

**FANS Interoperability Team Meeting
(FIT/22)**

**Santiago, Chile
3-4 March 2015**

Agenda Item [8]

Analysis of CPDLC Transfer of Authority Failures

Presented by the ISPACG CRA

SUMMARY

This working paper represents an inter-regional analysis of FANS problem reports submitted for CPDLC transfer of authority failures in the South Pacific, North and Central Pacific, North Atlantic, and Asia regions during the 2013 to 2014 period.

1. INTRODUCTION

- 1.1 At the IPACG/40 FIT/27 meeting in September 2014, the IPACG CRA accepted the assignment to perform an analysis of FANS problem reports submitted for CPDLC transfer of authority failures in the North and Central Pacific region.
- 1.2 Considering that this analysis is relevant to other regions over a sustained period of time, this working paper represents an inter-regional analysis of FANS problem reports submitted for transfer failures to the ISPACG CRA (South Pacific region), IPACG CRA (North and Central Pacific region), NAT DLMA (North Atlantic region), and FIT-Asia CRA (Asia region) during the 2013 to 2014 period.

2. DISCUSSION

- 2.1 Figure 1 below shows that of the 577 total FANS problem reports (PRs) that the ISPACG CRA, IPACG CRA, NAT DLMA, and FIT-Asia CRA – after this collectively referred to as the CRA – received during the 2013 to 2014 period, 99 PRs (17%) involved transfer failures.

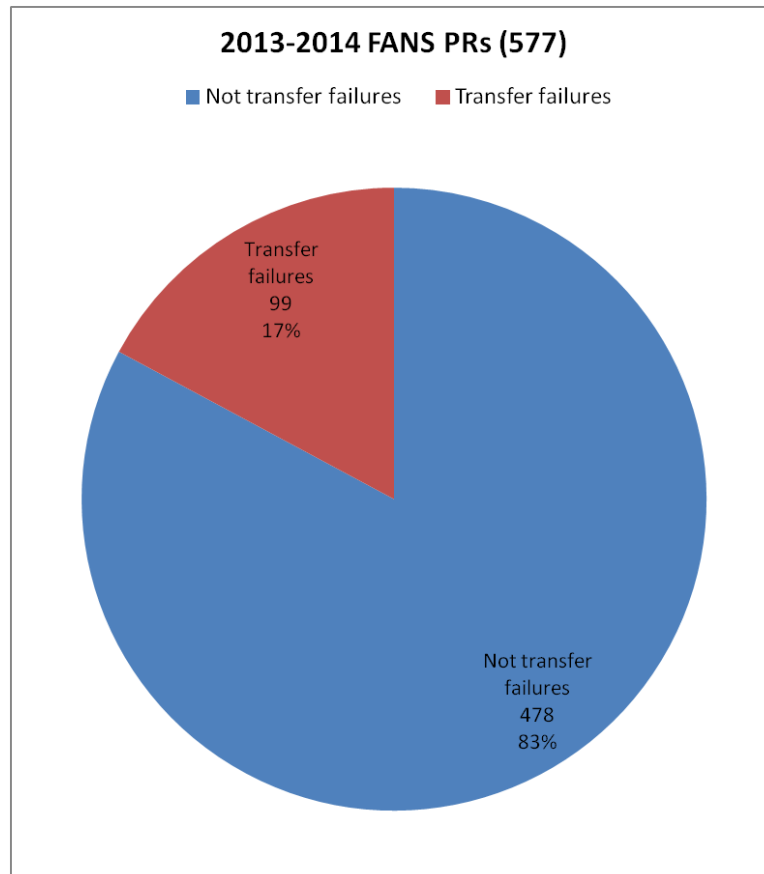


Figure 1: 2013-2014 FANS PRs

2.2 Figure 2 below shows the proportions of the 99 transfer failure PRs that apply to the South Pacific, North and Central Pacific, North Atlantic, and Asia regions.

