 to 31 December 2021: Ten segments on AMOS-2 and two segments on AMOS-3 (12 segments total). • Once AMOS-6 starts operation (estimated to be sometime in 2016): Four segments on AMOS-3 and eight segments on AMOS-6 (12 segments total). • From 1 January 2022 to 31 December 2028: Nine segments on AMOS-6. • "*yes*" has the option to take an additional two segments under certain conditions.
Price:	Currently [redacted] million per segment per year.
Back-up:	Prior to launch of AMOS-6, "*yes*" guaranteed six segments on AMOS-2 and AMOS-3. In the event that AMOS-6 fails to reach orbit, nine segments guaranteed on AMOS-3. After the successful launch of AMOS-6 and successful commencement of operation a guarantee of 50 per cent of the currently used capacity. Spacecom to exercise best efforts to find alternative satellites in the event of unavailability of the capacity.
Consideration for satellite / transponder degradation:	Yes. In the event that AMOS-6 is late, then discounts for capacity on AMOS-2 from March to end December 2016 (anticipating inclined orbit operation) and general discounts (up to [redacted] per cent) for degraded transponder performance.
Termination for cause:	Yes – subject to provisions of the Agreement.
Termination for convenience:	Yes. Detailed formula provided for payments required to terminate for convenience.

In December 2012, COMSYS was retained by Bezeq to provide an opinion on whether the terms of the contract between "*yes*" and Spacecom were fair and reasonable and represented current market pricing under then current conditions. COMSYS determined, in its opinion, that the terms of the contract met these criteria.

On 1 September 2016 (one day before the planned launch date), the SpaceX launch vehicle, with the AMOS-6 satellite on board, exploded on the launch pad, destroying the AMOS-6 satellite. This failure created three problems for "*yes*":

1. AMOS-2 was reaching the end of its life and would need to be put into an inclined orbit – thus degrading the performance of the "*yes*" DTH services.[6] Services will continue to

[6] In mid-2016, Spacecom stopped performing north-south station keeping manoeuvres, allowing the satellite to drift in the north-south direction. Because of this, the subscriber terminals would in time not be pointed directly at the satellite and would receive a reduced signal from the satellite. The result is a loss in rain fade margin such that subscribers will lose the satellite signal earlier than otherwise. This results in an increase in the estimated service outage of [redacted] per month during the worst (rainiest) month of the year.

degrade until reaching an unacceptable level at which point the satellite would be useless for DTH services (estimated to be sometime around mid to late 2017).

2. Without AMOS-2 in service, "*yes*", under the terms of the existing contract would be provided with fewer segments that would require that "*yes*" drop certain channels from its channel line-up. Under the terms of that contract, Spacecom would have been required to provide "*yes*" with six segments on AMOS-3 (increasing to nine segments from 1 January 2017), providing about 60-75 per cent of the capacity that "*yes*" was utilising at the time of the destruction of AMOS-6.

3. Elimination of any in-orbit back-up capacity.

Upon the destruction of AMOS-6, Spacecom immediately began the search for a replacement satellite that could be located into the 4° West orbital position and provide the full segments to "*yes*" as well as in-orbit back-up capacity. Construction of a new satellite was not an option as an immediate solution as the earliest a new satellite could be constructed, launched and placed into service would be between 30 and 40 months.

After completing the search for a replacement satellite, Spacecom found the offer from AsiaSat to temporarily re-locate the AsiaSat-8 satellite to the 4° West orbital position to be the best alternative for "*yes*" and its other customers. On 1 December 2016, Spacecom announced it had reached an agreement with AsiaSat to locate the AsiaSat-8 satellite into 4° West slot for a period of four years with an option to extend it to five years. The satellite is expected to reach its new location in early 2017.

While AsiaSat-8 is in the 4° West orbital position, Spacecom will designate the satellite as "AMOS-7".

Table 3 below summarises the satellites that Spacecom evaluated before concluding that the AsiaSat-8 satellite was the best alternative.

Table 3 - AMOS-6 Gap Filler / Options Researched (Source: Spacecom)[7]

Operator	Status	Response / Comments	Interest?
ABS	Discussion with management	No asset available	
AngolaSat	Internet research	No satellite	
AOneSat	Internet research	No satellite	
APT	Discussion with management	No asset available	✓
ArabSat	Contact via third party	Irrelevant	
Arsat	Discussion with management	Required too many ArSat customers to transfer	✓
AsiaSat	Discussion with management	Contract – AsiaSat-8	✓✓
AT&T / DirecTV	Internet research	No suitable assets available	
Avanti	Internet research	Asset not available	
AzerSpace	Email contact	Asset not available	
Belarus	Discussion with management	Satellite not relevant to requirements	
China Satcom	Discussion with management	Asset not available	
EchoStar	Internet research	No suitable assets available	
Eutelsat	Discussion with management	No sufficient reply	
Gazprom	Email no reply	No reply	
HellasSat	Same as Arabsat	No asset available	

[7] Spacecom also informed us that they approached several operators and manufacturers with ground-based assets but none of these was suitable.

Hispasat	Discussion with management	Asset not available	
HSN		Owned by Echostar	
Intelsat	Discussion with management	Serious discussion. Asset not released by customer	✓✓
Intersputnik	Discussion with management	Asset not available	
ISRO	Discussion with management	Very slow in discussions – no asset	
JCSat	Discussion with management	Asset not available	✓
KazSat	Contact via third party	Can't move DTH	
KT	Internet research	Asset not available	
MeaSat	Email exchange	Asset not available	
Nigcomsat	Internet research	Asset not available	
Optus	Internet research	Asset not available	
PT PSN	Internet research	Asset not available	
PT Telkom	Discussion with management	Asset not available	
Rascom	Internet research	No suitable assets	
RSCC	Email exchange	Asset not available	
Satmex	Discussion with management via Eutelsat	Same as Eutelsat	
SES	Discussion with management	Offered two satellites. Too old and / or dependent on SPACEX launch	✓✓
SingTel	Discussion with management	Asset not available	
Star One	Internet research	Asset not available	
Telenor	Internet research	Asset not available	
Telesat	Discussion with management	Offered satellites not right frequencies	
Thaicom	Discussion with management	Offered satellite not enough relevant capacity	✓✓
TurkSat	Internet research	Not relevant	
Venesat	Internet research	Not relevant	

4.2. AMOS-5 and AMOS-6 Satellites, plus Replacement AMOS-8

This section provides background and analysis on the two satellites that were lost in service or destroyed before launch. We do not believe that there is a connection between the two incidents, despite the conspiracy theories that have been suggested and consequently it has not been included as a factor in our analysis.

Table 4 below lists the satellites that have been or are currently operated by Spacecom.

Table 4 - Spacecom Satellites / Summary

Satellite:	Location:	Comment:
AMOS-1	4° West	Launched in 1996 and now retired. Israel and Eastern Europe spot beams. Sold to Intelsat in 2009 and relocated to a new orbital location.
AMOS-2	4° West	Co-located with AMOS-1 and coverage of Middle East, parts of Europe and East Coast USA / Canada. Launched December 2003 and expected EOL[8] is Q1 2017.
AMOS-3	4° West	Primary satellite for "yes" and co-located with AMOS-2. Launched April 2008. On-board battery problems result in limited eclipse operation.
AMOS-4	65° East	Launched August 2013. Ku and Ka-band for Asia and Africa. Not used by "*yes*".
AMOS-5	17° East	Launched December 2011 and failed in-orbit in November 2015. Not used by "*yes*".
AMOS-5i	17° East	Launched as AsiaSat-2 in November 1995 and leased to Spacecom in September 2009 as a gap filler for the delayed AMOS-5 (see Section 4.2.1 below).

[8] End of Life.

AMOS-6	4° West	Planned Ku and Ka-band coverage of Africa, Europe and Middle East. Destroyed in pre-launch explosion in September 2016.
AMOS-6R	TBD	Internal name for in-orbit backup satellite for AMOS-6. Planned but not ordered (see Section 4.2.2).
AMOS-7	4° West	Temporary name for leased AsiaSat-8 satellite while located at 4° West. Expected ISD[9] at that location is Q1 2017 for a period of 4-5 years. "*yes*" planning to use four transponders.
AMOS-8	4° West	New name for AMOS-6 replacement satellite.
AMOS-17	17° East	Contract with Boeing in December 2016 for launch in 2019. Planned coverage of Middle East / Europe / Africa at C/Ku/Ka-band. Not planned for use by "*yes*".

4.2.1. AMOS-5

Spacecom contracted for the AMOS-5 satellite in July 2008 after an international competition including established Western satellite manufacturers and Russia's ISS Reshetnev (ISS). The latter's Express-1000H satellite platform, housing a C and Ku band payload supplied by Thales Alenia Space (TAS) was selected, despite it being the very first order of a new and unproven product line from ISS.

השערה ביחס להחלטה על בחירת ISS בקבלן

[redacted]

After a somewhat troubled programme, beset by delays and communications problems between Spacecom and ISS, the satellite was launched in December 2011 and entered service at 17° East in early 2012.

Established Western insurers were briefed on the satellite before launch and, despite some concerns, insurance was successfully placed for the launch and in-orbit operations. One factor that influenced the insurers was that ISS had secured additional orders for the Express-1000H / K family of platforms, including Telkom-3 for PT Telkom (Indonesia) and Yamal-300K for Gazprom in 2009, and, notably, for AT-1, AT-2, AM-8 for RSCC and Lybid for Ukraine in 2010. A further international order for Kazsat-3 was secured in 2011 before the launch of AMOS-5.

As such, insurers felt that AMOS-5 was the first of a long line of Express-1000H / K satellites and insurance risk could be spread over a series of satellites.

After around two years of successful operations, AMOS-5 suffered a major anomaly in October 2013. Around half of the power supplies for the satellite's ion thrusters ceased to function, causing temporary loss of some essential station keeping thrusters. After a reconfiguration, Spacecom was able to restore full functionality to the satellite, but its continued operations were now dependent on a single-string of hardware, susceptible to failure at any time. Extra insurance was secured for this failure mechanism.

Finally, in November 2015, Spacecom suffered a complete loss of communications with the AMOS-5 satellite, which was unable to be restored, resulting in a total loss of the spacecraft. Spacecom reported in early 2016 that it would receive an insurance payout of $158 million for the loss of the satellite.

