

ICAO'S BALANCED APPROACH TO NOISE MANAGEMENT AND ITS INFLUENCE ON THE ECONOMIC IMPACT OF AIR TRANSPORTATION

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Abstract

On the basis of rising noise awareness more and more airports introduce noise mitigation programs. Since these programs consist very often mainly of operating restrictions harming the positive economic impact of an airport, ICAO established the Balanced Approach in 2001. This was to propose a systematic, flexible and globally applicable solution for this challenge as a harmonized approach, usable on an airport-by-airport basis. It consists of four pillars:

- (1) reduction of noise at source,*
- (2) land-use planning and management,*
- (3) noise abatement operational procedures and*
- (4) operating restrictions.*

The main objective of these pillars is that noise problems around airports can be addressed in an environmentally and economically responsible manner within the aviation system. So operating restrictions should only be the last resort. This decision was based on considerations that positive impacts in form of the reduction of the noise burden can most probably be achieved at lower cost. In this way, the positive economic impact of airports, and especially of night flights, shown so often in the literature, shouldn't be harmed too much.

1 Introduction

With rising living standards noise is more and more seen as a harming factor of the quality of life. The increasing noise awareness of the

population especially in the Western world is the main driver for more and more intense regulations especially of airports. The aviation industry itself was able to reduce the noise per movement tremendously by new technologies especially up to the year 2000 about. But this reduction was paralleled by an immense increase of movements which influenced more the perception of the population. However, in lots of cases people – especially in developed countries – moved nearer and nearer to the airports – a sign of inappropriate land-use-planning around the airports.

The impact of these developments on airlines is quite different according to different business models. Scheduled intercont services need often the late evening or very early morning arrival or departure time at an airport to optimize the different time windows they have to use on their flights. Holiday carriers offer night flights to get a higher utilization rate of their aircraft. But even more affected are the cargo and especially the integrator carriers. To guarantee overnight deliveries they have no other chance than to use night flights. These carriers feel often unfairly treated as the other business models get more capacity at day time whereas their capacity is more and more restricted over time.

In the first part after this introduction we intend to show briefly the intensity of noise regulations and then to describe the Balanced Approach as an appropriate measure to balance the benefits of less noise with the economic benefits of air services. After the presentation of the different

instruments of the Balanced Approach the European and US way of noise mitigation after its introduction will be presented. The economic benefits of airports are not questioned what will be shown in the next chapter by an overview of the current literature. This is especially the case for night flights increasing the welfare of the airport region. In the final conclusion we will then summarize the results and try to give some recommendations for a better application of the Balanced Approach.

2 ICAO's Balanced Approach

2.1 Background

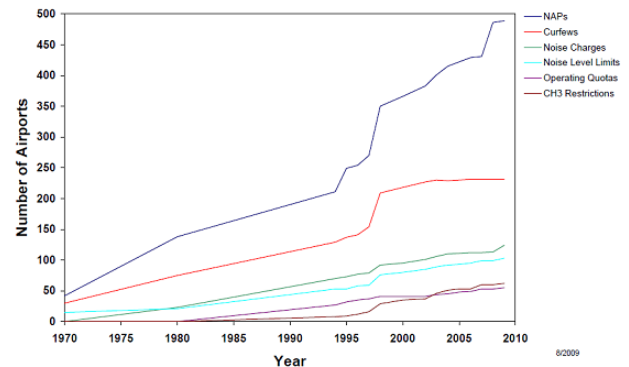
Noise problems are increasing because air traffic is growing and the sensitivity against noise becomes stronger. This affects a growing number of airports in various regions of the world. Increased public awareness of people affected in areas adjacent to airports has aroused community opposition to aircraft noise leading to opposition towards any kind of airport decisions relative to capacities. In absence of a coordinated global framework, airports and airport authorities imposed own individual measures, including operating restrictions limiting airport capacity and the free flow of air traffic.

Noise annoyance caused by a constant growing air transport system arouses public concerns and community opposition in the vicinity of noise-affected airports. The number of people exposed to aircraft noise has increased considerably in the last half of the 20th century. Thus, noise is a significant and increasing challenge for airports. Despite the technological progress, noise exposure shows a positive trend in the future due to growing air traffic. Furthermore, public concerns and the sensitivity of individual persons regarding aircraft noise have increased over time.