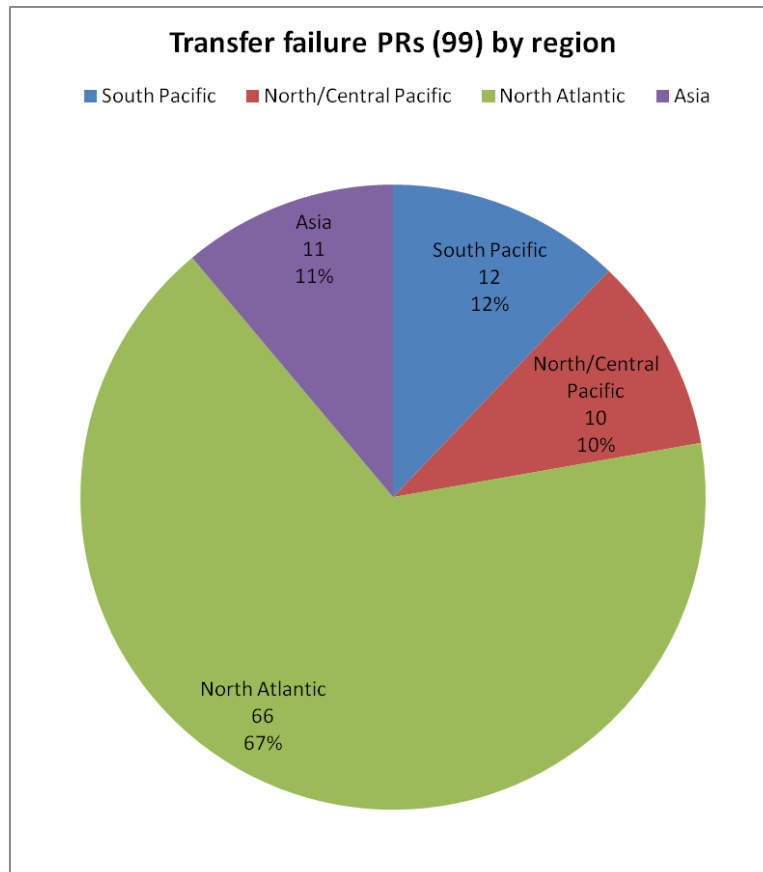


Figure 2: Transfer Failure PRs by Region

2.3 Considering that most (67%) of the 99 transfer failure PRs apply to the North Atlantic (NAT) region, the CRA further analyzed those 66 PRs in terms of NAT sub-regions, namely:

- The NAT proper, involving transfers to/from air traffic service units (ATSUs) that administer the New York Oceanic, Gander Oceanic, Sondrestrom, Reykjavík, Bodø Oceanic, Shanwick Oceanic, and Santa Maria Oceanic FIRs
- Canada, involving transfers between ATSUs that administer Canadian FIRs
- Europe, involving transfers between ATSUs that administer European FIRs, namely the Shannon, Scottish, and London FIRs and also the Maastricht UAC (the PRs for which the CRA referred to the EUROCONTROL CRO)

Figure 3 below shows the proportions of the 66 NAT transfer failure PRs that apply to the NAT proper, Canada, and Europe NAT sub-regions.

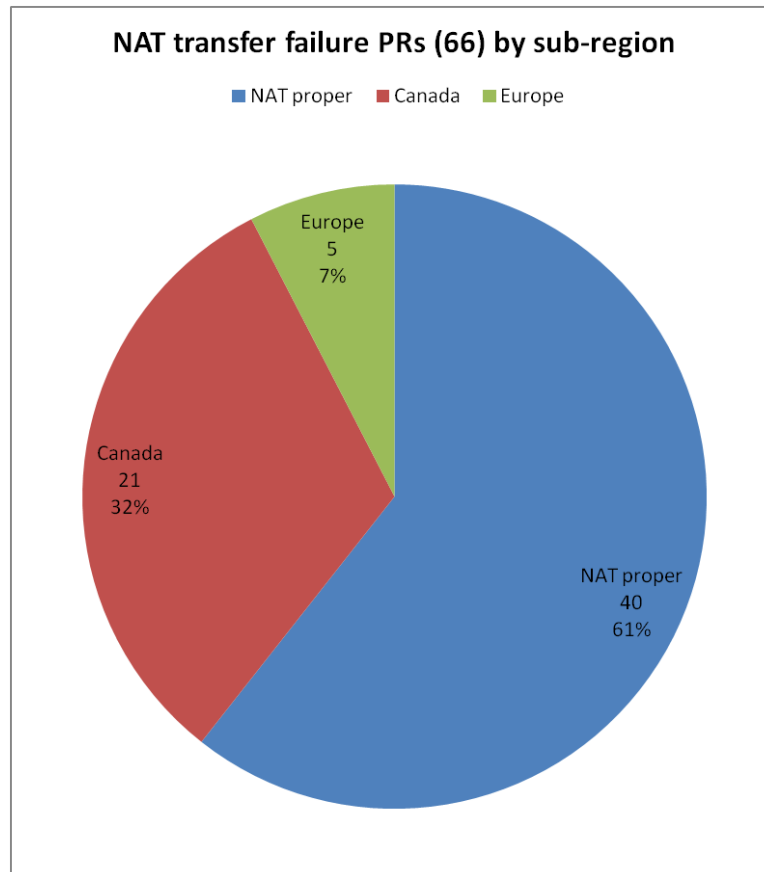


Figure 3: NAT Transfer Failure PRs by Sub-Region

- 2.4 Figure 4 below shows the proportions of the 99 transfer failure PRs that apply to each involved aircraft model. (The Airbus A330 and A340 aircraft models share common avionics and are therefore grouped together. Similarly, the Boeing 757 and 767 aircraft models share common avionics and are therefore grouped together.)