Since then, there are believed to have been six successful launches of Express 1000H / K class satellites, Yamal 300K (2012), AT1, AT2, Kazsat-3, Loutch / Olimp-1 (2014) and AM8 (2015). Their in-orbit status is believed to be nominal, although given that most of them are operated

[9] ISD: In-Service Date.

by Russian customers, it may be that anomalies or failures are not fully reported if they indeed occurred.

Notably, there have been no orders of Express 1000H / K class satellites by non-Russian satellite operators since Kazsat-3 in 2011. השערה ביחס לשיקולי והחלטות היצרן בקשר עם בניית הלוויין

[redacted]

Whereas it can be argued that Western satellite insurers would not have taken on such a risk if they held such an opinion, it is believed that they did so due to feelings in the 2010-2013 timescale that the Russian satellite sector was a growing market for them, a market in which they had to participate for their long-term prosperity, even if they suffered some early losses. For example, a very large insurance placement was made for RSCC's Express AM5 / AM6 satellites in 2012 / 2013 (based on ISS's newer and larger Express 2000 platforms, with payloads supplied by MDA). The successful launch of the AM5 satellite in December 2013 was reportedly insured for $217 million, with a similar insured value expected for the successful launch of AM6 in 2014, representing significant premiums for Western insurers.

In summary, it is our opinion that the long-term reliability of the Russian-built AMOS-5 satellite was always in doubt, and it came as no surprise to many Western experts when it suffered catastrophic in-orbit failure in 2015.

4.2.2. AMOS-6

Spacecom signed a $195 million contract with IAI in June 2012 for the construction of the AMOS-6 satellite. The satellite was originally due to be launched in mid-2015, but apparently suffered significant constructions delays resulting in a planned launch in September 2016. During early September 2016 preparations for launch on SpaceX's Falcon-9 rocket, however, the satellite was completely lost in a launch pad explosion the day before the planned launch.

Spacecom reported in November 2016 that it would receive a $196 million insurance pay-out from IAI, as well as seeking an additional $10 million from IAI for late delivery penalties. It will also receive $50 million or a relaunch (at no additional cost) with SpaceX.

The satellite had 22 active Ku-band transponders, 24 active Ka-band spot beam transponders and two S-band transponders. It included installed equipment for many different combinations of Ku-band transponders and Ka-band spot beams, enabling, for example, full replacement of AMOS-2 capacity, in-orbit back-up for AMOS-3 capacity, and service growth capacity for Spacecom.

The original AMOS-6 contract with IAI included a programme of procurement of Long Lead Items (LLIs) for an identical AMOS-6R satellite, to enable rapid build and launch in the event

of AMOS-6 failure (this was reported to us at the time of our report for "*yes*" in January 2013). At some time during the course of construction of AMOS-6, however, this programme appears to have been terminated, resulting in a situation where IAI can no longer rapidly build a replacement for AMOS-6 following its destruction in September 2016.

4.2.3. AMOS-8

As with all satellite programmes, it is possible to build and launch an identical replacement satellite for AMOS-6 in substantially less time than it would take to design, build and launch a new satellite design. This is because there are several months of substantial non-recurring satellite design activities in every new programme, which do not need to be repeated when building an identical replacement satellite.

Moreover, the cost of such a replacement satellite is expected to be substantially lower than the cost of a new satellite design. In the case of AMOS-6, which was reported to have cost $195 million, we would expect an identical replacement satellite to cost [redacted] million. We would also expect that it can be constructed by IAI in 24-30 months.

A new satellite design from IAI, however, is likely to cost at least [redacted] million and is estimated to require 36-42 months to be ready for launch. It is possible that another manufacturer could be found with somewhat lower costs and schedule, but not below those for an identical rebuild of AMOS-6 (assuming similar overall satellite performance capabilities).

We understand that Spacecom is more inclined towards a new satellite design than an identical replacement of AMOS-6. Spacecom has suggested that satellite technology has advanced in the past few years, enabling a new design to be more efficient than AMOS-6.

We are not sure whether this statement can be applied to the Ku-band payload, where we believe there have been only minor improvements in technology over the past few years. It may perhaps refer to new design techniques for Ka-band spot beam payloads, where more capacity can be provided for the same mass / power of satellite hardware (due to the use of improved satellite antenna architectures). Another possibility is the full use of electric orbit raising (EOR), to increase the available payload mass for a given launch.

From the perspective of "*yes*", which only has an interest in the Middle East beam of the Ku-band payload, therefore, we can see the advantage of Spacecom pursuing a more advanced, efficient design to replace AMOS-6, to deliver more performance for the "*yes*" Ku-band transponders.

While there may be some risk in the construction of a new AMOS-8 satellite design, compared with the rapid build and launch of an identical AMOS-6R satellite, this is manageable within the overall schedule of AMOS-7 being available for the next four or five years.

As we have noted, AMOS-3 has already suffered two major battery cell anomalies that both reduce its capacity during eclipse and leave it susceptible to further degradation and failures in the future. Moreover, AMOS-3 has no Ku-band transponder redundancy, meaning that one or more of the "*yes*" transponders could be lost at any time, without sufficient in-orbit back-up. The spare capacity available on AMOS-7 in the event of AMOS-3 failure would only provide a total of 7.5 TPE for "yes".

Note, however, that we have assessed that the risk of further degradation or failure of the AMOS-3 is low, because Spacecom and IAI have put in place a careful battery management plan that protects the battery from further degradation.

Also, the risk of any failures on the AMOS-7 satellite is very low. This is a relatively new satellite, built by SSL, with adequate transponder redundancy, fuel and power margins. Based on previous failure rates and scenarios for similar spacecraft it is highly unlikely to suffer any partial or total transponder loss in the next 4-5 years.

As such, although we accept from the perspective of "*yes*" that Spacecom will proceed as rapidly as possible with a replacement satellite for the lost AMOS-6 satellite, we believe it is also acceptable for Spacecom to take a reasonable amount of time to optimise the design of AMOS-8, as long as it is able to plan to deploy the satellite – ideally within the next four years and no later than five years. Given that Spacecom has elected to pursue a new AMOS-8 satellite design, we recommend that "*yes*" participates in regular briefings with Spacecom and its manufacturer, to assess the adequacy of the design and its progress to the necessary launch schedule. The new arrangement requires Spacecom to facilitate these meetings and provide the agreed information.

5. SATELLITE ALTERNATIVES: TECHNICAL AND OPERATIONAL CONSIDERATIONS

5.1. Current Situation

"*yes*" currently transmits ten multi-channel digital satellite television carriers for Direct-to-Home (DTH) services via the Middle East beams of Spacecom's AMOS-2 and AMOS-3 satellites, co-located at 4° West longitude. Each carrier is allocated 36 MHz of spectrum within 72 MHz satellite transponders. As such, two carriers are present in many of the satellite transponders, as shown in Figure 1 below.[10]

Figure 1 – "*yes*" Carriers (current situation)

The white text is the satellite transponder designation, the black text is the carrier centre frequency, and the yellow text is the "*yes*" carrier designation ("X" means this part of the transponder is not used by "*yes*").

AMOS-2 and AMOS-3 are designed to operate co-located together without any overlapping of operating transponder frequencies. All "*yes*" transponders operate with horizontally polarised uplinks and vertically polarised downlinks. As such, all of the "*yes*" carriers are well isolated from one another without any mutual interference, as illustrated further in Annex 1.

The AMOS-2 and AMOS-3 transponders provide the EIRP and G/T levels illustrated below in Figure 2 and Figure 3. Since there are two carriers in the 72 MHz transponders, these are operated with a small amount of back-off resulting in a minimum of 52.5 dBW per carrier for "*yes*".

[10] "KFS" refers to the "*yes*" uplink site in Kfar Sava and "RR" refers to the backup site.

Figure 2 - AMOS-2 EIRP per 72 MHz Transponder (Vertical Polarisation)

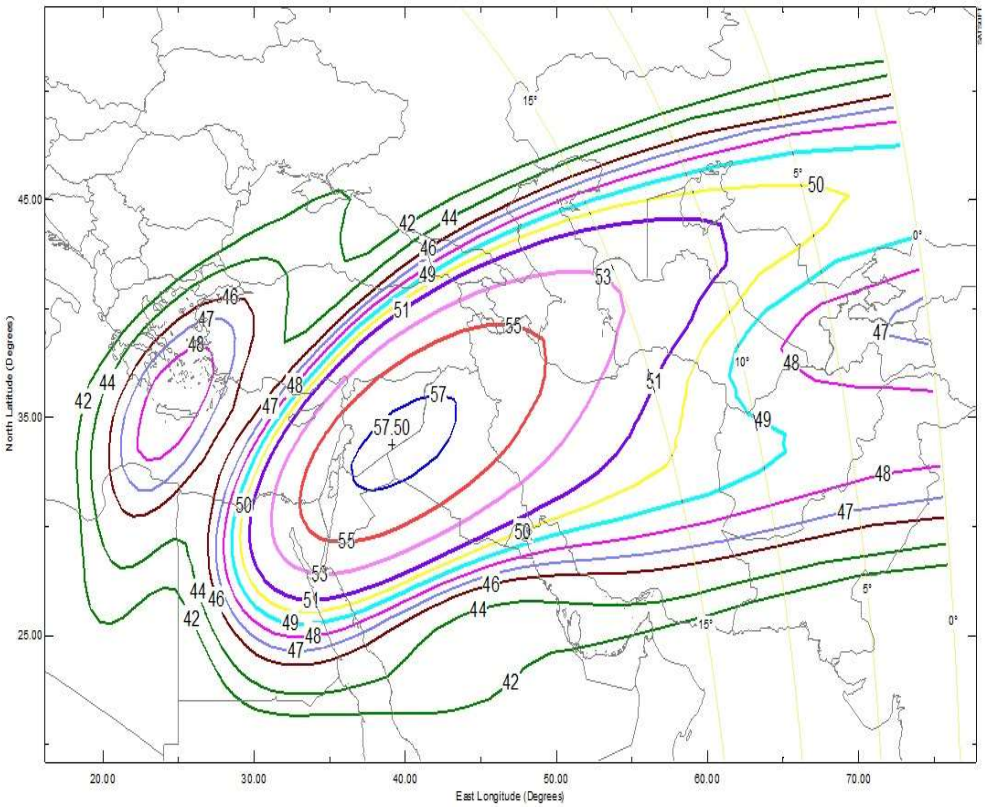


Figure 3 - AMOS-2 G/T (Horizontal Polarisation)