Consequently, the noise issue at airports concerned climbed the political agenda. In order to address the concerns of the people affected,

local, national and regional noise restrictions escalated worldwide. Since the 1970th several noise mitigation measures were introduced primarily in form of operating restrictions at individual airports to counteract this development (see figure below). [1]

Figure 1: Growth in airport noise restrictions



However, the proliferation of uncoordinated noise mitigation programs at airports worldwide provoked the risk of disturbing the aviation system. On the one hand, airports suffer under limited opportunities to expand the infrastructure according to the need due to growing air transport demand. On the other hand, aircraft operators face a high economic burden due to the arbitrariness of the implementation of noise mitigation programs at airports throughout the world.

The uncoordinated approach of individual airports led to cumulative disputes between the different stakeholders and nations. Consequently, the necessity of a more common framework on a global level gained more and more weight. Thus, ICAO and its Contracting States dedicated themselves to elaborate a consistent and coordinated way to face this issue in an environmentally responsive and in the most cost-effective manner. As a result, ICAO incorporated new policies and guidance material to create an integrated approach. The aim was to address the noise problem in an environmentally responsive and in the most cost-effective manner. Furthermore, it should promote consistency, harmonization and transparency in international civil aviation.

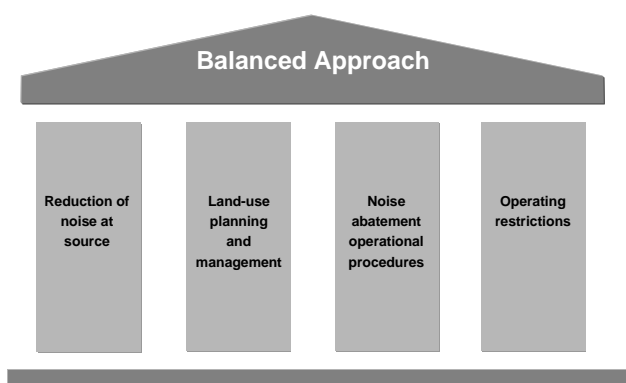
2.2 The concept

In the 33rd Assembly in 2001, ICAO published the concept of the “Balanced Approach” in 2001 to noise management [2] which is based on the four principal elements:

- (1) reduction of noise at source,
- (2) land-use planning and management,
- (3) noise abatement operational procedures and
- (4) operating restrictions.

Since there are significant regional differences the Balanced Approach was formulated to be applied on an airport-by-airport basis to ensure the flexibility needed in order to be able to adjust and apply it according to specific circumstances. Within the ICAO approach all principal elements should be considered equally. However, operating restrictions should only be implemented as a last resort and, if implemented, an appropriate phase-in time should be granted so that aircraft operators can adjust their business plans according to the new circumstances. The four elements do not represent a fixed catalogue of potential measures, but rather four main pillars which can be extended by various measures.

Figure 2: The four pillars of the ICAO Balanced Approach



Source: DLR

In order to select the optimal measures for the particular airport and to ensure transparency, a comprehensive noise assessment and evaluation process should be performed consisting of the following steps [3]:

- (1) assessment of the current and future noise impact at the airport concerned, compared to the noise objective to be achieved;
- (2) evaluation of the likely costs and benefits of the various measures available;
- (3) selection of measures with the goal to achieve maximum environmental benefits most cost-effectively;
- (4) provision for dissemination of the evaluation results;
- (5) provision for consultation with stakeholders at different stages from assessment to implementation;
- (6) provision for dispute resolution.

The Contracting States supported the idea of a balanced approach and committed themselves to adopt it on national level. The Balanced Approach has been amended continuously in the following ICAO Assemblies. For instance, public involvement was incorporated into the assessment and evaluation process to underline the vital importance of the participation of the people affected in this process [4].

2.3 The instruments

The four pillars of the ICAO Balanced Approach to noise management incorporate several measures that can be used to mitigate the noise level at airports. In order to get an overview of the available measures, we will briefly introduce the different elements of the four principal categories [5].