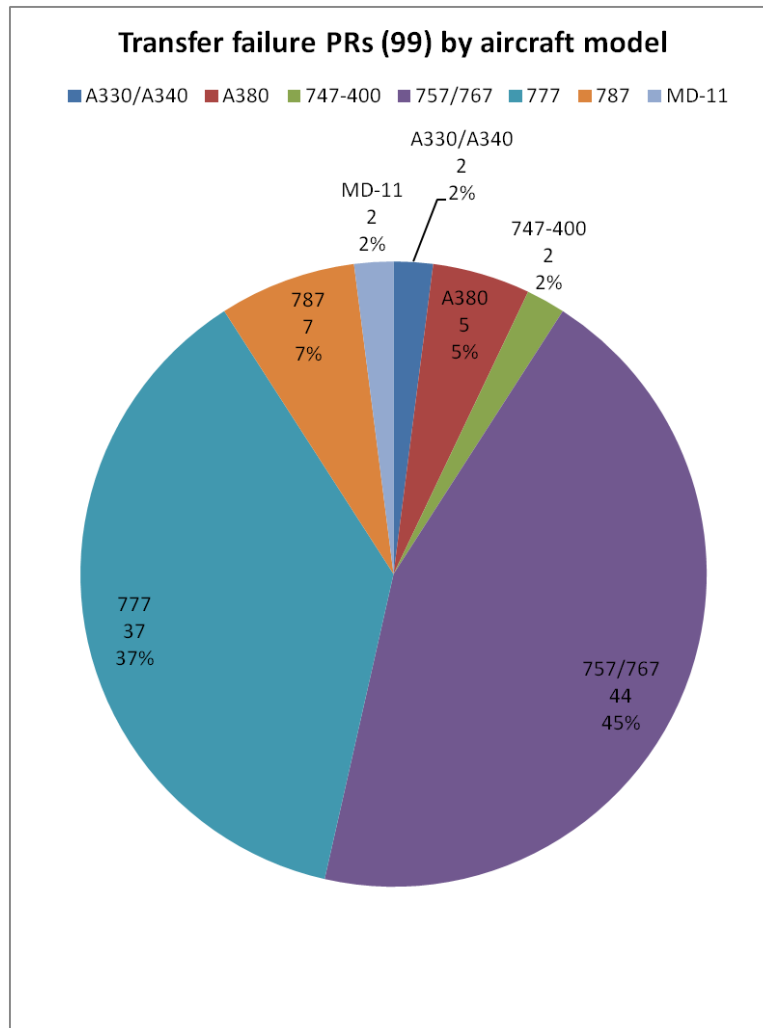


Figure 4: Transfer Failure PRs by Aircraft Model

2.5 Figure 5 below shows the 99 transfer failure PRs that occurred each month during the 2013 to 2014 period. Notably, since the per-month peak in April 2014 the CRA has received a decreasing number of transfer failure PRs.