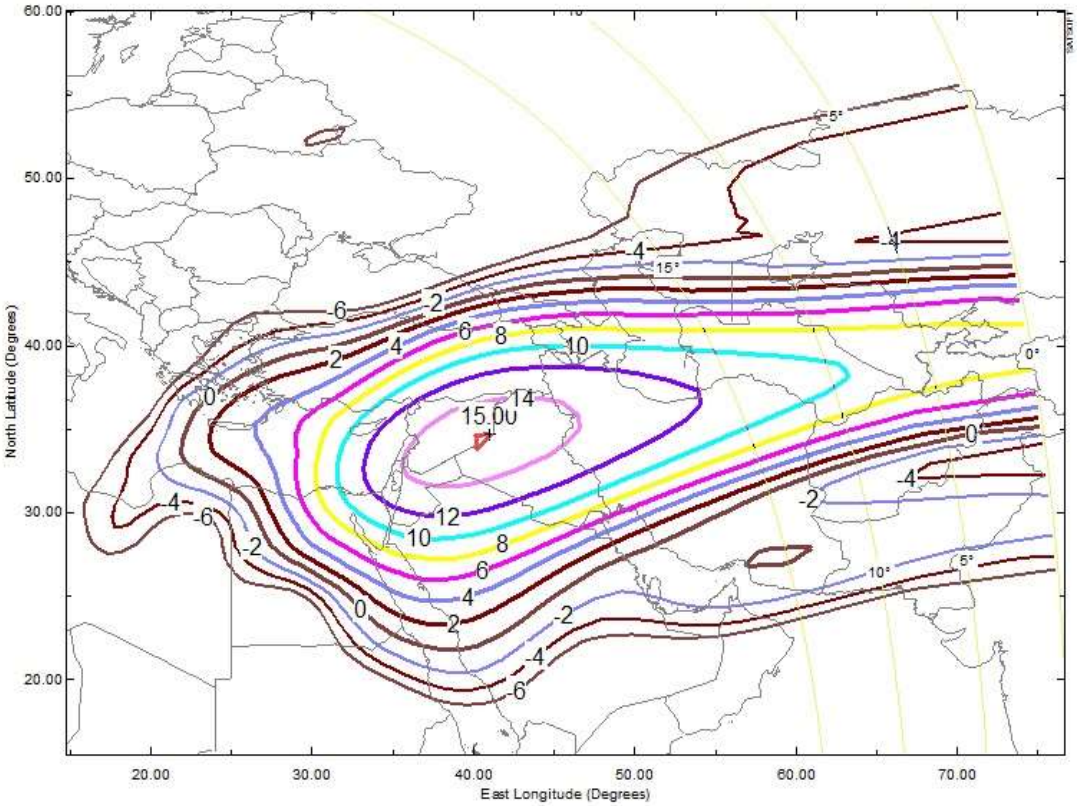


Figure 4 - AMOS-3 EIRP per 72 MHz Transponder (Vertical Polarisation)

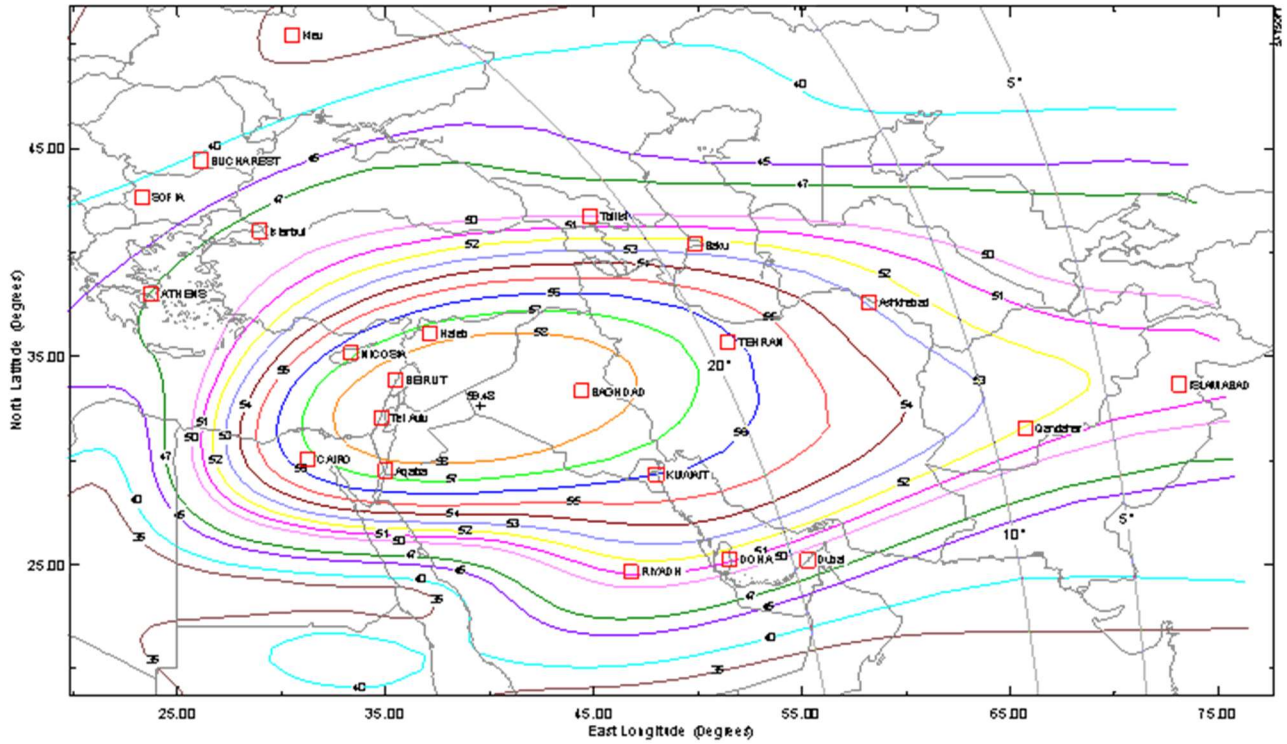
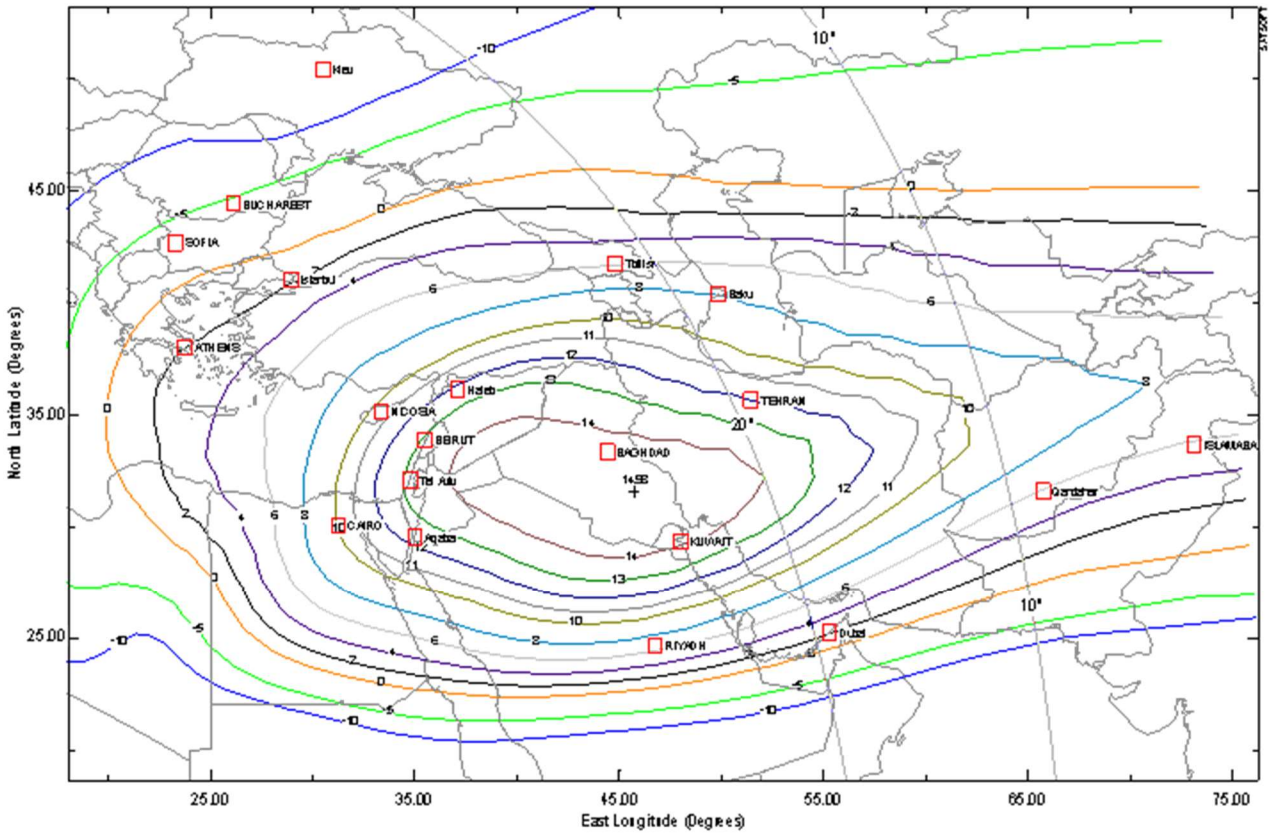


Figure 5 - AMOS-3 G/T (Horizontal Polarisation)



5.2. Alternatives for Continuation of "*yes*" DTH Services

The following alternatives were identified by "*yes*" for assessment and comparison:

a) Entering into a deal with Spacecom which includes the following aspects:
   i. Utilisation of the AsiaSat-8 satellite (to be designated AMOS-7) which will be re-located to the 4° West orbital slot in combination with AMOS-3.
   ii. Replacement of the AMOS-7 satellite in 4-5 years with a new satellite.
b) Alternative satellite to the Spacecom satellite(s) to be located at a different orbital location requiring a re-point of the customer antennas.
c) Alternative satellite which could be re-located to the Spacecom orbital slot at 4° West, thus eliminating the need to re-point customer antennas.