The **reduction of noise at source** has proven to be one of the most effective means to limit aircraft noise. Instruments in this category are typically the result of extensive research and development in the fields of aircraft and engine design, and thus are not initiated by or within the control of individual airports. Instead, they are induced by the adoption and implementation of noise certification standards in Annex 16, Volume I, to the Chicago Convention. Measures involve the introduction of newer, quieter aircraft types, as well as the reduction of acoustic output of existing aircraft types by modification. A further example of measures in

this group includes the adoption of an additional Chapter 4 certification standard.

Land-use planning and management measures aim at achieving compatibility of the land-use with the airport activities. In order to reduce the number of people affected by aircraft noise, airports have the choice among several options which can be further grouped into:

- (1) *planning instruments*: comprehensive planning, noise zoning, subdivision regulations, transfer of development rights and easement acquisition);
- (2) *mitigation instruments*: building codes, noise insulation, reallocation measures of buildings;
- (3) *financial instruments*: capital improvements planning, economic incentives, noise-related airport charges for covering the expenses of alleviation or prevention of noise impacts in the affected vicinity of the airport.

Land-use planning and management means, particularly those of the categories (1) and (2), are appropriate during the design stage of new airports, since a proper planning process can mitigate ex ante the negative impact of aircraft noise on surrounding communities. Also existing airports can achieve positive impacts by applying land-use measures such as funding of soundproofing and constructions of noise barriers and, in the long-term, the acquisition of property.

Exemplary for the latter, the international airport Dusseldorf, together with the state of North Rhine Westphalia and the city of Dusseldorf grant an option on acquisition of property in areas of high noise exposure (>75dB(A)). Thus, house owners can inform the airport if they are interested to sell their property. The airport purchases the houses under the condition that the property is uninhabited. The primary goal of this strategy is to reduce the number of affected people within these areas and, consequently, encourage the development of compatible land-use in defined noise-affected areas. Overall, land-use planning and management measures can significantly reduce the adverse effects of aircraft noise in the

vicinity of airports and should be taken into account by airports and authorities in order to minimize the number of noise affected people.

Noise abatement operational procedures reduce aircraft noise by changing the way how an aircraft approaches to or departs from a particular airport. There are several operational measures which can significantly reduce the aircraft noise exposure: Noise preferential runways and routes encourage the use of a particular runway or route in order to concentrate flights over the least noise-sensitive areas, or at least to evenly distribute the noise disturbance among the surrounding areas. Furthermore, the use of low noise flight procedures for the take-off and landing such as the continuous descent approach (CDA) and reversed thrust can achieve lower noise levels at comparatively low cost. The appropriateness of any of these measures is subject to the physical lay-out of the individual airport and its surroundings. In all cases, though, the procedure must give priority to safety considerations. Furthermore, several operating procedures constrain aircraft ground operations. Limiting engine-run up and using the aircraft's auxiliary power unit in noise-sensitive areas or during a certain period of time, further reduces the level of noise exposure to the surrounding community can be further reduced.

Operating restrictions refer to noise-related bans or limitations in the operations of all or certain aircraft types at a particular airport. In order to limit the impact of aircraft noise especially during the most sensitive time periods, they are often of a temporary nature. Operating restrictions can be classified into global, aircraft-specific, partial and progressive restrictions. Potential measures of this group are cap rules and noise quotas. Cap rules define a maximum number of operations permitted for a particular period of time, whereas noise quotas allow for a limited, cumulative level of noise that determines the actual number of aircraft movements. Beyond, night-time restrictions and curfews limit or ban aircraft movements during noise-sensitive time periods. However, while all elements should be considered equally,

operating restrictions should be considered as a last resort.

2.4 Noise management at European airports

In Europe, airports have already implemented several noise mitigation measures according to existing national legislation and complementary Union legislation.

Concerning noise reduction at the source, these measures are limited to new technology developments and the adoption of stricter noise certification standards on an international level. Taking into account environmental factors, technical feasibility and economic consequences, Directive 2006/93/EC regulates the operation of chapter-3-certificated civil subsonic jet aeroplanes. Furthermore, it has to be mentioned that issues of land-use planning and management fall into the exclusive legal competence of the respective Member States. Therefore, no harmonized approach can be found on European level. In contrast, several noise abatement operational procedures are in force ranging from preferential runway use and restrictions on maintenance engine run-up to specific flight routes.