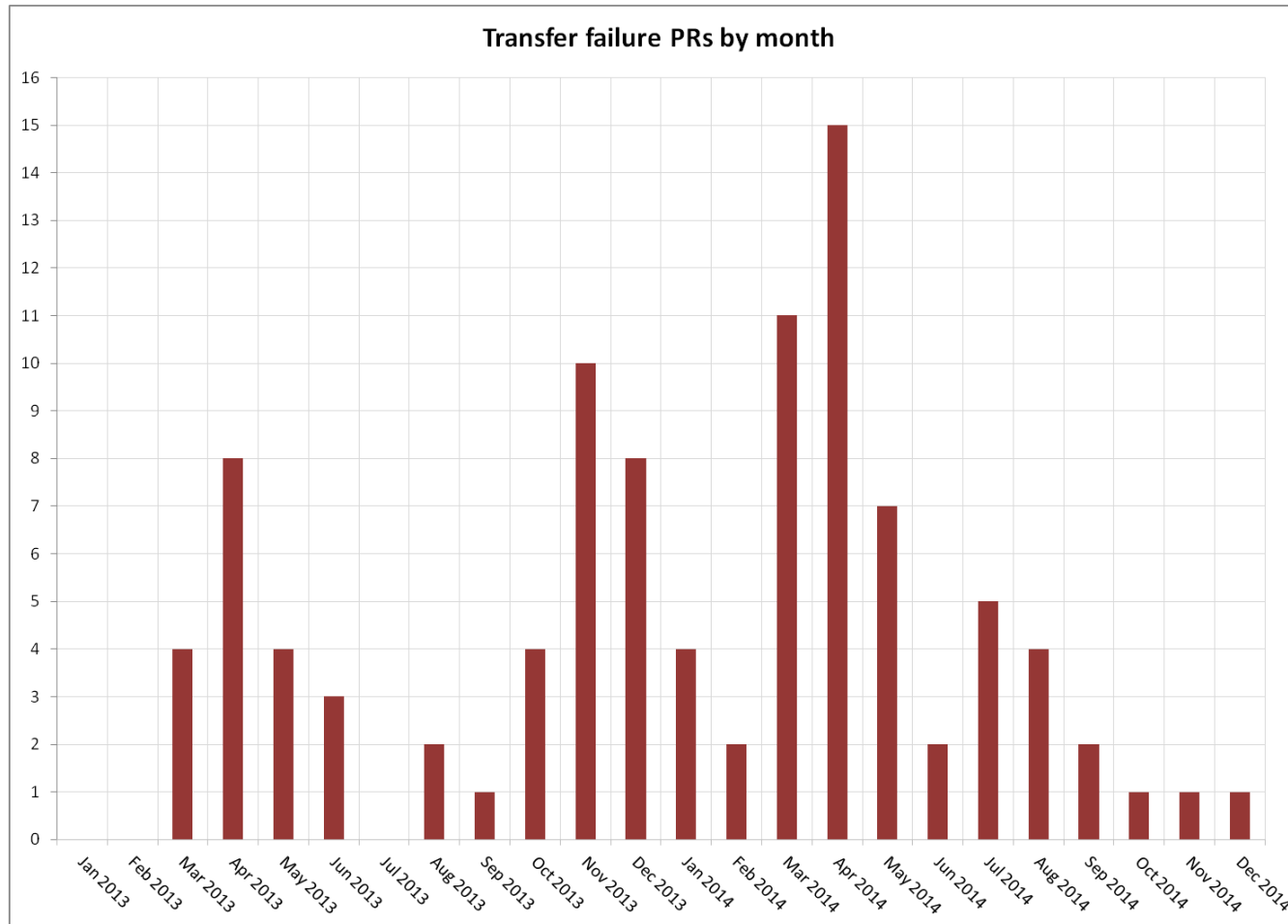


Figure 5: Transfer Failure PRs by Month

2.6 Considering that most (67%) of the 99 transfer failure PRs apply to the North Atlantic region, the CRA further analyzed those 66 PRs by month. Figure 6 below shows the NAT transfer failure PRs that occurred each month during the 2013 to 2014 period. Notably, since the per-month peak in April 2014 the CRA has received a decreasing number of NAT transfer failure PRs.