5.3. Alternative Satellite at a different location

Given the fact that "*yes*" has more than 600,000 subscribers with approximately [redacted] antennas pointed at the 4° West orbital position, moving to an alternative satellite at a different orbital position would require a complete re-pointing of the all subscriber antennas at a cost of approximately [redacted] million.[11] Furthermore, the logistics of re-pointing the entire network could take 12-24 months and there is no guarantee that moving to another satellite at a different orbital slot will provide any recurring cost savings or other performance benefits.

Therefore, at this time, COMSYS does not recommend that "*yes*" seriously investigate moving to an alternative satellite(s) at an alternative location.

As part of this report, COMSYS performed a "first level" search of potential satellites that are in view of Israel, operate in the Ku-Band and have coverage over Israel. The results of this search are provided in Annex 2 at the end of this report.

COMSYS contacted three of the major satellite operators in the region who would be most likely to be able to provide capacity at an orbital location suitable for the "*yes*" coverage requirements. We provided each of them with a Requirements Specification developed by "*yes*".

Negotiations with these satellite operators will probably take several months to conclude and there is no guarantee that a satisfactory technical and commercial outcome can be achieved, in particular in relation to pricing, as these operators will be aware that "*yes*" has limited options available and needs to make a quick decision. It is currently the view of "*yes*" management that these options do not represent a realistic and reasonable opportunity within the time constraints imposed by the imminent EOL of AMOS-2, and which involves a co-located satellite that is already being moved to 4° West. On the basis of the above constraints and risk factors it is the COMSYS view that unless there are significant delays in execution of the AMOS-7 agreement between Spacecom and "*yes*" the alternative satellite option will be unreasonably risky.

[11] COMSYS believes this cost could be [redacted] million lower than this amount depending on where the alternative satellite would be located (satellites close to the 4° West orbital position would require minimal re-pointing effort whereas satellites further away would require a re-pointing plus a possible re-location to avoid obstructions) and what discounts the alternative satellite operator would be willing to provide to "*yes*" during the transition period. However, such an effort would typically require 1-2 years for planning, negotiation and implementation.

5.4. Alternative Satellite relocated to 4° West

We note that this alternative was mooted by "*yes*" before Spacecom committed to relocating AMOS-7 to 4° West. Given that Spacecom will be operating AMOS-3 and AMOS-7 at 4° West with both satellites having Ku-band beams and many transponder frequencies over the Middle East, there is insufficient unused Ku-band frequency spectrum over the Middle East to permit another satellite to be co-located at 4° West and provide an adequate number of transponders to "*yes*". As such, we evaluate that this alternative is not feasible due to the decisions that Spacecom has taken regarding AMOS-7.

5.5. AsiaSat-8 Satellite (AMOS-7) relocated to 4° West

Spacecom announced on 1 December 2016 that it had entered into an agreement with AsiaSat to relocate its AsiaSat-8 satellite from its current orbital position to Spacecom's orbital position at 4° West.[12] AsiaSat-8 (to be renamed "AMOS-7") will be co-located with AMOS-3, for a four-year period. The satellite is expected to begin service for Spacecom in Q1 2017 to replace AMOS-2. Spacecom has an option to extend the agreement for an additional year of service.

Following receipt of the required regulatory approvals, AsiaSat is now relocating its satellite to the 4° West orbital position where it is expected to arrive by end February 2017. Following testing, AMOS-7's beams will cover the Middle East, Central Eastern Europe and Africa and the satellite is expected to be in commercial operation during March 2017.

AsiaSat-8 was launched in August 2014 with an expected lifetime of at least 15 years. It was built by Palo Alto-based SSL, one of the world's most experienced and reliable satellite manufacturers. The satellite and payload are reported to be fully operational, in good health, operating nominally, with no anomalies affecting any part or subsystem, and with 24 active TWTAs plus six spares supporting its four beams.

The "*India Beam*" will be used to replace the AMOS-2 "ME Beam", when operated from 4° West, and can provide eight 54 MHz operating transponders into this beam. The predicted EIRP and G/T of each AMOS-7 "*India Beam*" transponder, when positioned at 4° West over the Middle East are shown in Figure 6 and Figure 7 below. Spacecom is then planning to perform a fine tuning repointing around this location once the satellite arrives at 4° West, based on measurements that "*yes*" will perform in Haifa and Kfar Saba. The new coverage map that will be generated will be attached to the contract as part of the technical annex and will serve as the reference point. Spacecom believes that the predicted performance levels indicated in these coverage plots are conservative and that the actual measurements will be higher.

As can be seen from these plots (and even taking the above conservative approach), AMOS-7 provides EIRP of greater than [redacted] dBW and G/T of +8 dB.K^{-1} per 54 MHz transponder over most of the "*yes*" service area. When used with two carriers of 36 MHz and 18 MHz, this EIRP level [redacted] dBW per 36 MHz including 1.5 dB OBO[13] for two carrier operation) is around the same as is currently shown in the predicted coverage plots for AMOS-2 ([redacted] dBW over most of Israel giving [redacted] dBW per 36 MHz including 1.5 dB OBO for two carrier operation). The G/T is a few dB lower than provided by AMOS-2, thereby having some effect on the "*yes*" uplink budgets, which will need to be addressed, but is not considered to be a significant issue.

[12] The Spacecom / "yes" Agreement specifies (Clause 7.4) that "*yes*", "*….will be entitled to participate alongside Spacecom in negotiations for supply of the Alternative Capacity in the Other Satellite*".

[13] Output Back-Off – a reduction in transmission power required for technical reasons (to prevent intermodulation) when using Travelling Wave Tube Amplifiers with more than one carrier.

Figure 6 - AMOS-7 Middle East EIRP (dBW) - with predicted repoint from 4° West[14]

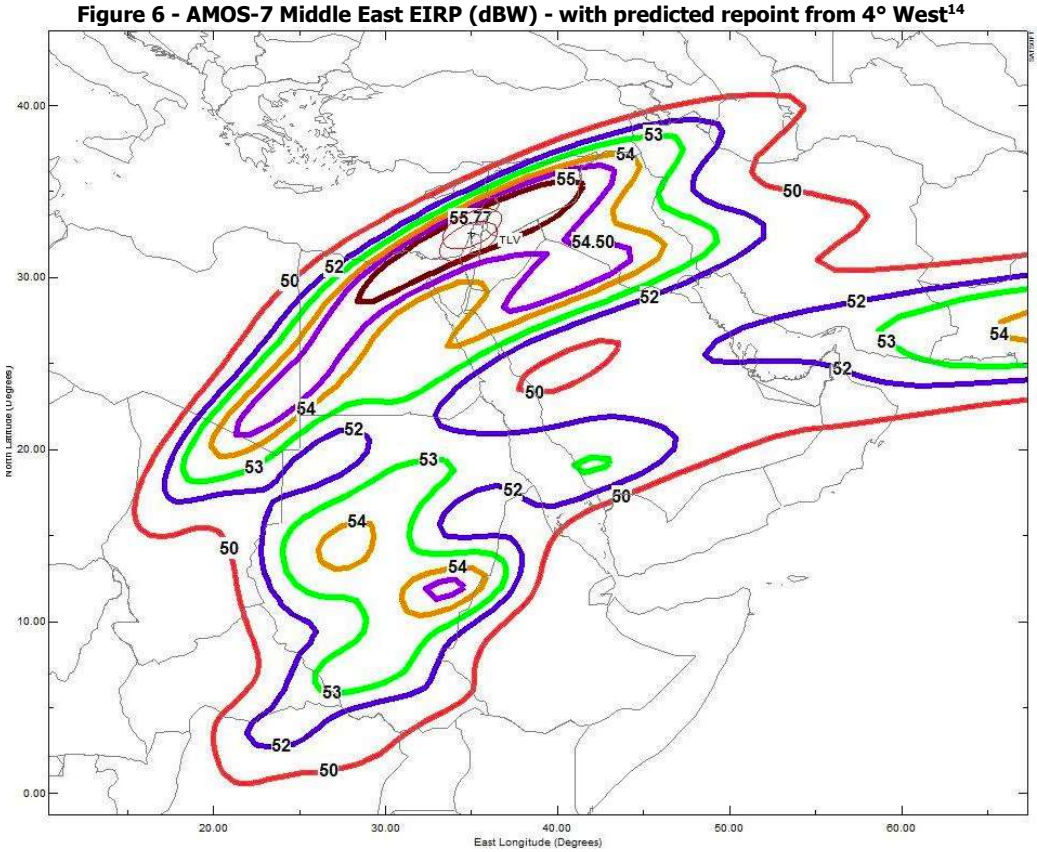
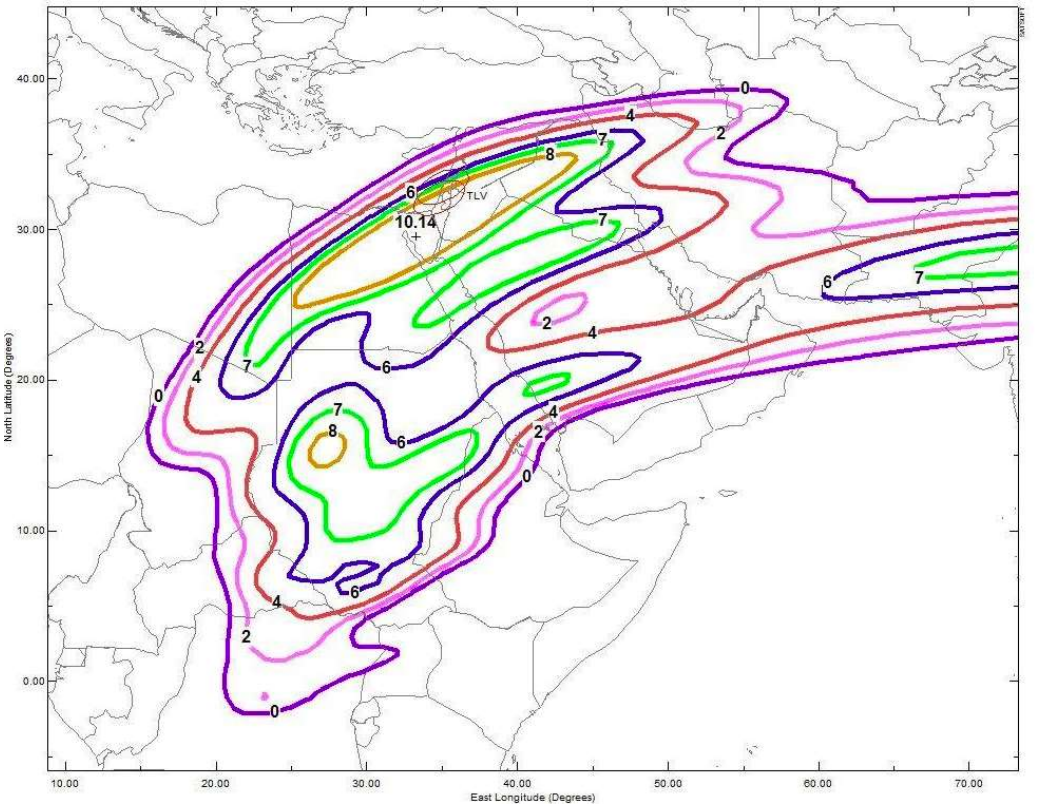


Figure 7 - AMOS-7 Middle East G/T (dB.K-1) – with predicted repoint from 4° West



[14] Subject to contractual confirmation and in-orbit tests at 4° West (applies also to Figure 7).