In March 2002, the EC adopted the Directive 2002/30/EC [6] concerning the rules and procedures for noise-related operating restrictions at Community airports. The main objective of the Directive is to provide a common framework for the Member States to facilitate the introduction of operating restrictions of marginally compliant aircraft in a consistent manner at an individual airport level. The Balanced Approach as stated in the resolution of the 33rd ICAO Assembly was explicitly adopted into EU law and is defined in detail and in full consensus with the ICAO approach in Article 2(g).

In 2007, a first review on the application of Directive 2002/30/EC [7] has been carried out in order to evaluate its effectiveness with regard to the reduction of the total impact of aircraft noise within the EU. The study's strategy was

based on a three-fold approach. Firstly, it contains an extensive analysis of aircraft movements in the base year 2002 and 2006 at 70 EU airports currently or potentially soon to be covered by the Directive's traffic limit of 50,000 aircraft movements per annum. Secondly, the same airports and other stakeholders have been interviewed and were asked to provide facts and figures on operating restrictions and other measures related to noise management. Thirdly, noise contours were modeled for five case study airports to estimate the effect of banning marginally compliant aircraft.

Given the limited period of time since the Directive's entry into force, the surveyed airports indicated heterogeneous experiences with the legislation [8]. The study results have been summarized in a Communication on the implementation of the current Directive on airport noise management published by the EC [9]. As pointed out by the report, the present Directive is not sufficient to reduce noise around airports, particularly with regard to a growing traffic demand. In contrast, the amount of people affected will increase in the future. Furthermore, measures of the Directive have been implemented by only a limited number of Community airports. Therefore, the EC aims at a clarification of the provision and the scope of the Directive but does not provide any particular policy options in the report. Before a formal decision on further steps is made, the Commission expressed its willingness to receive comments from the stakeholders.

Furthermore, it should be taken into account that the implementation of the Balanced Approach by Directive 2002/30/EC is only one instrument which has to interact with several other measures on national level to solve noise problems within the European Union. This shows that the elements and the various measures within the Balanced Approach are existent in the Member States, however, have not yet been implemented in an integrated approach as intended by ICAO.

2.5 The US approach

The US aviation noise policy differs in its application compared with the approach applied in the EU. In response to the proliferation of individual operating restrictions, the US Congress enacted the 1990 Airport Noise and Capacity Act (ANCA) to guarantee a coordinated and consistent approach for all airports in the United States. These regulations, implemented by the FAA (Federal Aviation Administration) in 14 CFR (Code of Federal Regulations) Part 161 [10], establish a program for reviewing noise and access restrictions concerning Chapter 2 and Chapter 3 aircraft.

Hence, the competence of the airports' authority to implement operating restrictions was reduced significantly. After the entry into force (1st October, 1990), all restrictions affecting operations of Chapter 3 aircraft have to be approved by the FAA while existing restrictions were granted as grandfather rights. Airport proprietors have to apply for the implementation of an operating restriction which will then be evaluated by the agency.

A central element of the US approach for the selection of potential capacity-related airport projects, such as noise mitigation projects, is the CBA [11]. This guidance provides a consistent approach for comparable analyses. The concerned airport has to conduct a similar analysis to prove the cost-effectiveness of the proposed measures. The systematic US approach with regard to operating restrictions considers a broader point of view on a federal level with the aim to ensure the functioning of the aviation system considering a great variety of aspects which might cause adverse effects (e.g. safety and economic issues). Thus, this approach might increase the acceptance of all stakeholder concerning decisions made by the agency.

Established prior to ANCA, 14 CFR Part 150 was issued under the authority of ASNA (Aviation Safety and Noise Abatement Act) of 1979 and is another central element in the

Federal Aviation Regulation (FAR) of the United States. The aim was to standardize the process of identifying noise and land use incompatibilities and to develop effective abatement strategies. Consequently, Part 150 describes specific procedures, standards and methodologies concerning noise exposure maps and noise compatibility programs at airports, including the process for evaluating and (dis)approving those programs. The regulations in Part 150 are voluntary, however, the rate of participation is quite high since Federal grants for noise abatement projects can be achieved. With these regulations as described above the United States already integrated all elements of the Balanced Approach into its national aviation noise policy.

The different applications and interpretations of the Balanced Approach have also been subject to the second stage negotiations concerning a more liberal Open Skies Agreement between Europe and the US. It seems interesting to develop a harmonized structure to weigh the likely costs and benefits of various measures in order to ease decision-making. The following chapter gives an overview of different analyses already existing in this field.