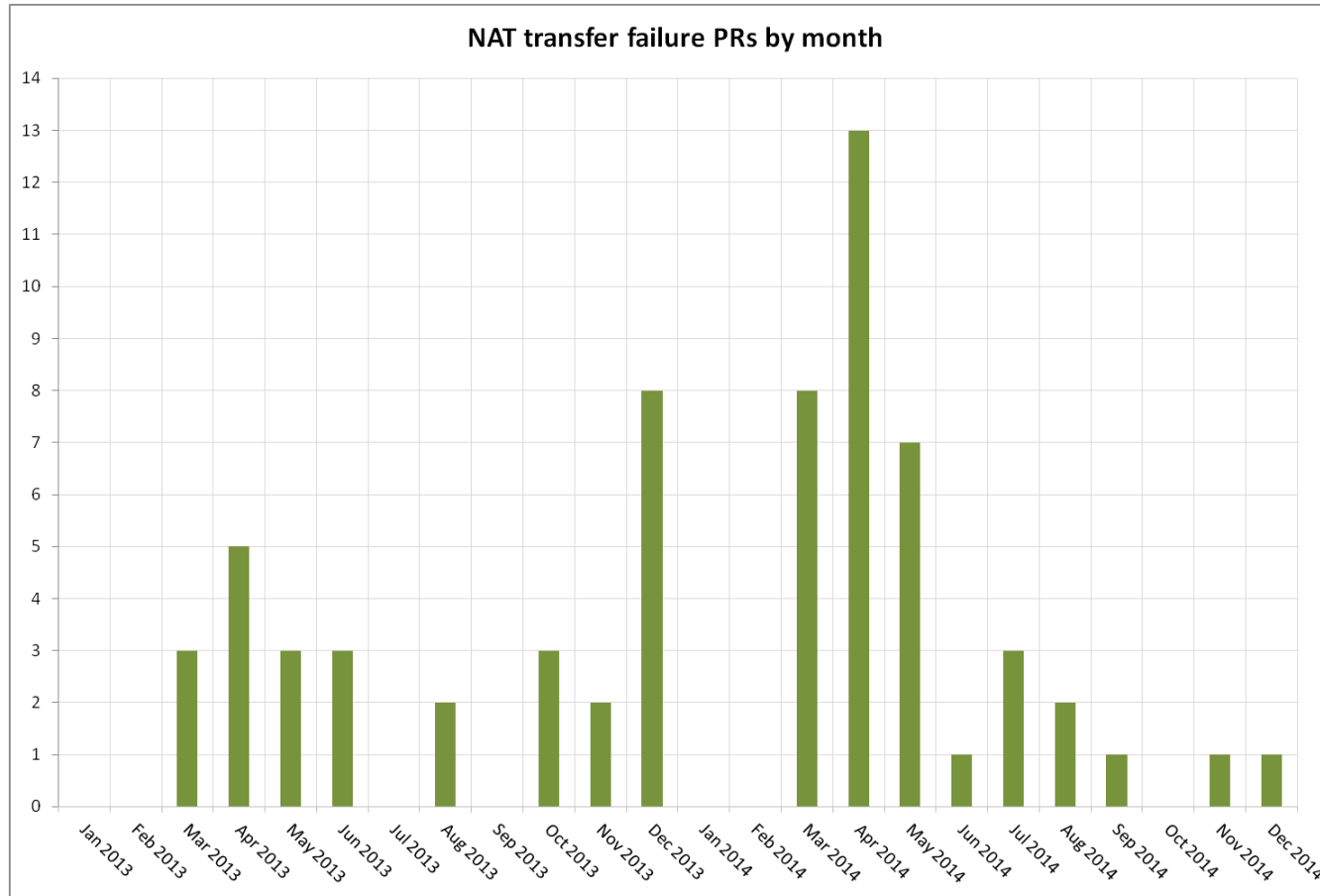


Figure 6: NAT Transfer Failure PRs by Month

2.7 Figure 7 below shows the proportions of the 99 transfer failure PRs that apply to each PR type assigned by the CRA. (“TBA” indicates that the PR type is “to be assigned”.) Notably, the CRA assigned the “GROUND” type to most (60%) transfer failure PRs.

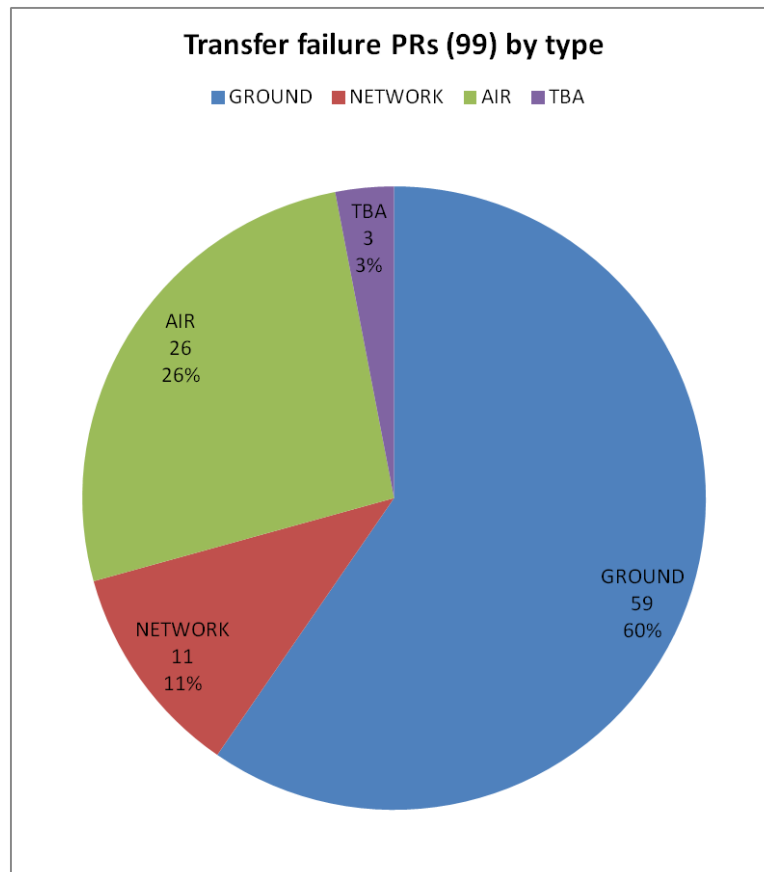


Figure 7: Transfer Failure PRs by PR Type

2.8 Considering that the four PR types are fairly broad, the CRA further analyzed the 99 transfer failure PRs in terms of the source of each problem from among the following choices:

- Aircraft operator, specifically flight plan filing
- ATSU automation, which is analyzed in more detail in Section 2.9 below
- Controller, meaning controller procedures and training
- Ground-ground network, specifically ground-ground network configuration
- Air-ground network, including air-ground network coverage and transitions
- Avionics, which is analyzed in more detail in Section 2.10 below
- Flight crew, meaning flight crew procedures and training
- Under investigation, indicating PRs that the CRA is still investigating

Figure 8 below shows the proportions of the 99 transfer failure PRs in terms of those problem sources. Notably, ATSU automation was source of nearly half (48%) of the transfer failure PRs.