5.6. Co-location of AMOS-7 with AMOS-3 for "yes" Services

AMOS-7 can provide eight 54 MHz transponders into the "India Beam", which becomes the "ME Beam" at the 4° West orbital position. These transponders are summarised in Table 5below.

Table 5 - AMOS-7 "ME Beam" Transponders

[redacted]

These transponder frequencies are in the suitable range for operation at 4° West, as they largely overlap / interleave with the transponder frequencies of AMOS-2 and AMOS-3. Also, since AMOS-3 has a flexible frequency plan enabling it to re-allocate transponder frequencies, this enables the frequency plans of AMOS-7 and AMOS-3 to be arranged in a largely complementary fashion.

As such, Spacecom has proposed to transition today's AMOS-2 plus AMOS-3 services to a combination of transponders on AMOS-3 and AMOS-7. To achieve this transition, Spacecom has also proposed an interim reconfiguration of *"yes"* AMOS-2 plus AMOS-3 carriers, as shown in Figure 8 below.

Figure 8 - Reconfiguration of AMOS 2, AMOS 3 capacity before the arrival of AMOS-7

[redacted]

This option preserves all of "*yes*"s ten carriers and eases the transition to AMOS-7. A more detailed frequency plan is illustrated in Annex 1, showing that all the transponder allocations are separated from one another without any mutual interference.

After the arrival of AMOS-7 at 4° West, Spacecom proposes the transponder assignments listed in Figure 9 below, in which AMOS-7 transponder IK1V has been assigned to "*yes*". We assume that IK2V has been assigned to other users. Presumably this was done to make the carrier frequency transitions easier for "*yes*", as illustrated in the detailed frequency charts in Annex 1.

Figure 9 - AMOS-3 and AMOS-7 Transponder Assignments for "*yes*"

The proposed plan continues to preserve the services for all twelve "*yes*" carriers with six segments assigned to AMOS-3 and six segments assigned to AMOS-7.[15]

The six "*yes*" carriers assigned to AMOS-3 continue to be operated with two carriers per 72 MHz transponder and will be provided with the same EIRP and G/T levels as today's "*yes*" carriers on AMOS-3. They will also use the same uplink and downlink polarisations as today's services, with just some minor frequency retuning required for four of the six carriers. Carriers 8 and 10 are maintained on AMOS-3 at exactly the same frequencies as today which we view as a positive aspect to the new arrangements.

The four "*yes*" transponders assigned to AMOS-7 are each occupied by two "*yes*" carriers, one at 36 MHz, and the other occupying the remaining available transponder bandwidth (three at 18 MHz; one at 12 MHz).[16] Of these carriers, those that come from AMOS-2 will have around

[15] The six segments on AsiaSat-8 will be allocated as four 36 MHz segments and three 18 MHz segments, and one 12 MHz segment (equivalent to six 36 MHz segments overall).
[16] In the event that "*yes*" broadcasts SD channels in this remaining 18 MHz of transponder bandwidth there will be a very small number (less than [redacted] per cent) of boxes ([redacted] model) which may be unable to receive the service. Also, this represents the total number of [redacted] boxes and it is likely that at least some of these are

the same EIRP levels per 36 MHz as they currently have on AMOS-2. The carriers coming from AMOS-3 have slightly lower EIRP on AMOS-7, but this is not critical since the AMOS-2 minimum performance drives the overall quality of services provided by *"yes".*

All AMOS-7 carriers will also have a few dB lower G/T than either AMOS-2 or AMOS-3, but again this is not considered to be significant, since it only affects a few *"yes"* uplink stations, which we believe can readily accommodate the reduced satellite G/T.

The detailed co-located frequency plan in Annex 1 illustrates some key points, as follows:

- AMOS-7 transponders K7V and IK3V slightly overlap with AMOS-3 transponder 204/116. There is 5.5 MHz overlap between 204/116 and K7V only on the downlink; there is 9 MHz overlap between 204/116 and IK3V only on the uplink. Since 204/116 and IK3V and assigned to other users, Spacecom will need to carefully co-ordinate between these users and *"yes"* to avoid any interference between the transponders. To avoid any problems, it appears that Spacecom is proposing that *"yes"* only use the lower 48 MHz of the K7V transponder. This enables Spacecom to use the full 204/116 transponder for other users and *"yes"* should be aware that there could be high powered downlink carriers in the 5.5 MHz adjacent to the upper end of its 48 MHz in transponder K7V.

- With the assignment of six of the eight available AMOS-7 transponders in the "ME Beam", this appears to block Spacecom from operating at least one of the AMOS-3 transponders ([redacted]). This makes sense for two reasons: firstly it enables two AMOS-7 transponders to be used, which in aggregate have more power and bandwidth than a single AMOS-3 transponder; secondly it may enable reduced power demand for AMOS-3 during eclipse, which is important for battery management.

Regarding polarisations, all of the AMOS-7 transponders use vertically polarised downlinks, the same as currently used for all *"yes"* services. This means there will be very little disruption (if any) for *"yes"* customers - only some minor changes to the receive frequencies of some channels, which we believe can be accommodated with software programming updates to the receivers.

For the uplinks, however, three of the four AMOS-7 transponders will use Vertical polarisation as compared to Horizontal polarisation currently in use. This means that some of *"yes"'* uplink stations will need to be reconfigured to operate in Vertical polarisation and we have been informed by "*yes*" that they are already equipped to do so.

In summary, the solution of co-locating AMOS-7 with AMOS-3 in order to replace the moribund AMOS-2 satellite enables the full preservation of all *"yes"* DTH services with negligible (if any) levels of service disruption and reconfiguration. The power and bandwidth are comparable to the *"yes"* services that it will replace on AMOS-2. As such, we consider this to be as fair reasonable additional value added (in addition to other pricing and discount incentives, as detailed in Section 6) to compensate for the slightly higher transponder payments agreed with Spacecom.

not still in use. "*yes*" believes this to be a relatively insignificant issue which is easily rectified with supply of different decoder boxes where required, free of charge to the customer.

5.7. AMOS-7 Capability to Back-Up Further AMOS-3 Issues

As described earlier, AMOS-3 has battery anomalies that restrict the number of transponders that can be used during eclipse. It also appears to have no redundancy in the event of any on-board Ku-band TWTA anomalies.

In the event of further degradation or complete failure of the AMOS-3 battery, or the loss of one or more Ku-TWTAs, therefore, it is important to consider if "*yes*"s' full set of 9-10 carriers can be maintained.

In case of failure of the entire Middle East beam on AMOS-3 then "*yes*" is entitled to receive an additional 1.5 segments on AMOS-7 – which then provides a total of 7.5 segments on AMOS-7.

The health of the AMOS-3 satellite appears to have stabilised, despite the battery anomalies suffered in 2011, due to the corrective actions taken by Spacecom and IAI. Provided that the restrictive operating conditions during eclipse are strictly maintained by good operating procedures (maximum 1,225 Watt power demand) then the probability of further loss of AMOS-3 capacity is very low for the remaining design lifetime of the satellite. Similarly, the probability of a spate of Ku-band TWTA losses is very low.

In contrast to today's situation, therefore, where the AMOS-2 satellite is almost out of fuel and is being allowed to drift into inclined orbit, the proposal by Spacecom to co-locate AMOS-7 with AMOS-3 is a far more robust solution for "*yes*" and is judged to have a very high probability of maintaining current "*yes*" services (and possibly even allowing some modest growth in the channel capacity).

On the basis of the options currently available we therefore recommend this alternative to "*yes*".

5.8. New Satellite Option for "yes"

COMSYS has also considered the option of "*yes*" (or Bezeq) procuring a new satellite which probably need to be located at a different location to 4° West.[17] We approached a number of spacecraft manufacturers[18] with a Request for Information (RFI) about the possibility of procuring a new satellite, either as a sole customer, or in a CondoSat arrangement (in which the payload is shared with another customer). Each of them provided a positive interim response indicating that they have customers who might be interested (at least in principle) in entering into a CondoSat arrangement. There were also offers of small satellites that could be built and launched within an 18-24 month period. However, given that AMOS-2 has already reached EOL, it is most unlikely that negotiations could be completed in less than a few months and for that reason the COMSYS view is that this does not provide a prudent or reasonable option for "*yes*".

[17] Spacecom operates its satellites at 4° West under a licence / permit from the Government of Israel. COMSYS has not seen a copy of the appropriate licences but it is likely that Spacecom would retain the right to operate at that location to the exclusion of other operators.
[18] Airbus / Boeing / Loral / Orbital ATK / Thales Alenia Space.

5.9. Long Term Solution

AMOS-6 was unfortunately lost during launch preparations in September 2016. It is our opinion that the principles underlying Spacecom's well-conceived planning for AMOS-6 remain intact with respect to "*yes*"' services.

Although we were commissioned to assess Spacecom's plans for the replacement satellite for AMOS-6, which has been designated by Spacecom as AMOS-8, as part of this report, we were informed by Spacecom that only preliminary details were available because it is still being designed.

We also understand that Spacecom has stated that it may take 3-4 years to bring AMOS-8 into service. The original AMOS-6 programme was started in June 2012 and ready for launch in September 2016. Although this is slightly over four years, we understand that the AMOS-6 satellite contained a number of new technology developments which required a long period of development.