3 The economic impact of air transport activities

In its main intention the Balanced Approach applies to achieve optimal environmental benefits in combination with the postulate to realize this in the most cost-effective manner. That is why the ICAO Assembly of 2001 clearly requires for every airport to combine and assess possible measures planned in the context of the Balanced Approach with a preceding economic analysis [12]. This analysis, may it be done in form of a benefit-cost analysis (CBA), a cost-effectiveness analysis (CEA) or a sensitivity analysis, shall guarantee that best-practice methods are identified and the right approach is chosen which is able to fulfill the different needs of all involved stakeholders. Taking into account the ICAO recommendation, that operating restrictions as one of the four

elements of the Balanced Approach should in any case only be regarded as last option to be realized, an economic analysis safeguards in this context that all measures are weighed carefully against each other and operating restrictions are not chosen prematurely if the objectives can be achieved by alternative means.

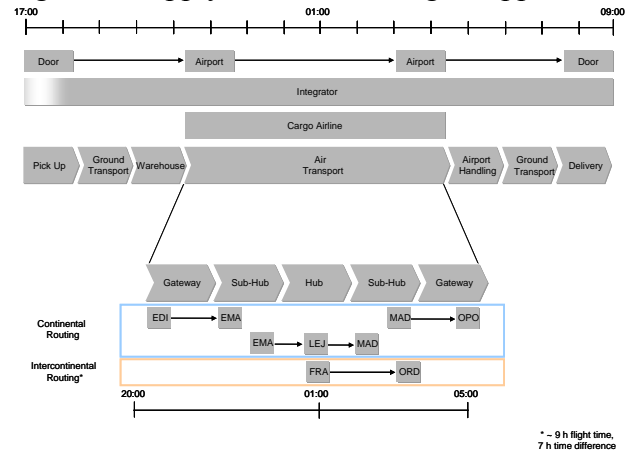
Given this relevance of economic analysis within the Balanced Approach, the question must be raised how this concept is realized worldwide and especially in Europe. As the application of Directive 2002/30/EC indicates, many airports in Europe favored operating restrictions especially with regard to the establishment of curfews and addressed requirements of the Balanced Approach therefore in a very unbalanced manner. This leads to the estimation that economic impact studies are finally more or less not in any case on top of the agenda when noise issues at airports are discussed and decisions for changes are made. In the US this development differs as the FAA provides much of guidance materials as to how CBAs in the context of airport planning processes can be done and recommends this approach clearly [13].

However, for Europe it was assumed that economic impact studies are not done in any case to assess the effects of noise abatement measures. In order to look at this situation in more detail a review of existing economic impact studies was done to review especially the economic impact of the freight and express industry and to evaluate the influence of noise abatement measures and the need for a common behavior in this field in the sense of ICAO's Balanced Approach.

The outcome of this broad analysis showed that in general all air transport activities contribute to a large extent to the prosperity of a special region by providing employment and increasing the overall GDP. As part of this economic system, cargo and express operators fulfill a special role in this framework by transporting goods in a fast, safe and reliable way in order to support international trade. A necessary requirement to guarantee these services is the

establishment of a global network and the opportunity for night flights to optimize the logistic processes in the background and make all operations as effective as possible. This becomes clear in the following graph which summarizes the typical supply chain of a cargo or an integrator carrier.

Figure 3: Supply chain of overnight supplies



Source: DLR

Given these conditions, operating restrictions which often aim at night flights can have a huge impact on the activities of airlines and especially those of cargo and express operators up to the state that their business cannot be effectively run anymore. This is especially the case if operating restrictions at airports are realized arbitrary and in the short-term, which might have negative impacts also on the prosperity of a region in terms of job and income losses. Therefore it is, as also recommended in the Balanced Approach, mandatory that all intended measures to reduce airport noise are investigated with regard to their usefulness and their influence on all concerned stakeholders by a CBA.