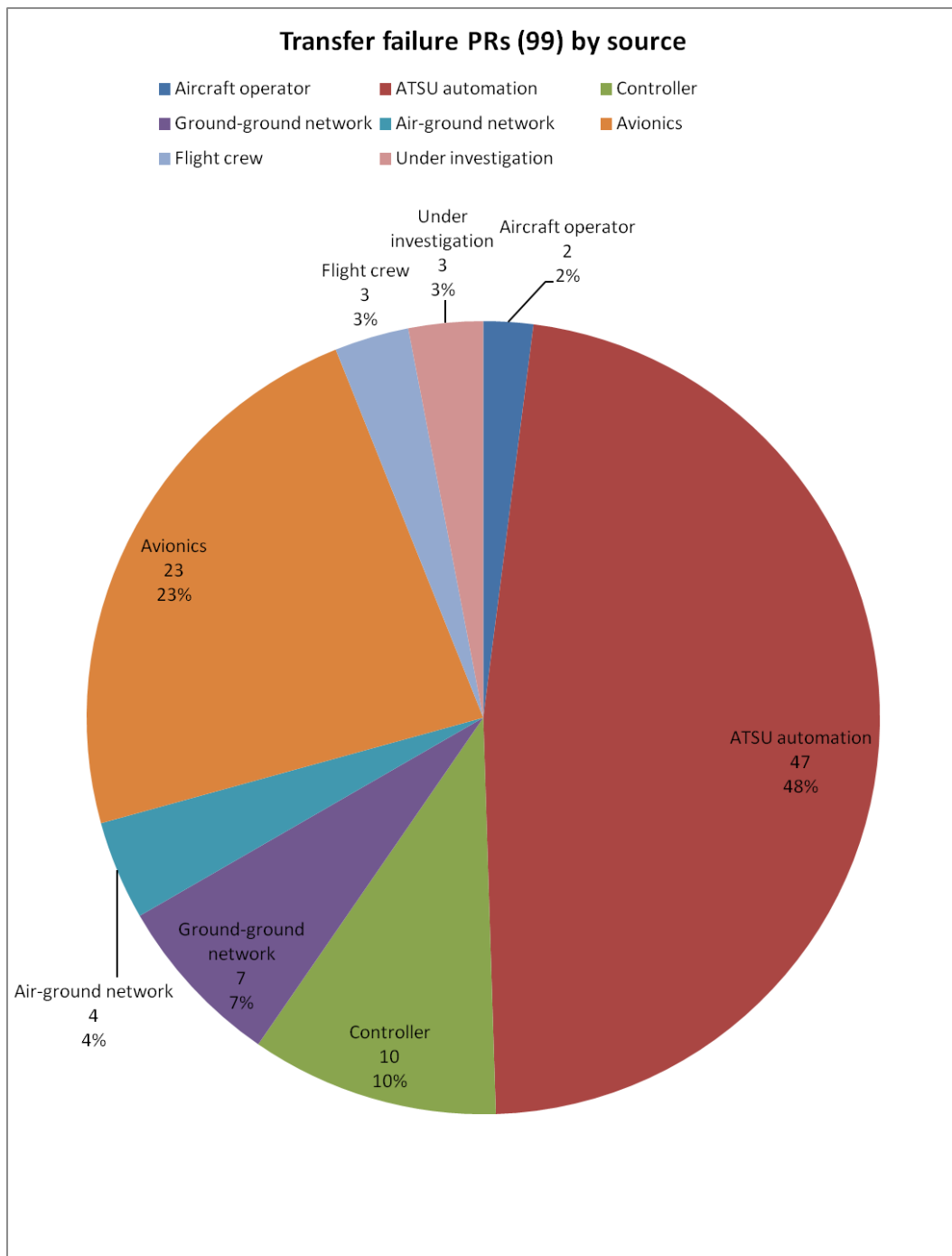


Figure 8: Transfer Failure PRs by Source

2.9 Considering that ATSU automation was the source of nearly one-half (48%) of the 99 transfer failure PRs, the CRA further analyzed those 47 PRs in terms of the reason for each problem. Reasons that the CRA found for those problems include the following:

- CDA did not designate NDA
- CDA redesignated NDA, which causes the avionics to terminate the CPDLC connection with the NDA
- CDA did not perform AFN address forwarding
- CDA did not send END SERVICE
- NDA did not send CR1
- ATSU automation software / configuration, which includes software issues, timer problems, and message formatting inconsistencies

Figure 9 below shows the proportions of the 47 ATSU automation transfer failure PRs in terms of those problem reasons.