The proposed Amendment requires Spacecom (before EDC) to meet with "*yes*" every three months "*in order to obtain information about the progress of negotiations regarding an agreement with the manufacturer of AMOS-8.*"[19] Once AMOS-8 is under contract, Spacecom is required to meet with "*yes*" and the AMOS-8 manufacturer every two months, to "*to obtain information about the progress of the satellite design contract, construction of the satellite, launch and positioning (as applicable).*"[20]

[19] Informal translation of Clause 4.1.5 of the Amendment.
[20] Ibid.

6. THE PROPOSED NEW ARRANGEMENTS

COMSYS has reviewed the proposed new arrangements to the agreement between Spacecom and "*yes*" executed in November 2013. The following are the main elements of the new arrangement:

- Allocation of Segments:
  - During the lifetime of AMOS-3 and AMOS-7 "*yes*" will have six segments on AMOS-3 and six segments on AMOS-7.
  - During the lifetime of AMOS-3 and AMOS-8 "*yes*" will have four segments on AMOS-3 and eight segments on AMOS-7.
  - Following the EOL of AMOS-3 "*yes*" will have twelve segments on AMOS-8.
- Pricing:
  - AMOS-3 and AMOS-8: [redacted] million per segment per year.
  - AMOS-7: [redacted] million per segment per year.
- Potential Pricing Reductions and Discounts:
  - If Spacecom's total gross annual revenue from AMOS-3 and AMOS-7 (from any customer) during the operational period of AMOS-7 exceeds [redacted] million then "*yes*" will receive a payment of one third of any such additional revenue.
  - If during the AMOS-8 operational period the total number of segments leased by Spacecom to any customer) exceeds [redacted], then for each additional segment (up to a maximum of four additional segments) "*yes*" will receive an annual discount of [redacted] for each segment leased by "*yes*". Thus, the maximum annual discount receivable by "yes" will be $2.4 million.
- Term:
  - Nominally, until end 2028.
  - Termination for Convenience: Same as existing agreement, but with full payment for AMOS-7 capacity until the end of its lease term (four or five years).
  - Early termination with no penalty (following the AMOS-7 lease term) if the AMOS-8 EDC does not occur within 24 months of signature of the new agreement.
- Subletting:
  - Right to sublet any segment is maintained as per existing agreement.
- AMOS-3 Eclipse:
  - Provided that the total capacity leased by "*yes*" on AMOS-3 exceeds six segments, then the new Amendment provides for Spacecom to shut off one transponder during eclipse periods, provided that it will use its best reasonable efforts to avoid such shut-off. In any case the shut-off shall be for the minimum required duration.
- "Most Favoured Nation" (MFN):
  - Spacecom warrants that it has not contracted with any third party having similar lease parameters which provides the third party with more favourable terms that those agreed with "*yes*".

Of particular interest are the improved backup arrangements as summarised below.

Under the existing agreement, in the case of unavailability of AMOS-6 or AMOS-6R by 31 March 2017 (or failure to launch by 31 January 2017) , "*yes*" may terminate for cause, or Spacecom is required to provide "*yes*" (following notice from "*yes*") with nine segments on AMOS-3 for the rest of its life.

Also, under the existing agreement, in any case of space segment unavailability during the period of the agreement, Spacecom is required to provide "*yes*" with at least 50 per cent of

the leased capacity (e.g. six space segments in the event that "*yes*" is leasing twelve segments).

The proposed amendment includes the following backup commitments from Spacecom to "*yes*", which we assess as representing improved levels of service to "*yes*":

1. During the period of AMOS-3 and AMOS-7 operations, where the Middle East beam of one of them fails:

    a. If AMOS-3 fails, "*yes*" is allocated 7.5 segments on AMOS-7.
    b. If AMOS 7 fails, then:
        i. During any period of unavailability before 15 March 2021 (and if the planned ISD for AMOS-8 of 1 February 2021 has not been achieved), "*yes*" gets eight segments on AMOS 3 (plus best reasonable efforts to provide an additional segment on AMOS-3).[21]
        ii. During any period of unavailability on or after 15 March 2021 and if the AMOS-8 ISD is still delayed:
            1. Then for periods of unavailability from 15 March 2021 to 1 July 2021 then "*yes*" is allocated nine segments on AMOS-3.[22]
            2. For periods of unavailability from 1 July 2021 then "*yes*" is allocated a total of ten segments on AMOS-3.[23]

2. In the case[24] where all of the capacity is on AMOS-3, as described above, and AMOS-8 becomes commercially operational at 4° West by 1 February 2022, then the segments allocated to "*yes*" will be eight on AMOS-8 and four on AMOS-3. In case it becomes commercially operational at 4° West at a later date, "*yes*" will have the right, but not the obligation, to switch to this allocation.

3. During the period of AMOS-3 and AMOS-8, where one of them partially or totally fails, "*yes*" will be allocated segments as follows:

    a. In case of AMOS-3 partial or total failure:[25] - a total of twelve segments.
    b. In the event of AMOS-8 total failure (or partial failure in which "*yes*" has less than six segments on AMOS-8):[26] A total of ten segments on one or both of AMOS-3 and AMOS-8.

4. Under the existing agreement, Spacecom is required to reserve an exclusive transponder for "*yes*" for an event of unavailability and an additional transponder as a "General Reserve". In the new agreement these two reserve transponders will be provided on AMOS-8. In both the existing and new arrangements if the Exclusive Transponder and General Transponder are together unable to provide backup for unavailability of the "*yes*" services then Spacecom is required to use "best reasonable efforts" in order to provide "*yes*" with additional segments on Spacecom's own fleet of satellites. If Spacecom is still unable to provide such backup then it is required to use "best efforts" to provide "*Alternative Capacity*" on "*Other Satellite[s]*". The new agreement provides for additional backup in that three TWTAs are reserved on AMOS-7 for exclusive use by "*yes*".

[21] Clause 3.2.1.3.
[22] Ibid.
[23] Ibid.
[24] Clause 4.1.7 (paragraph 2).
[25] Clause 5.3.
[26] Clause 4.2.2.2.

7. SATELLITE HEALTH

7.1. AMOS-2 Health, Redundancy and Lifetime

AMOS-2 was launched in December 2003 and has already exceeded its worst-case predicted fuel lifetime of September 2016 (99.7 per cent confidence) (i=0). The latest health report (dated 1 December 2016) provides the following fuel lifetime related information:

1. Although some fuel remains, much of this is needed for de-orbiting the satellite and other non-usable amounts; there is very little fuel left for station keeping. Moreover, IAI reports that [redacted] of fuel plus oxidiser was used in June 2016 to recover from an anomaly, reducing the lifetime by 2.5 weeks.
2. At Spacecom's request, the last inclination manoeuvre was performed in June 2016. Since these manoeuvres are normally performed every 3-4 months in order to keep the satellite within its North South Station Keeping (NSSK) limits, Spacecom is allowing AMOS-2 to drift outside of these limits to preserve fuel. With inclination drift of ~0.85° per year, the satellite is already close to 0.4° inclination, and increasing each day. At some point this inclination drift will reduce the performance of the "*yes*" customer receivers, since they are all pointed at a fixed location in the sky corresponding to 4° West with zero inclination angle.
3. Other manoeuvres are continuing to keep the satellite pointed at the Earth and within its East West Station Keeping (EWSK) limits, since these use much less fuel than NSSK manoeuvres.

Apart from its very limited fuel lifetime, AMOS-2 appears to be in generally good health for a satellite of its age. Full 14-for-11 transponder redundancy remains, as well as redundancy of other subsystems and units. It also has very good electrical power margins both during sunlight and eclipse, meaning there is always sufficient power for all eleven operating transponders.

The only major loss of redundancy appears to be the loss of Beacon-2 in September 2015. Beacon-1 operates nominally. If Beacon-1 failed then pointing of "*yes*'" transmitting Earth Stations could be compromised, as well as the installation of new customer receivers, but such a failure is unlikely within the few remaining months of operation.

Given the AMOS-2 fuel situation, and resulting discontinuation of NSSK in June 2016, therefore, it is imperative that "*yes*" finds replacement capacity for AMOS-2 at its earliest convenience.

7.2. AMOS-3 Health, Redundancy and Lifetime

AMOS-3 was launched in April 2008 and has a predicted EOL of February 2026 (with 99.7 per cent confidence). All payload and platform subsystems and units are performing nominally with as-designed redundancy, with the notable exception of the Electrical Power Subsystem (EPS).

Within the EPS, the Battery has suffered two battery cell partial failures in the Spring and Autumn eclipse seasons of 2011, respectively. To prevent further degradation of these cells, IAI has determined that the maximum eclipse power demand must be strictly limited to no more than [redacted] Watts.

This limitation means that some of the AMOS-3 transponders must be switched off during eclipse. [redacted]

תיאור של המענה הטכנולוגי של לוויין עמוס3 לתופעת תופעת "אקליפס" (מצב המתרחש פעמיים בשנה קלנדארית, למשך כ-46 ימים כל פעם, במהלכו לא קיים קו ראייה ישיר בין השמש ללוויין במהלך חלק מהיום לפנות בוקר, באופן שבו בתקופה זו נאלץ הלוויין לפעול באמצעות מצבריו בלבד)

[redacted]

[redacted]

[redacted]

Other than the battery anomaly, we also note that AMOS-3 appears to have no Ku-band transponder redundancy (i.e. it operates in 13-for-13 TWTA configuration). While TWTAs are highly reliable, with a long term average failure rate of around 1 per 500 transponder years of operation, there is some risk that AMOS-3 transponders could randomly fail over the coming years, potentially reducing the capacity available to "*yes*".

8. TERRESTRIAL IPTV ALTERNATIVE

As part of its scope, COMSYS was asked to provide an opinion on moving from a satellite distribution alternative to wholly terrestrial IP distribution of programming. Such an approach may offer the following advantages over satellite distribution:

1. **More robust solution:** With an IP distribution model, multiple servers could be used to distribute programming, thereby eliminating the single point of failure (or significantly reduced capacity) in a satellite distribution model.

2. **More cost-effective solution:** Satellite distribution is characterised by high fixed distribution costs (satellite costs) and low variable distribution costs (essentially, just the cost of an additional STB. With an IP distribution model, the distribution costs are driven by the cost per GB to put programmes onto the IP network. With non-linear programming (like the "*yes*" current VOD service), there is a cost to "*yes*" for each movie / programme distributed to each customer. With linear programming, "*yes*" would stream (multi-cast) its full channel line-up into the IP network and customers would decide what channels or programmes to store for later viewing (non-linear viewing) on their DVR.