Nevertheless, although this is already partly done at the airports within Europe, a failure of the airport operators and the political regulators is still that often only special measures are regarded in an isolated way. Thereby it is forgotten that the effectiveness of the Balanced Approach strongly depends on a combination of the four pillars and amongst those especially of the first three ones as they are most appropriate to avoid noise problems in advance due to their preventive function. This approach is – besides

by the EU – also strongly recommended in the scientific literature by hinting at the fact the Balanced Approach can in times of growing air transport only be effective if noise reduction is realized in a manifold manner [14]. This includes always a coordinated, systematic and long-term oriented focus on possible measures while on the other side, it excludes at the same time a spontaneous, only politically determined and arbitrary approach which would give no stakeholder – either airport neighbors, airport operators or the airline industry – the long-term planning stability that is needed to improve the current system and to optimize the economic outcome under respect of ecological restrictions.

4 Conclusion

The overall analysis in the previous chapters has shown that it is very important, that successfully established transportation networks can operate for several years without deeper regulative intervention changes like in the form of operating restrictions as there is not much flexibility to change existing networks and adapt to new market conditions. This holds especially for the case when a strong regulative measure like night curfews at an airport is intended, which leave especially for freight operators and express services often the only possibility to abandon operations completely or to switch to another location to the price of **sunk costs**. A prominent example is DHL and the relocation of its European hub from Brussels to Leipzig/Halle in 2008 due to the lack of planning security.

Nevertheless, the population around airports' vicinities has to be protected from increasing aircraft noise. In order to solve this conflict the ICAO has already developed a good solution. The Balanced Approach with its four pillars – as described above – was chosen to reconcile the different interests in order to find the most suitable solution on an **airport-to-airport basis**.

This process includes that a **CBA** is done for every planned measure in the light of the

Balanced Approach, what shall guarantee to find the most cost-effective and most efficient option to handle noise problems correctly. After our extended literature review we regard this as essential requirement for the success of the Balanced Approach if its measures should be established at an airport in the intended manner. Nevertheless, the result of the study review shows that in practice there still exist some aspects which could hinder a correct implementation especially with regard to European airports. Therefore we identified some potential improvement points resulting in the following recommendations:

- If measures are planned at an airport, **all** of the four **pillars** of the Balanced Approach should be regarded, especially by taking into account a preference of the first three ones against the fourth pillar of operating restrictions. The study analysis tends to show that regarding the first three pillars can already have a positive impact at lower cost as the fourth pillar can result in high economic disadvantages especially when an airport has a special traffic mix with operators that are very sensitive to operating restrictions (e.g. express services, touristic flights).
- For every intended measure linked to the four pillars a CBA should be undertaken in order to develop a set of alternatives of which the best one or a combination should be chosen.
- The CBA should take the situation of all concerned stakeholders into account.
- Furthermore, the CBA should include monetized environmental benefits/disbenefits (with regard to noise) and monetized economic benefits/disbenefits (with regard to traffic figures/performance figures) which have to be compared to each other.
- With regard to the economic benefits/disbenefits it is very important that established and proven scientific metrics (e.g. employment, value added, and contribution to GDP) are used in order to estimate such impacts correctly. This facilitates comparisons between airports. In this context it is also very important that a common methodology as it was already initially

developed in the MPD study [7] with a special toolkit is improved and commonly used within the EU. The FAA can serve as a good reference case here as it already provides detailed information on CBA conduction and common standards [13].

- Considering the postulate of the Balanced Approach to find adequate measures on an airport-to-airport basis it is also essential to regard the traffic mix at each airport separately and in detail. The literature study had shown that especially with regard to night flights there are big differences between all airline operators. For each traffic segment the night and the core time of night fulfils other functions and is more or less important. To lose sight of this fact can have the result that the wrong alternative in implementing Balanced Approach measures is chosen.
- In addition, it is important that future plans of the concerned stakeholders up to two years are taken into account in a CBA of intended changes compared to an existing regime. This gives stakeholders the chance to address economic disadvantages they would gain due to a loss of planning security if they have to adapt their business strategy to changes. In addition, every CBA should be based on a traffic forecast in order to find the right CBA measure for a long-term time horizon as this gives additional planning security to all involved stakeholders.
- In order to gain the best qualitative and most reliable data as base for decisions the cooperation and transparency of all involved stakeholders is a necessary prerequisite. In the same time it must be guaranteed that anonymity of the data is taken care of as especially between airline operators competitive disadvantages can arise if confidential information becomes publicly available.

All in all, these are first considerations how the current handling of the Balanced Approach framework especially with regard to CBAs could be improved.

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