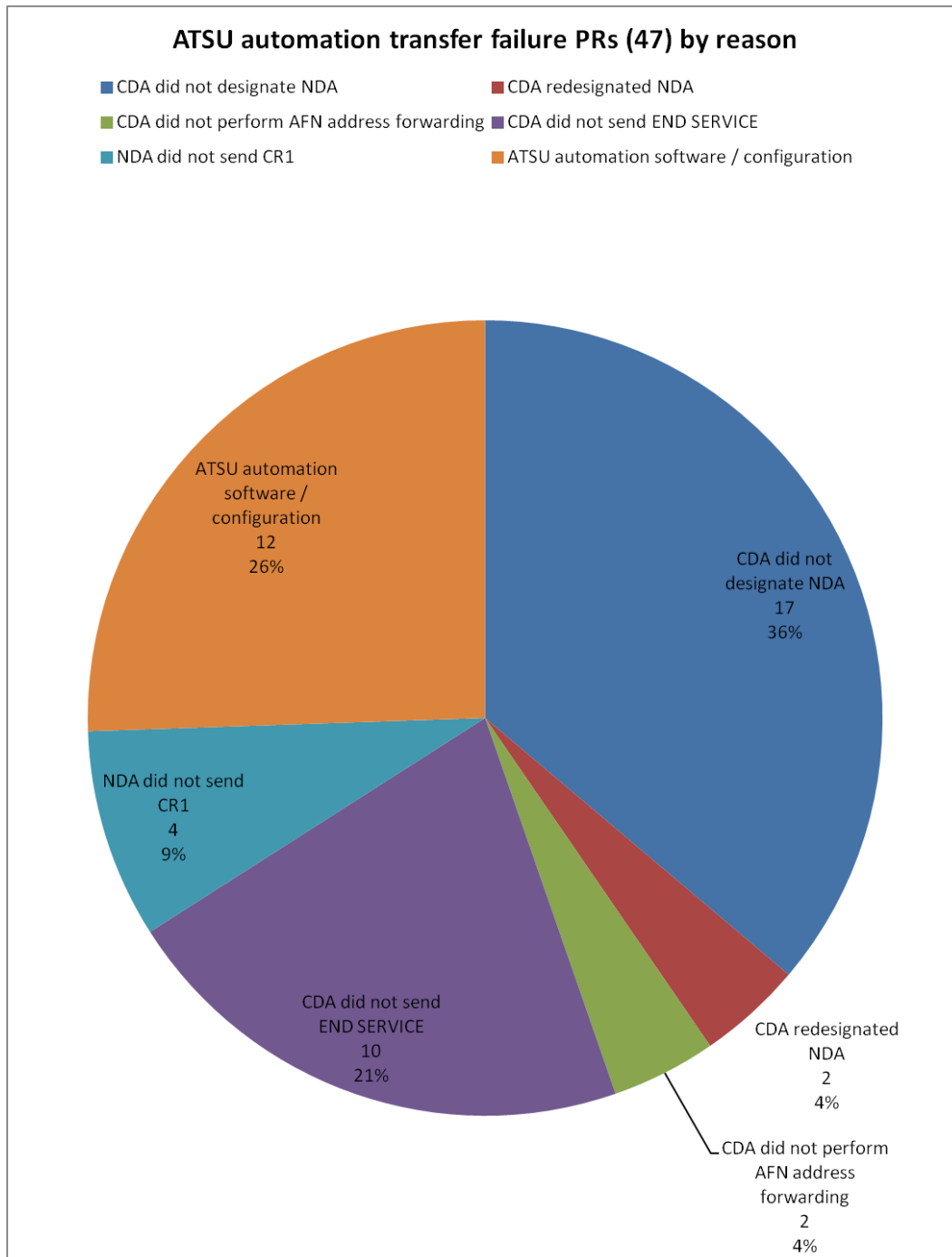


Figure 9: ATSU Automation Transfer Failure PRs by Reason

2.10 Considering that avionics were the source of nearly one-quarter (23%) of the 99 transfer failure PRs, the CRA further analyzed those 23 PRs in terms of the reason for each problem. Reasons that the CRA found for those problems include the following:

- 757/767 END SERVICE + ERROR processing

As described in NAT CNSG/11 WP/08: “When CDA sends END SERVICE + ERROR (typically with commanded Termination), 757/767 aircraft incorrectly disconnect from subsequent NDAs instead of transferring authority to them. GOLD contains contradictory guidance concerning that uplink combination –

on page 2-18, it states that ATS units may send a “CPDLC message containing UM 161 END SERVICE and UM 159 ERROR (commanded termination)” as an abort request, but in section F.22 regarding “a FANS uplink containing a concatenated end-service (um161) and ERROR (um159)... this construct is recommended in DO-258/ED-100... [but] it was not included in DO-219, which is the basis of FANS designs. ATC should therefore avoid using this... concatenated message.” Fix is candidate for next 757/767 FMC software release and GOLD Working Group notified of inconsistency. In the meantime, ATS units should ensure that they follow the bolded guidance.”

- 777 “ack-n-toss”, by which 777 avionics acknowledge receipt of a FANS uplink message via ACARS but do not fully process the message at the application (AFN, CPDLC, and ADS-C) level
- 787 comm, which includes various 787 data communications issues (e.g., a loss of a Cat B VHF link may prevent determination of VHF NO COMM and the subsequent transition from VHF to SATCOM)
- CMU-FMC “ack-n-toss”, by which older Boeing aircraft models (including the 747-400 and MD-11) with federated CMU and FMC avionics acknowledge receipt of a FANS uplink message via ACARS but do not fully process the message at the application (AFN, CPDLC, and ADS-C) level

Figure 10 below shows the proportions of the 23 avionics transfer failure PRs in terms of those problem reasons.