While the technology exists to support such an approach, there are several issues that must be addressed before "*yes*" could even consider moving from satellite to terrestrial broadband for distribution of programming. These include:

1. The costs of streaming the full channel line-up in a linear fashion (multi-casting).
2. The costs of streaming all channels in a non-linear fashion (essentially VOD for all channels).
3. The costs of upgrading all set-top-boxes (STB) to IP compatible STBs.
4. The costs of satellite capacity during the transition period where both satellite and terrestrial capacity will be required.
5. The availability of broadband capacity and speeds in Israel. Approximately [redacted] Mbps speeds would be sufficient to transmit two or three channels of HD programming and provide additional capacity for other internet services. However, Ultra-HD[27] (when programming becomes available) will require significantly mode capacity (approximately [redacted] Mbps per channel). Bezeq and "*yes*" have estimated that users will require a minimum of [redacted] Mbps speeds to support Ultra-HD services.
6. Agreements with programmers that may restrict or limit "*yes*" ability to distribute programming via IP. Some programmers believe that IP distribution may not be as secure as other methods and may have restrictions incorporated into programming agreements.
7. There is a trend away from "nuclear" family watching TV to each individual watching on their own devices, and this significantly increases the data requirement for each home.[28]

"*yes*" provided us an analysis of the costs related to items 1-4 above. We believe these costs are reasonable and in line with our expectations. Table 6 below shows how satellite and terrestrial (IP) distribution compare on these issues.

[27] Ultra-HD includes 4K and 8K modes. The latter is likely to become common only in several years' time, but within the lifetime of the proposed AMOS-8 satellite.
[28] It will, of course, be possible to limit data rates and video mode (such as SD / HD / 4K) on some or all devices and all devices may not be in use at the same time but it can be expected that (a) peak data rates will increase and (b) that overall data volume will significantly increase.

Table 6 - Comparison of Satellite and IPTV Options

	Satellite Distribution	Terrestrial (IP) Distribution
Costs for linear distribution	Costs of the transponders: 12 segments at [redacted] million or $21.6 million per year	Capital costs from "*yes*" to support IP distribution of programming: [redacted] million.[29] Costs from Bezeq to support multicast streaming of programming and support of Ultra-HD programming on the network: [redacted] million ([redacted] million in capital costs and [redacted] million in operating costs).[30].
Costs for non-linear distribution	Not practical	Not practical for full distribution of programming in a non-linear fashion.
Costs for STB upgrade	Not required	Approximately [redacted] per cent of installed STBs ([redacted] million) do not support IPTV. The costs to upgrade each of these STBs is estimated to be an average of [redacted] per STB (including equipment and labour costs), or a total cost of [redacted] million.[31]
Costs of satellite capacity and terrestrial capacity during the transition period.	Not required.	We estimate that transition from the current satellite distribution to IPTV distribution will require 12 to 24 months from the time the conversion begins (January 2019). The costs of the satellite capacity alone from 2017 to the end of the transition period (end of the "*yes*" satellite commitment at the end of [redacted]) is [redacted] million per year (nine segments at [redacted] million each), so we estimate the additional costs during the overlap period to be approximately [redacted] million.
Availability of broadband (to support current HD and SD programming)	Not a problem.	Per Bezeq, almost 100 per cent of the homes in Israel are passed with a minimum of [redacted] Mbps Internet service. Also, per Bezeq, approximately [redacted] per cent of households subscribe to Internet services with these speeds. Therefore, today, the terrestrial network could support IP distribution. However, to

[29] Source: "*yes*"
[30] Source: "*yes*". The [redacted] million in operating costs is [redacted] million per year for seven years.
[31] Source: *"yes"*

		support the IPTV distribution [redacted], will require an investment by Bezeq estimated at [redacted] million (see "*Costs for linear distribution*" above).
Availability of broadband (to support Ultra-HD programming)	"*yes*" estimated that within [redacted], they will be distributing [redacted] channels of Ultra-HD programming. "*yes*" currently has two segments that are not being used and will have additional capacity available when the SD programming is phased out. COMSYS estimates that "*yes*" will be able to accommodate [redacted] Ultra-HD channels within its current satellite commitments with Spacecom at no additional satellite costs.	As mentioned above, [redacted] Mbps speed is not sufficient to distribute Ultra-HD programming along with other services. Therefore, any move to Ultra-HD programming would require an upgrade to the terrestrial IP network. The Bezeq network uses fibre optic transmission to the "curb" and then copper to the home (ADSL). The speed of transmission to the home is determined by the length of the copper loop. The shorter the length the higher the speed (and vice-versa). Therefore, Bezeq would be required to "re-wire" its network to support near 100 per cent distribution of Ultra-HD programming to customers. Bezeq's cost estimate of [redacted] million (see "*Costs for linear distribution*" above) will allow the Bezeq network to support Ultra-HD programming services.
Programmer restrictions or limitations	Not an issue.	This would require further investigation by reviewing the terms of each programmer's contract with "*yes*".

The issue eventually comes down to one of economics and availability and quality of broadband services. Based on information provided by "*yes*" and Bezeq (and which, from our experience and knowledge of the industry, we consider to be reasonable) we estimate the total costs to transition to an IPTV distribution model to be in excess of [redacted] million when all costs are considered and normal programme contingencies are considered.[32] While it is difficult to quantity issues related to the quality of the broadband services, such issues usually result in schedule delays that will increase the costs of the overlapping transition period. We have most recently observed the difficulties that AT&T has experienced while trying to add a limited number of OTT ("Over-the-Top") channels (the DirecTV "*Now*" service) that are distributed over the terrestrial IP network.[33] This service had been in the planning for several years.

[32] Normal programme contingencies for a project of this complexity would be between 5-10 per cent.
[33] Reference: "http://www.businessinsider.in/atts-new-35-streaming-tv-service-keeps-getting-hit-with-big-outages/articleshow/55987285.cms"

It should be noted that satellite distribution is an extremely efficient method of broadcasting information, whether it be video or audio. Transmitting a single signal(s) can reach very large geographic areas and large populations with no consideration for the terrestrial broadband infrastructure.

We note that both DirecTV and Sky have announced that they will be using IPTV to expand their service offerings, but this is in addition to their satellite delivery option, not as a replacement. We also note that Airtel in India, which implemented a partial IPTV delivery option in 2008, has now reverted to full satellite delivery, and no satellite DTH operator has moved its delivery platform to full IPTV. This supports the "*yes*" caution in considering the option of moving to full IPTV delivery.

8.1. Conclusions re IPTV Options

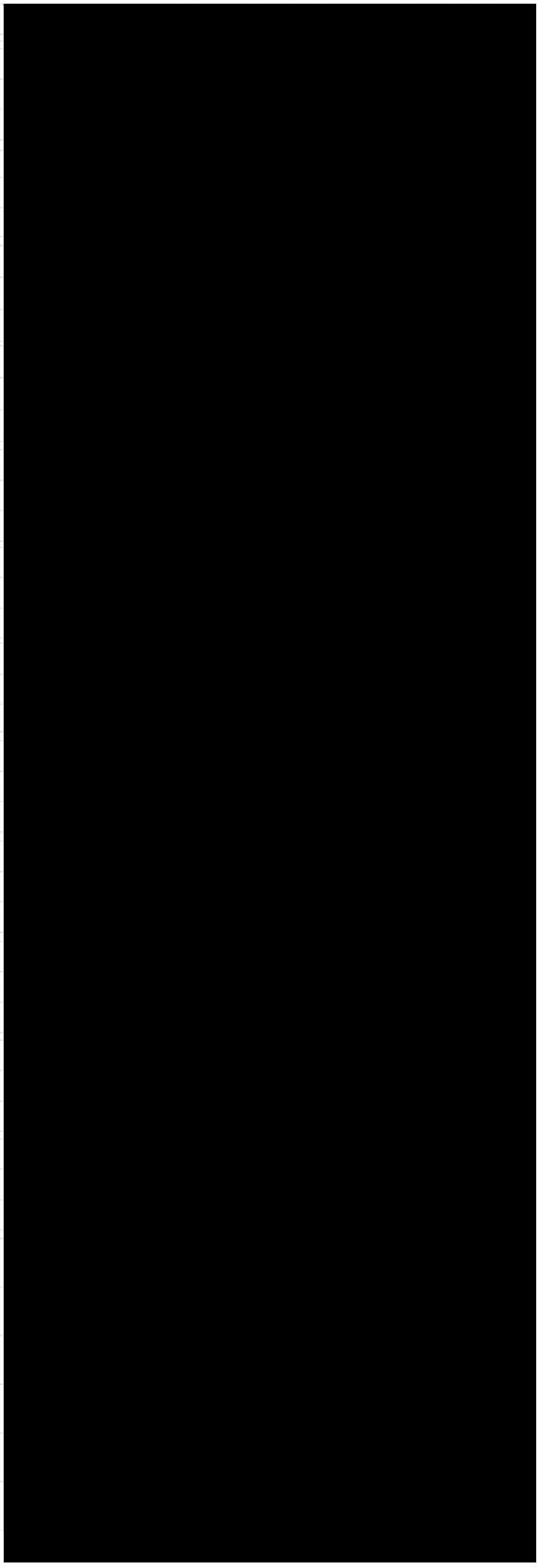
Based on our analysis we believe that in the foreseeable future satellite distribution of programming is the best method of primary distribution for "*yes*".

We conclude that a full IPTV delivery option will be unattractive for "*yes*" for the following main reasons:

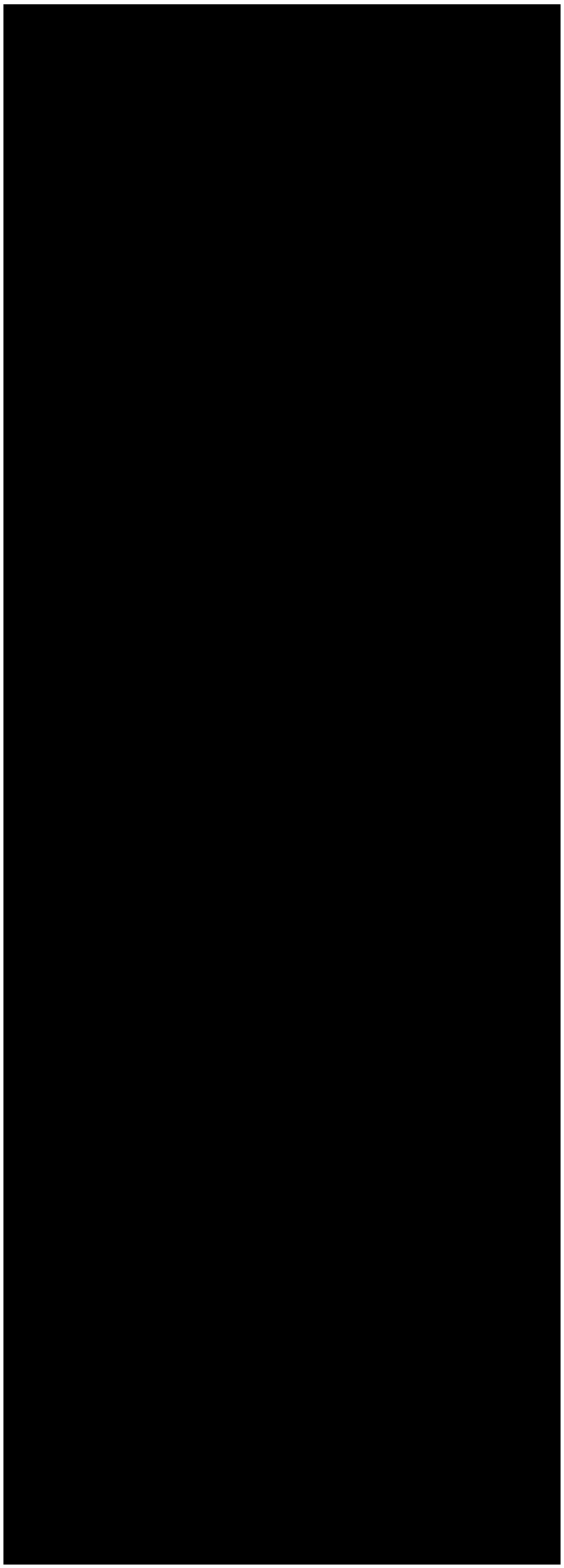
- The high costs of transitioning to full IPTV distribution (estimated at more than [redacted] million when normal programme contingencies and satellite capacity through the end of 2020 are included).
- Uncertainties as to how fast the terrestrial network will be upgraded to [redacted] Mbps to support Ultra-HD content.
- Uncertainties regarding restrictions and limitations on distributing programming via IP.
- The experience of other Pay TV networks (such as DirecTV and Sky) is that they are continuing to use satellite as their primary delivery method, even when they are expanding their customer base with the use of complementary IPTV / OTT delivery.
- No other DTH operator has moved completely to IPTV delivery - and in the case of Airtel, their partial move to IPTV has now been reversed.

9. ANNEX 1: DETAILED FREQUENCY PLANS

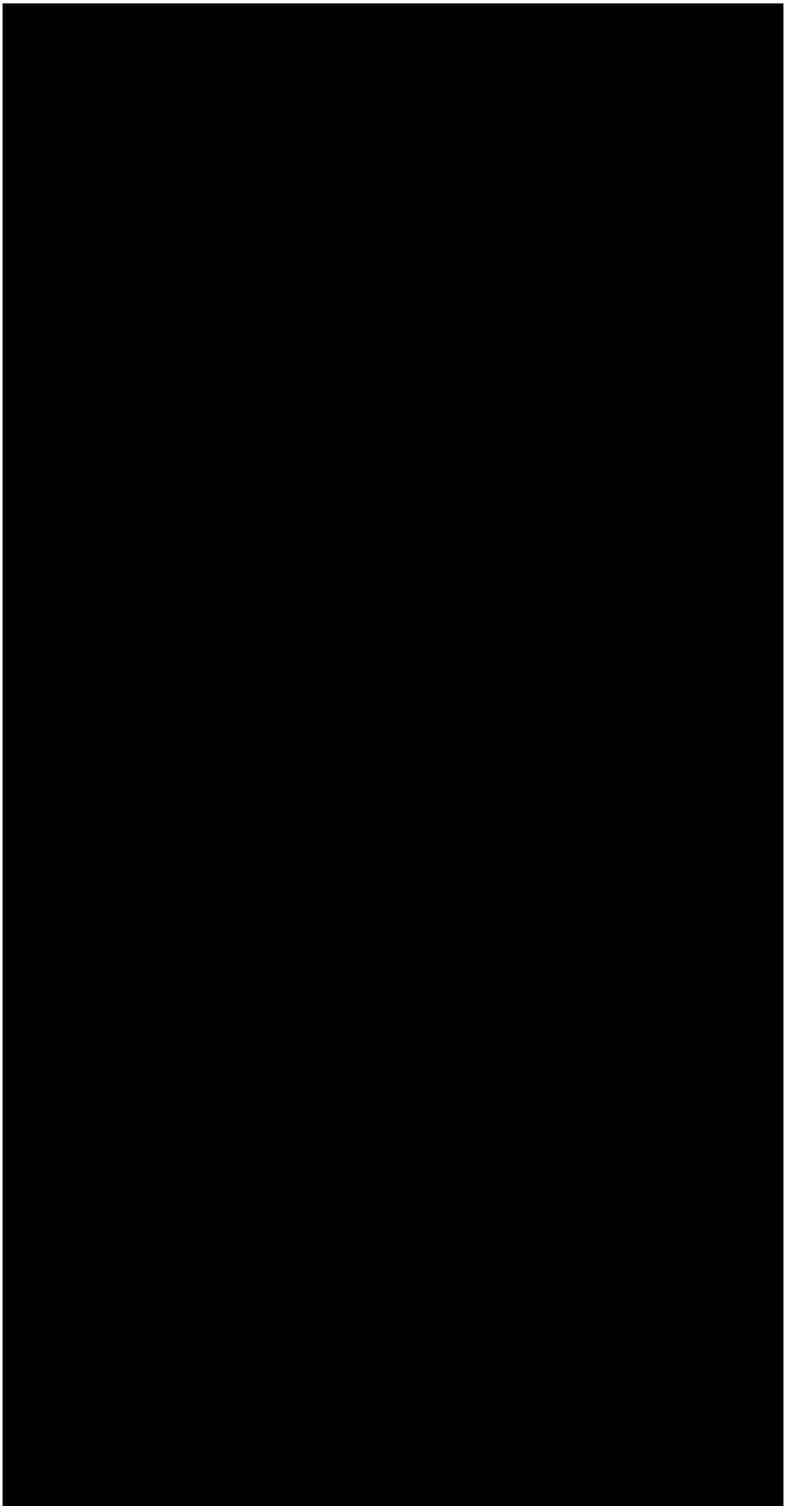
AMOS-2 AND AMOS-3 / EXISTING TRANSPONDER CONFIGURATION



AMOS-2 AND AMOS-3 BEFORE ARRIVAL OF AMOS-7



AMOS-3 AND AMOS-7 INCLUDING DETAILS ON AMOS-2 + AMOS-3 DOWNLINKS BEFORE THE TRANSITION



10. ANNEX 2: POSSIBLE ALTERNATIVE SATELLITES IN ALTERNATIVE ORBITAL POSITIONS

Table 7 below was compiled based on those satellites in an orbital position viewable from Israel, operating in some part of the Ku-Band and with coverage over Israel. For the purposes of this report there was no attempt to verify if the satellite operator had capacity available to lease and under what price and terms such capacity would be available. Furthermore, it should be noted that satellites operate in different portions of the Ku-Band which may require that "*yes*" modify the subscriber terminals to be compatible with those satellites.

As mentioned in Section 5.3 of the report, COMSYS recommends that "*yes*" maintain a database of possible satellites in the event that any of the Spacecom satellites had substantial degradation and / or failures.

Table 7 - Alternative Satellite Options

Orbital Location	Satellite	Band(s)	Coverage of Israel (EIRP in dBW)
72.1° East		C/Ku	Yes (50.8)
70.5° East		Ku	Yes (48)
68.5° East		C/Ku	Yes (49)
68.5° East			No
66.0° East		C/Ku	Yes (51)
64.2° East		C/Ku	No
62.0° East		C/Ku	Yes (49)
61.0° East			Yes (55)
60.0° East		C/Ku	No
59.5° East			N/A
58.5° East		Ku	No
57.0° East		C/Ku	Yes (50)
56.0° East		Ku	No
54.9° East		Ku	No
		Ku	Yes
53.0° East		C/Ku	Yes (49)
52.5° East		Ku	Yes
52.0° East		Ku	No
50.5° East		C/Ku	N/A
50.0° East		Ku	Yes (46)
48.0° East		Ku	No
47.5° East		Ku	Yes (48)
46.0° East		C/Ku	Yes
45.0° East		Ku	Yes (51)
42.0° East		Ku	Yes (46)
40.0° East		C/Ku	Yes (50)
39.0° East		Ku	Yes (46)
38.0° East		C/Ku	No
36.0° East		Ku	No
		Ku	Yes (44)
33.0° East			Yes (50)
33.0° East		Ku	No
		Ku	No
31.5° East		Ku	Yes
30.8° East		Ku	No
30.5° East		C/Ku	Yes

28.2° East	[redacted]	Ku	Yes
		Ku	No
		Ku	No
26.0° East		Ku	Yes
		Ku	Yes
		Ku	Yes
		Ku	Yes
25.5° East		Ku/Ka	Yes (50)
23.5° East		Ku	N/A
21.5° East		Ku	Yes
19.2° East		Ku	No
		Ku/Ka	No
		Ku	Yes
		Ku	No
16.0° East		Ku/Ka	Yes (44)
13.0° East		Ku	No
		Ku	No
		Ku	No
10.0° East		C/Ku	Yes (44)
		Ku	No
7.0° East		Ku/Ka	Yes (44)
		Ku/Ka	Yes (52)
4.9° East		C/Ku	No
		Ku/Ka	Yes
3.0° East		C/Ku	Yes (50)
		C/Ku	Yes
0.8° West		Ku	No
		Ku	No
		Ku	No
		C/Ku	Yes (53)
3.0° West		C/Ku	Yes (49)
5.0° West		C/Ku	Yes (47)
7.0° West		Ku	Yes
		Ku	Yes (48)
8.0° West		C/Ku	Yes (51)
11.0° West		C/Ku	Yes (51)
12.5° West		Ku	No
14.0° West		Ku	Yes (50)