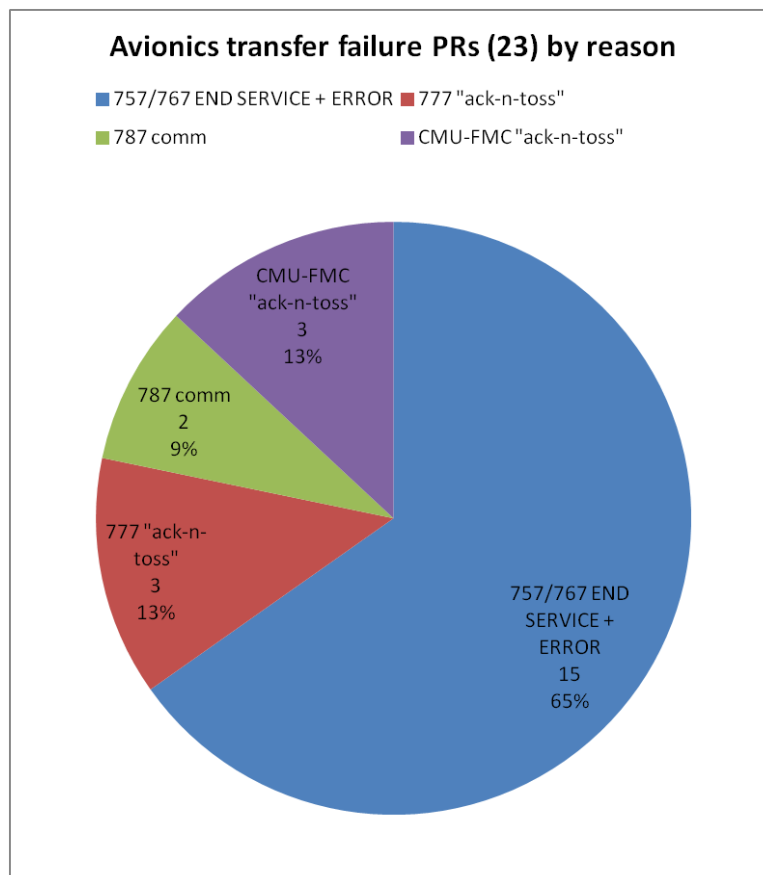


Figure 10: Avionics Transfer Failure PRs by Reason

2.11 Considering that most (66%) of the 23 avionics transfer failure PRs were caused by the 757/767 ERROR + END SERVICE processing issue, the CRA further analyzed those 15 PRs by month. Figure 11 below shows the avionics transfer failure PRs that occurred each month during the 2013 to 2014 period. Since the peak in April 2014, the CRA has received a decreasing number of 757/767 ERROR + END SERVICE processing transfer failure PRs. This positive trend demonstrates the value of the FANS problem reporting, investigation, and resolution process in determining the cause for these PRs and emphasizing the existing GOLD guidance for ATSU to refrain from sending ERROR + END SERVICE.

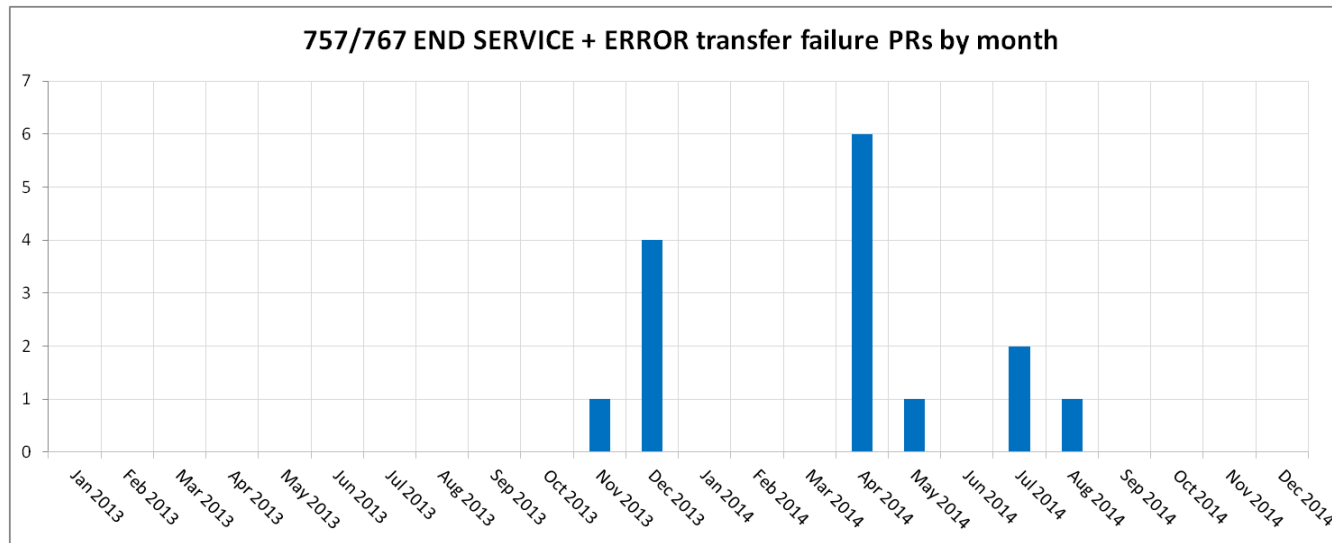


Figure 11: 757/767 END SERVICE + ERROR Transfer Failure PRs by Month



3. ACTION BY THE MEETING

3.1 The FIT is invited to:

- a) note the content of this working paper; and
- b) continue to work to reduce the number of CPDLC transfer of authority failures.